Infrastructure: Rapid Evidence Reviews

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Summary

By Sarah Reeves

Fifteen Rapid Evidence Reviews have been commissioned by DFID as background papers for its Infrastructure Position Paper. These Rapid Reviews, written by different consultancy experts, consider evidence on different sectors under three key themes: climate change adaptation, mitigation and low carbon development; service delivery to the poor; and, infrastructure's role in growth and poverty reduction.

Climate change adaptation, mitigation and low carbon development

Climate change is an increasing driver for change in all sectors including infrastructure. Infrastructure has to be able to withstand the impacts of climate change such as flooding and extreme heat and also can contribute to low carbon development and minimising greenhouse gas emissions.

The first rapid review on Climate change adaptation describes the scale of climate change impacts on developing countries, which due to their economic state are particularly vulnerable to climate change, and explores the role that improving infrastructure can play in increasing climate change resilience. It highlights the low cost of adaptation compared to other infrastructure costs and the importance of addressing the 'infrastructure deficit' - the poor condition of infrastructure in developing countries which increases their vulnerability.

The second review discusses infrastructure's role in Low carbon development and climate change mitigation. Improvements to infrastructure can be implemented in a manner that minimises greenhouse gas emissions during construction and use, and often have other additional benefits. For example, developing sources of renewable energy in developing countries can help to lower energy costs and improve energy security as well as reduce carbon emissions. This paper reviews key types of infrastructure, discussing how these can be developed sustainably while reducing emissions.

The third rapid review in this theme is focused on the use of Climate finance to resource actions to improve climate change resilience and carry out low carbon development. This encompasses public and private sector funding for research, construction and implementation. The review identifies a range of risks and barriers associated with climate finance and the various sources of climate finance, including the development banks and the private sector.

Service delivery to the poor

Under this theme seven rapid reviews explore how infrastructure can improve the quality of life of the poorest members of society in different sectors. The first Rapid Review looks at the role of Housing in reducing poverty, promoting economic growth, and its contribution to climate change mitigation and adaptation. Homelessness and inadequate housing are growing problems

in developing countries and impact detrimentally on health. The review also notes that green and climate resilient housing is not normally aimed at the poor.

Another important service is Water and sanitation, the rapid review on this area covers water provision for both domestic and productive purposes, and highlights the importance of sanitation and access to clean water to improving health, gender equality, access to education and reducing poverty.

Land transport is the key to providing access to services and for community engagement. This rapid review highlights the importance of appropriate technology and standards for construction in both enabling economically viable construction of transport infrastructure and in providing employment for local people.

An important issue related to land transport is Road safety, which has a separate evidence review. The document describes the impact of the rapid growth in motorised traffic on road safety in developing countries and the potential solutions. It also highlights the link between road safety and poverty reduction and sustainable development.

The role of Energy infrastructure (infrastructure that is used to produce fuel, and for transformation and delivery) in reducing poverty, in climate change mitigation and adaptation is described in the next rapid review. The provision of reliable, affordable energy for domestic purposes, health and education services and business helps to promote economic growth and improve the quality of life. This review highlights the potential of renewable energy and carbon capture to provide energy services whilst minimising carbon emissions.

Information and communications technology (ICT), which includes radio and television as well as newer technologies such as the internet, is used for economic and financial services and sharing of knowledge. The Rapid Review on ICT highlights the need for appropriate support if this service is to be provided to the poor. It also recommends projects make better use of existing technology such as radio, rather than focus on providing new technology.

The benefit of appropriate infrastructure for education and health services is discussed in the Education and health rapid review. This review identifies a range of design issues such as the provision of natural light, low background noise and temperature control for schoolrooms, and the use of evidence-based design for hospitals. Examples of projects where these have been used are given.

Growth and poverty reduction

Under the final theme, five Rapid Reviews describe how infrastructure can help to provide economic growth and reduce poverty. The first looks at the importance of infrastructure in terms of Jobs and skills and highlights the benefits of labour-based construction methods and training at graduate level. It also identifies the need for aid-funded projects to train local workforces in infrastructure maintenance, so that assets remain in good condition.

The Rapid Review on Urbanisation and growth found that a number of organisations believe that urbanisation can assist development, however the link between urbanisation and economic growth is complex and there are conflicting views. The review describes the economic gains that come with economies of scale and the division of labour as well as the possible environmental benefits to dense settlements.

High transport costs and unreliability due to poor transport infrastructure limit exports and reduces competitiveness. The third Rapid Review looks at the benefits of focusing on regional routes to provide Trade corridors to develop trade and increase regional integration. It provides several examples of this approach and highlights key issues such as the importance of improving the infrastructure along these routes, the reform of customs and related border services, and the improvement of logistics and management for the route.

The fourth Rapid Review is focused on Donor strategies; it examines financing trends for infrastructure by multi and bilateral agencies and newer aid providers. The review found that there has been a growing trend away from funding infrastructure projects to supporting governance, institutional and social reforms. It also identified the importance of engaging with new sources of finance and co-ordination between donors to generate greatest impact.

Corruption and transparency in the provision of infrastructure is reviewed in the final Rapid Review in this theme. The document summarises the evidence for corruption, the major risk factors and the policy responses to address these such as monitoring and sanctions. The review concludes that putting in place measures to tackle corruption and improving management is likely to increase value for money.

Conclusions

This set of Rapid Evidence Reviews show that infrastructure provision, construction and maintenance play a large role in all sectors; contributing to climate change resilience, low-carbon development, provision of services and providing economic growth. However, there is a major infrastructure financing deficit and donor funding is shifting away from infrastructure investment. New sources of finance need to be found, including climate finance which could be utilised to a greater extent for infrastructure projects.

Review 01

Climate change adaptation

By Michael Scott

1. Introduction

Climate change is one of the biggest challenges the world faces (DEFRA, 2011). Anthropogenic climate change has been underway since the 1950's and it is virtually certain to accelerate over the current century with increased climate variability, temperature rise and sea level rise.

The challenge of adaptation is to manage the long-term uncertainty and variability associated with a changing climate. The IPCC defines adaptation as the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial activities. For natural systems, human intervention may facilitate adjustment to expected climate (IPCC, 2012).

This paper reviews the evidence on the contribution infrastructure can play in adaptation. This evidence is based on the experience of the past 60 years and for future trends on computer simulation models. Future projections provide considerable confidence about global trends but with greater uncertainty over regional variations.

2. The scale of the adaptation challenge

The climate has been changing since the 1950's and anthropogenic climate change will accelerate in the 21st century.

In 2012, the IPCC concluded that since the middle of the 21st century:

- It is very likely that we have seen a decrease in the number of cold days and nights and an increase in the number of warm days and nights, but with low to medium confidence in Africa and South America;
- It is likely that the number of extreme precipitation events has increased globally; and
- There is medium confidence that in some areas droughts have become more intense and longer.

To date, the main impact of the changing climate has been in increased climate variability with a growing number of extreme climate events. Economic losses from weather and climate-related disasters are increasing but with large inter-annual variations. (UN-ISDR 2009; UN-ISDR, 2011).

It is the poorest who are most vulnerable to disasters and a pre-requisite for sustainable adaptation is addressing the underlying causes of vulnerability, and poverty. (IPCC, 2012). There have been 3.3 million deaths since 1970 (82,500 per annum) with 95% in developing countries (DFID, 2011). This high level of vulnerability is closely linked to a lack of (or inadequate) infrastructure, including flood defences, flood and storm shelters and housing. In addition, many of the poorest are unable to recover from the forced selling or loss of their assets. As well as suffering the overwhelming majority of deaths, developing countries are vulnerable to the economic impact of extreme climate events. Economic losses as a percentage of GDP were greatest in Middle Income Countries with losses of 1% of GDP compared to 0.3% for Low Income Countries and 0.1% for High Income Countries. However, estimates of economic impact in developing countries usually take account only of tangible impacts and result in major underestimates of losses, particularly in the poorest countries. They ignore the huge impact on livelihoods at household level; an impact which is difficult to measure and aggregate.

Evidence on how the climate will change in individual countries and regions the 21st century is based largely on computer simulations (Doll, 2002; IPCC, 2007). The 2012 IPCC SREX report projects that anthropogenic climate change will accelerate in the 21st century, although with uncertainty about the precise nature and scope of change. It is virtually certain that global temperatures will continue to rise; the 1-in-20 year extreme daily maximum temperature is projected to increase by between 2°C to 5°C by the late 21st century. It is very likely that sea levels will rise; the number of floods (is likely to) increase; and there is medium confidence that (overall) droughts will intensify. There is very likely to be a further increase in the number and intensity of sudden onset, climate-related disasters as well as in gradual onset disasters, such as flooding and saline intrusion from sea level rise. However, there will be considerable regional variations. For example, it is likely that there will be decreasing dryness in East Africa and increased dryness and drought in Southern Africa.

3. Adapting to the changing climate; what are the wider implications for investment in infrastructure?

As already noted, there is strong accumulated evidence that poor countries, societies and households are most vulnerable to climate change (Burke and Lobell, (2010; DFID 2011). They suffer from a major development deficit; including a lack of drainage, all weather roads

and piped water and access to electricity, income earning opportunities, health and education services. The provision of infrastructure is crucial to tackling this deficit. Estimates of the cost of addressing the infrastructure component of the deficit in low and middle income countries range from $2.4 billion and $40.8 billion (UNFCCC, 2007) and $350 billion (Satterthwaite and Dodman, 2009) a year by 2030.

Adaptation to climate change is not taking place in isolation. The wider context is one of a growing, potentially wealthier, increasingly urban, global population, with changing land use practices and resource limitations. In addition, successful policy responses to climate vulnerability will be context specific – addressing the causes of vulnerability and best practice in building resilience in a given social, economic and environmental situation. There is good practice but no policy panacea.

Examples of how this wider developmental context will impact on adaptation policies and decisions include the impact of coastal flooding on urban populations in the context of rural urban migration. The world's urban population is projected to grow from 3.6 billion in 2011 to 6.3 billion in 2050 (UN-ESA 2012). An analysis of 136 port cities around the world concluded that the number of people at risk from flooding in these cities would grow from 40 million in 2007 to 150 million in 2070 if no action is taken (OECD, 2007). Policy options will vary. Pro-poor measures, e.g. improved housing, also reduce risks from flooding and climate change (Satterthwaite, 2006). In some cases, investments to reduce vulnerability and improvements in flood warning and infrastructure-based flood protection systems may manage the risks. In others relocation of populations may be a preferred policy option.

Similarly, the total world population is projected to grow from 7.0 billion in 2011 to 9.3 billion in 2050 (UN-ESA, 2012). Increased and potentially wealthier populations will increase demand for food at a time of changing climate. It is projected that annual cereal production will need to rise by 50% to about 3 billion tonnes in 2050 from 2.1 billion in 2009. Annual meat production will grow by more than 70% to over 200 million tonnes to reach 470 million tonnes in 2050 (FAO, 2009). Simultaneously addressing the challenges of climate adaptation and increased demand for food will have major implications for land and water use policies (Carruthers et al; 1999; Bruinsma, J; 2010). Appropriate responses will vary, for example, between irrigated and rain-fed farming systems.

Assessing and managing risk and uncertainty lie at the heart of making "climate smart" decisions on infrastructure investments for climate adaptation. In managing this risk potential adaptation options can usefully be categorised as those that carry "no regrets" and those that are "climate justified (Alavian et al, 2009). "No regrets" options generate net social and/or economic benefits irrespective of whether anthropogenic climate change occurs. "Climate justified" options might only be justifiable under man-made change in climate variability.

The Costs of Adaptation. The World Bank estimated that the additional cost of adapting infrastructure to climate change - at no more than 1% to 2% of the total costs of that infrastructure- is small in relation to other factors that may influence the future costs of infrastructure (World Bank, 2010). However, the same study also concluded that the impact of climate change on the overall demand for infrastructure may be more important than the increase in the cost of providing the baseline level of provision. The cost of narrowing the infrastructure component of the development deficit would be much larger than the additional costs of climate proofing new infrastructure.

In 2007, the United Nations Framework Convention on Climate Change (UNFCCC) estimated the global costs of adapting infrastructure to climate change in low and middle income countries at between $2.4 billion and $40.8 billion a year in 2030 (UNFCCC, 2007); a

range that demonstrates high levels of uncertainty. The UNFCCC figures cover the cost of adapting new infrastructure to climate change but omit the costs of climate proofing housing; of investments in governance and technical capacity to operate the infrastructure effectively; and any consideration of social infrastructure.

Crucially, the UNFCCC report did not address the cost of closing the "infrastructure deficit"; the additional investment needed to address the very large deficiencies in infrastructure and to provide additional infrastructure for adaptation to climate risks – lack of all-weather roads; piped water; drains, electricity supply etc. The report highlights "the mounting losses from extreme weather events such as floods, droughts, tropical cyclones and other storms" and argues that "the evidence suggests that the adaptation deficit continues to increase because losses from extreme events continue to increase. Societies are becoming less well adapted to current climate".

A review of the UNFCCC estimates concluded that the UNFCCC figures were too low and suggested alternative figures for annual investments in infrastructure, including the cost of removing this "infrastructure deficit" in low and middle income countries. These figures were more than eight times higher than the UNFCCC estimate; some $350 billion a year invested in infrastructure by 2030 (Satterthwaite D and Dodman D, 2009).

Hence, the scale of investments in infrastructure, in the context of a changing climate and an increasing number of extreme climate events, will depend more on the extent to which the world invests in infrastructure to reduce the development deficit, rather than on the additional cost of adapting that infrastructure to climate change. Extreme weather events are the major cause of disasters and there is growing evidence that "disaster risk reduction is an investment not a cost" strengthening the economic and value for money case for closing the "adaptation deficit" – the shortfall in investment in building resilience to climate change (UN-ISDR, 2009).

Adaptation and investment in renewable energy. The potential effects of climate change on the contribution of renewable energy to mitigation are set out in the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (IPCC, 2011). Renewable energy is susceptible to extreme climate events, but for solar, wind and bio-energy the impact on overall technical potential is expected to be small. For hydropower the impact will be location specific but may be slightly positive globally.

However, renewable energy production should be also be seen in the context of competing demands for adaptation. Bio-energy crops may have increased water requirements, with potential impacts on a resource particularly susceptible to climate change. Competition for land and water to increase food production is likely to be the biggest constraint to any expansion of bio-energy crops (FAO, 2009).

4. Infrastructure to build resilience to extreme climate events

Vulnerability to climate change remains closely linked to weather-related disasters. DFID's Humanitarian Emergency Response Review (DFID, 2011a), the UK Government's response to that review (DFID, 2011b), and a subsequent approach paper on disaster resilience (DFID, 2011c) represent a significant shift in DFID's approach to extreme weather events and to other disasters, moving from an emphasis on the humanitarian response to one of building "resilience".

The DFID definition of disaster resilience is “the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses - such as earthquakes, drought or violent conflict – without compromising their long-term prospects” (DFID, 2011c).
The Resilience Engineering Network[1] describes resilience as being both reactive and proactive (Resilience Engineering Website, 2012). Resilience lacks a unifying and universally accepted analytical framework, but places great emphasis on managing long-term risk and uncertainty. It is system specific posing the question “resilience by whom to what”.
Climate resilient design and construction. The UK Government’s policy document on climate resilient infrastructure aims to make infrastructure resilient to potential increases in extreme weather events by ensuring that an asset is located, designed, built and operated with the current and future climate in mind (DEFRA, 2011). Resilient infrastructure has built in flexibility so that assets can be modified in the future without incurring excessive cost. Existing infrastructure can be made climate resilient by ensuring that maintenance regimes incorporate resilience to the impacts of climate change over an asset’s lifetime.

The UK policy document cites the World Bank’s estimate that the additional cost of adapting infrastructure to climate change is no more than 1% to 2% of the total costs of that infrastructure (World Bank, 2010), as providing prima facie evidence that “building” climate resilience into infrastructure could be very cost effective.

Flood Risk Management and Protection. Serious flooding associated with extreme weather events is increasing and the risks will increase further as sea levels rise. At least 233 cities are located in or close to areas with a high risk of flooding, (148 of these cities are not coastal cities), potentially affecting 663 million inhabitants (UN-ESA; 2011). Exposure to floods will rise further with population increase, but this need not lead to increased vulnerability. Infrastructure has an important role to play in flood risk management and protection, particularly as part of an integrated strategy involving both structural and non-structural measures (Jha et al 2012). The UNFCCC conservatively estimated that the additional investment in coastal infrastructure in 2030 needed for adaptation to sea level rise would be $4 billion a year, omitting consideration of the infrastructure deficit (UNFCCC, 2007).

There is strong evidence of the benefits of investing in flood risk management. Early warning systems for floods are classical “no regrets” options. They provide good value for money and positive benefit/cost ratios, typically in excess of four and often higher (Teisberg, T J and Weiher, R F, 2009; Rogers, S and Tsirkunov, V, 2011). However, there are exceptions. Investment may not pay in high cost, “over-built”, specialized early warning systems designed to reduce risks from low-frequency events.

There is a large “adaptation deficit” in infrastructure for flood protection, including in critical infrastructure that plays a vital role in the community in the context of disasters e.g. schools that can be used as flood shelters. Studies provide strong evidence of the cost effectiveness of flood protection measures with major infrastructure components (World Bank, 2010a). In Bangladesh, raising 100,000 homesteads on plinths above flood levels had a benefit to cost ratio of 4.3 to 1 (DFID, 2007). This was a “no regrets” option; flooding was an annual event and plinth raising was part of a wider employment programme.

However, not all forms of flood protection are good investments. Risk reduction may not pay where strategies have major externalities and/or depend heavily on specific knowledge

concerning the magnitude and probability of specific events (Mechler, R. et al 2008: Moench, M. et al 2008). Heavily engineered structural measures, particularly if “climate justified” rather than “no regrets” options, merit particular attention to risk analysis (Hobbs et al, 1997).

The complexities of planning and designing flood protection structures are significant. There is no flood management blueprint and it is impossible entirely to eliminate the risk from flooding. Heavily engineered flood prevention measures may simply transfer risk and household vulnerability upstream or downstream. It is important that flood risk management is integrated into the planning processes, with an appropriate balance between structural and non-structural measures. Crucially, as well as assessing the economic case, it is important to consider the wider social and ecological consequences of flood risk management through multi-stakeholder co-operation (Jha et al 2012).

5. Infrastructure and adaptation to long-term climate change

Water resource management. Freshwater resources serve a range of crucial functions. They provide safe water for domestic, industrial and agricultural use; they are important in sanitation and the removal of effluent. Rivers and other freshwater resources are used for navigation, for recreation and ecosystem services, to manage flood hazards and to produce hydropower. In 1999, current annual expenditure for water-related infrastructure in developing countries was estimated at USD 15 billion for hydropower, USD 25 billion for water supply and sanitation, and USD 25 billion for irrigation and drainage; a total of USD 65 billion (Briscoe J; 1999).

One of the largest impacts of climate change is likely to be on water resources and their management (Arnell N; 2009; Nicol and Kaur 2009). Water is the key medium that links atmospheric temperature rise to changes in human and physical systems. Climate change will alter the hydrological cycle in many ways. The trigger is the warming of the atmosphere and oceans, which will change major weather systems and alter the temporal and special patterns of rainfall. For example, in Southern Africa there is “medium confidence” that droughts will intensify over the 21st century (IPCC 2012).

Population growth, land use change, economic growth and technological change are already increasing global demand for water and changing the patterns of that demand. Climate change will place even greater pressure on water resources. Climate change is projected to increase the demand for water for irrigation by an additional 5-20% by 2080 although the projected increase in household and industrial water demand is likely to be smaller – less than 5% by the 2050s in some locations (Nicol and Kaur 2009; IPCC, 2008).

Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits. By the 2050s, the area of land subject to increasing water stress due to climate change is projected to be more than double that with decreasing water stress. The OECD projects that 47% of the world’s increased population could be living in severe water stress by 2050; an increase from 44% in 2005 (OECD, 2010). The UNFCCC estimates that the additional investment required to adapt to the potential changes in the availability of water supplies would be $9-11 per year in 2030 (UNFCCC 2007). Arnell, considered these figures to be too low (Arnell, N. 2009). The figure ignores the large adaptation deficit. Also, adaptation will not remove all the consequences of climate change. There will be residual impacts which are likely to be high, because adaptation will be imperfect and lagged, but they are not included in the UNFCCC figures.

Improved water storage is driver of economic growth and will increase resilience to climate change. Dams built for hydro power have tended to have better economic returns than those built for irrigation or domestic water supply. an important aspect of water resource management. Multipurpose water storage, justified economically on returns from hydropower, may be used to provide additional benefits such as irrigation to support local livelihoods and improve food security (DFID, 2011f). Concern has been expressed about the decline in investment in irrigation at a time when climate change is increasing the uncertainties associated with rain-fed agriculture and demand for food is rising sharply (Carruthers et al, 1999). However, a study of World Bank projects concluded that groundwater irrigation projects had evaluation estimates of economic return that are 21 percent higher than for surface irrigation projects (World Bank, 2011).

Milly et al (2008) cited by Nicol and Kaur (2009) stress that climate change challenges the underlying principles of water management, which include decision-making based on historical trends and notions of predictable variability in precipitation and river flows. Adaptation in the water sector will be about responding to longer-term challenges in a context of uncertainty and variability. Bates et al concluded that current water management practices may not be robust enough to cope with the impacts of climate change and that it is very likely that hydrological characteristics will change in the future (IPCC, 2008).They proposed an integrated demand-side and supply side approach to adaptation (Table1).

Integrated Water Resources Management (IWRM) is in its infancy but provides a framework to achieve adaptation measures across socio-economic, environmental and administrative systems. It can resolve conflicts between competing water uses and, therefore, facilitate adaptation in the water sector (Nicol and Kaur, 2009). A fully integrated approach is not always needed but, rather, the appropriate scale for integration will depend on the extent to which it facilitates effective action in response to specific needs.

Table 1. Some adaptation options for water supply and demand (IPCC, 2008)

Supply side	Demand side
Prospecting and extracting of groundwater Increasing storage capacity by building reservoirs and dams Desalination of seawater Expansion of rainwater storage Removal of invasive non-native vegetation from riparian areas Water transfer	Improvement of water use efficiency by recycling water Reduction in water demand for irrigation by changing the cropping calendar; crop mix; irrigation method and area planted Reduction in water demand for irrigation by importing food i.e. virtual water; Promotion of indigenous practices for water use; Expanded use of water markets to reallocate water to highly valued uses; Expanded use of economic incentives, including metering and pricing to encourage water conservation

Irrigation. Agriculture makes the largest demands on the world's freshwater resources being responsible for about 70% of withdrawals and 90% of global consumptive use (Alavian et al, 2009). Climate change is just one of the many challenges that agriculture will face over the next forty years. With population growth and increased per capita incomes it is projected that

global food production will grow by up to 70% for cereals and up to 100% for animal protein by 2050 (Bruinsma, J 2010; FAO, 2009; OECD, 2010). This will place additional demands on finite land and water resources.

Irrigation land covers 20% of the arable area in developing countries accounts for some 40% of agricultural production. Over the period to 2050, it is estimated that harvested irrigated land will increase by 17% and water withdrawals for irrigation by 11%. Some 80% of the increased food production will come from increased productivity. Achieving these projections will require huge public interventions investments in water efficient and environmentally sustainable irrigation technologies and agricultural research, as well as a reduction in water demand for irrigation by changing the cropping calendar and crop mix.
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However, investment in large-scale irrigation schemes has declined since peaking in the 1970s (Carruthers et al, 1999; World Bank, 2011). Carruthers examined the reasons for this and highlighted low food prices, complacency about future food security and environmental concerns e.g. salinisation. They criticised the environmental critique that water for irrigation should be seen as a reserve stock that is readily available for redeployment for non-agricultural use and stressed the importance of continued investment in irrigation.

The economic case for greater investment in irrigation is strong and will become stronger as population growth and climate change put global food security under threat.. When weighted by size of area served, a World Bank evaluation of 208 irrigation projects gave an evaluation rate of return of 25% as opposed to a 15% un-weighted average for the whole portfolio. Groundwater irrigation projects had evaluation estimates of economic return that are 21 percent higher than for surface irrigation projects.

Large-scale irrigation programmes have been subject to particular criticism over recent years with resettlement, large dams and drainage the elements of irrigation which are the most criticized (World Bank, 2011). The World Bank evaluation study concluded that there is no justification for a bias against large projects. Large irrigation projects are more likely to succeed than smaller ones, in part because there are engineering economies of scale. However, with much of the most suitable land already under irrigation, the emphasis will continue to shift away from new sites, but not to simply rehabilitating existing projects to old standards. Irrigation systems serve a changing environment and need to be constantly redesigned. Upgrading requires intensive application of engineering and social solutions to improve existing irrigation, thus lowering unit costs, conserving water, and improving service to people. Higher sunk costs and an established irrigation tradition should lead to higher returns than the returns on all-new projects

Infrastructure has a major role to play in ensuring irrigation contributes effectively to maintaining food security at a time of changing climate. There remains potential for constructing new irrigation schemes. However, most of the growth in irrigation production (and productivity) will come from the rehabilitation, extension and upgrading of existing schemes and, crucially, improving water use efficiency. Improving water use efficiency requires investment in irrigation technologies, charging full economic costs for water, greater involvement of users in decisions on water allocation and water-efficient crop rotations.

6. Infrastructure in country adaptation plans

The United Nations Framework Convention on Climate Change (UNFCC) co-ordinates the preparation of National Adaptation Programmes of Action (NAPA)and has received 47 of these since 2005. (UNFCCC, 2012). The main content of NAPAs is a list of ranked priority adaptation activities and projects.

The series of World Bank/Global Facility for Disaster Risk Reduction and Recovery (GFDRR) Climate Risks and Adaptation Profiles offer a common platform to guide access, synthesis, and analysis of relevant country data and information for Disaster Risk Reduction and Adaptation to Climate Change (GFDRR, 2012). The 49 profiles include sections on infrastructure requirements. DFID is an active supporter of GFDRR.

The UN-International Strategy for Disaster Reduction (ISDR) Strategic National Action Plans also seek to address vulnerability to extreme weather events (UN-ISDR, 2012). UN-ISDR scored poorly in the DFID Multilateral Aid Review (Mitchell, 2011).

7. International climate finance

There has been a burgeoning of international climate funds in recent years – for adaptation, low carbon development and forestry. A list of these funds is at Annex 1 (Climate Funds Update, 2012). More details on climate financing will be found in a separate evidence paper.

Climate funds established by DFID include the UK International Climate Fund (ICF) - together with DEFRA and DECC; the Disaster Risk Reduction and Climate Change Adaptation Support Fund; the Climate Investment Funds; the UK Fast Start Climate Change Finance fund (with DECC); the climate change advocacy fund and numerous research programmes including the Climate and Development Knowledge Network (CDKN) and the Climate Change Adaptation in Africa programme

The ICF is an umbrella for a number of other initiatives. It has a budget of £2.9 billion with an allocation of 50% for adaptation, 30% for low carbon development and 20% for forestry to be disbursed between 2011/12 and 2014/15.

DFID also directly funds several bilateral and regional funds supporting climate change adaptation and mitigation, including through the Africa Enterprise Challenge Fund REACT window (AECT, 2012); the Energy and Environment Partnership in East, Central and Southern Africa; and the Climate Innovation Centre in Kenya.

Annex 1. International Climate Funds

(www.climatefundsupdate.org/listing)

Fund	Type	Administered by	Area of focus	Date operational
Adaptation Fund	Multilateral	Adaptation Fund Board	Adaptation	2009
Amazon Fund (Fundo Amazônia)	Multilateral	Brazilian Development Bank (BNDES)	Mitigation - REDD	2009
Clean Technology Fund	Multilateral	The World Bank	Mitigation - general	2008
Congo Basin Forest Fund	Multilateral	African Development Bank	Mitigation - REDD	2008
Forest Carbon Partnership Facility	Multilateral	The World Bank	Mitigation - REDD	2008
Forest Investment Program	Multilateral	The World Bank	Mitigation - REDD	2009
GEF Trust Fund - Climate Change focal area (GEF 4)	Multilateral	The Global Environment Facility (GEF)	Adaptation, Mitigation - general	2006
GEF Trust Fund - Climate Change focal area (GEF 5)	Multilateral	The Global Environment Facility (GEF)	Adaptation, Mitigation - general	2010
Global Climate Change Alliance	Multilateral	The European Commission	Adaptation, Mitigation - general, Mitigation - REDD	2008
Global Energy Efficiency and Renewable Energy Fund	Multilateral	The European Commission	Mitigation - general	2008
Indonesia Climate Change Trust Fund	Multilateral	Indonesia's National Development Planning Agency	Adaptation, Mitigation - general, Mitigation - REDD	2010
International Climate Fund	Bilateral	Government of the United Kingdom	Adaptation, Mitigation - general, Mitigation - REDD	2008
International Climate	Bilateral	Government of Germany	Adaptation, Mitigation -	2008

Initiative			general, Mitigation - REDD	
International Forest Carbon Initiative	Bilateral	Government of Australia	Mitigation - REDD	2007
Japan's Fast Start Finance - private sources	Bilateral	Government of Japan	Adaptation, Mitigation - general, Mitigation - REDD	2008
Japan's Fast Start Finance - public sources	Bilateral	Government of Japan	Adaptation, Mitigation - general, Mitigation - REDD	2008
Least Developed Countries Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
MDG Achievement Fund – Environment and Climate Change thematic window	Multilateral	UNDP	Adaptation, Mitigation - general	2007
Norway's International Climate and Forest Initiative	Bilateral	Government of Norway	Mitigation - REDD	2008
Pilot Program for Climate Resilience	Multilateral	The World Bank	Adaptation	2008
Scaling-Up Renewable Energy Program for Low Income Countries	Multilateral	The World Bank	Mitigation - general	2009
Special Climate Change Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
Strategic Climate Fund	Multilateral	The World Bank	Adaptation, Mitigation - general, Mitigation - REDD	2008
Strategic Priority on Adaptation	Multilateral	The Global Environment Facility (GEF)	Adaptation	2004

UN-REDD Programme	Multilateral	UNDP	Mitigation - REDD	2008

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Review 02

Low carbon development and climate change mitigation

By Jeremy Doyle

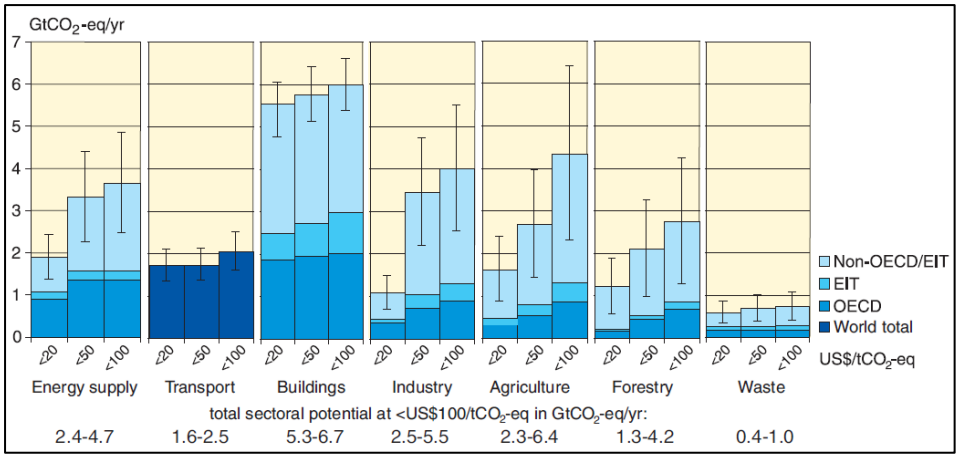
1. Introduction

Anthropogenic climate change is blamed on several human activities, but the biggest contributor is the increase in greenhouse effect produced by carbon dioxide (CO_2) (IPCC 2007). Most of CO_2 emissions - 57% in 2004 – (IPCC 2007) comes from burning fossil fuels to meet human energy needs[1].

Figure 1: Economic GHG abatement potentials by sector and region in 2030 (IPCC 2007 p59)[2]

[1] The other major sources of human-induced greenhouse gas emissions are deforestation and the decay of biomass (17%) and non-CO2 gases (26%), which are not within the scope of this paper.

[2] For comparison, avoided emissions through the CDM is expected to be 2.6bn units (CERs) over 8 years to 2012, i.e. an average of 0.33 GtCO2eq per annum (UNEP/RISO 2012).



Global energy use and supply is projected to continue to grow, especially with population growth and as developing countries pursue industrialisation. Without change in energy policies, the energy mix supplied to run the global economy in the 2025–30 timeframe will essentially remain unchanged. Energy demand will be up by one third with more than 80% of energy supply based on fossil fuels[3] and with non-OECD countries accounting for 90% of the increase in energy demand (IPCC 2007 p.28-30, IEA 2011 p.39-40).

All stabilisation scenarios concur that 60–80% of all CO2 emissions reductions need to come from the energy and industry sectors (IPCC 2007, MacKay 2009).

The main drivers for low carbon infrastructure investment are (IEA 2011, MacKay 2009):

- Energy economics: rising prices of conventional resources, namely fossil fuels and the falling costs of renewable/efficient options.
- Energy security: concerns over access to energy resources, particularly imported conventional/unconventional oil and gas.
- Climate change: voluntary and compliance investment in low carbon options as a result of climate mitigation policies, including carbon finance.

The transition to a low carbon future may be happening too slowly to meet mitigation objectives (IEA 2011 p.40). But there is very strong evidence of fast growth in many low carbon sub-sectors such as solar, wind, hydroelectric and energy efficiency at a range of scales, particularly in middle income countries (REN21 2011, IEA 2011, UNEP 2011). With the exception of large hydropower[4], expansion is from a very low baseline.

International climate negotiations have left uncertainty over carbon prices (IISD 2011). And the leader in terms of climate funds disbursement and experience remains the Global Environment Facility.[5] However, the Clean Development Mechanism (UNEP/RISO 2012) illustrates the prevalent economic mitigation sectors and regions as well as those that have likely been under-exploited in comparison to their potential[6].

[3] Fossil fuel subsidies (USD409bn in 2010), if phased out by 2020, could reduce global emissions by around 5.8% (IEA 2011 chapter 14).
[4] Renewables delivered close to 20% of global electricity supply in 2010, of which 13% was from hydropower – see section 5.3 below.
[5] Between 2004 and 2011, $2.97bn was approved for mitigation projects through dedicated climate funds. $1.17bn has been disbursed to date, USD 0.96bn of which through the Global Environment Facility (GEF) in 2004-10. (Nakhooda 2011).
[6] Note –CDM has tended to stimulated large scale, project based investment (power generation, industry) over small scale and programmatic schemes (transport, decentralised power).

Figure 2: Regional distribution of CDM projects (UNEP/RISO 2012)

	Small scale projects % (number)	Full scale projects % (number)	All projects % (number)
Latin America	12.7%	15%	14%
Asia & Pacific	82.9%	79.5%	81%
Europe & Central America	0.9%	1.3%	1.1%
Africa	2.5%	3.1%	2.9%
Middle East	0.9%	1.2%	1.1%
Sum (Less Developed World)	100% (3454)	100% (4674)	100% (8128)

Figure 3: Sector proportions of CDM projects and the quantity of accumulated certified emissions reductions (CERs) issued until the end of 2012 (UNEP/RISO 2012)

	Number of projects	CERs issued
HFCs, PFC's &N2O reduction	1.8%	67%
Renewables	67%	19%
CH4 reduction & cement & coal mine/bed	17%	6.1%
Energy Efficiency Supply side	8%	4.5%
Fuel Switch	1.8%	3.3%
Demand side Energy Efficiency	3.6%	0.2%
Afforestation & Reforestation	0.8%	-
Transport	0.6%	0.04%

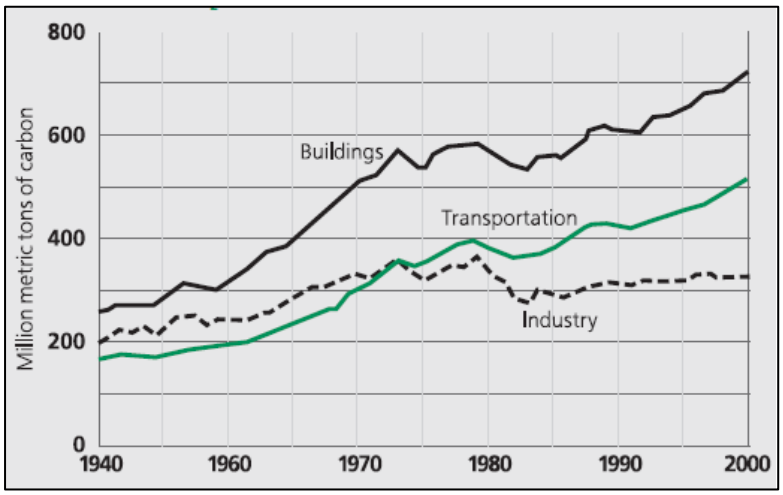
Noting the fundamental role of energy in supporting growth and poverty reduction, the UN Secretary General's Sustainable Energy for All initiative aims to achieve a) universal access to modern energy services, b) doubling the global rate of improvement in energy efficiency and c) doubling the share of renewable energy in the global energy mix, by 2030 (SEFA 2012). SEFA focuses on galvanising nationally appropriate action in the form of high ambition on energy efficiency, renewable energy and energy access and has identified seven sector action areas and four enabling action areas (SEFA 2012). This initiative and other developments in energy policy provide the potential for energy to feature in the post-MDG/SDG framework.

There is medium evidence for poverty reduction benefits of low carbon infrastructure, with benefits attributed mainly in the context of small scale technologies that provide improved access to energy services (IFC 2011, IEA 2011 ch 13, Geoghegan 2008, WHO 2011, Taverner 2010).

2. Buildings

The building sector is responsible for some of the highest CO_2 emissions. In some countries buildings produce higher emissions than both industry and transport. See Figure 1 below showing USA CO_2 emissions by sector over time.

Figure 4: CO_2 emissions by sector in the USA (The Community Solution (2007)



Buildings produce emissions in 3 ways:

- The materials used in construction contain embedded energy from their extraction and manufacture. Most modern buildings are constructed using cement, steel, aluminium, bricks and glass, all high in embedded energy.
- The process of construction itself is energy intensive. Excavation and site preparation, the transportation of materials to the site, the movement of materials around the site all consume energy and contribute to emissions.
- Buildings can also consume a lot of energy during their operation, through heating, cooling and lighting. Energy consumed in this way is largely a function of the design of the building. Poor design can lock the building into high levels of energy usage.

Energy used in operating a building can greatly exceed the embodied energy in the building materials and construction process over the lifetime of the building.

Emissions in the building sector can be reduced firstly by better design. Passive building design involves considering the orientation of the building, minimising the surfaces exposed to high levels of solar heat gain during hot months, maximising the solar gain during cold months and taking advantage of the prevailing wind for cooling. Passive buildings are also well insulated keeping heat in during the winter and heat out during the summer. Such design considers the full life-cycle of the building, including its deconstruction, maximise material re-used or recycling.

Secondly, passive building design reduces energy use by careful selection of materials. Building materials are manufactured locally where possible and are chosen to contain the low embodied energy. This includes using recycled building materials and certain types of industrial waste.

2.1 Legacy lock-in and a new built environment

Much of the current built environment was constructed without much consideration for its ecological footprint. In addition, much of the urban environments around the world were built during a period of abundant cheap energy that could be utilised to light, heat and cool buildings despite their design. They can only be adapted by retrofitting to reduce their ecological footprints (MacKay 2009).

It is important that past mistakes are not repeated in future and that all newly built buildings adopt passive design principles and minimise the wasteful use of resources. Buildings are

potential power generation plants and could in many instances feed energy back into the grid. They can collect and store rainwater and recycle wastewater.

Building maintenance too can be reduced through the choice of materials and finishes. For example, face-brick surfaces do not require painting, reducing the use of toxic chemicals.

Opportunities exist to cost-effectively reduce greenhouse gas emissions using existing technologies. Such technologies can cut energy consumption by 30-80% in new and existing buildings (UN HABITAT 2011a). The majority of analysis and implementation experience rests on strategies for energy-efficient buildings that include reducing loads, selecting systems that make the most effective use of ambient energy sources and heat sinks and using efficient equipment and effective control strategies.

Estimates from bottom up studies show that the buildings sector offers the highest economic abatement potential for both economies in transition and for non-OECD/economies in transition (IPCC 2007 p.59) with a large (negative cost) potential in retrofitting residential HVAC equipment (Enkvist 2010 p.8).

Poor people often use local materials for the construction of their homes, including those found on the sites of their buildings. This often includes stone and sand or clay. In urban areas, many poor people live in informal settlements, and build using recycled or reused materials to construct their homes. Many poor people undertake the construction of their homes themselves, or do so with the help of friends, neighbours or relatives.

There is medium to strong evidence that mitigation strategies for buildings can stimulate the growth of new businesses and jobs, as well as contribute to other social development goals, such as better housing and access to clean energy and water. Urban planners play an important role by working on development control and regulation, influencing building standards and codes, and working with building developers (UN HABITAT 2011a).

Overall, there is strong evidence for the opportunities to mitigate climate change through the commercial and residential buildings sector in urban areas of developing countries (SEFA 2012 p.10) but in contrast there is much weaker evidence for scaling up implementation, particularly in low income countries (CCI 2011).

There is some evidence of the role of more efficient building design and energy use in reducing poverty, mainly focusing on energy for cooking, lighting and cooling (Geoghegan 2008).

3. Transport

Transport accounts for 19% of global energy use and 23% of energy-related CO2 emissions. On current trends, transport energy use and CO2 emissions are likely to rise by 50% by 2030 (IEA 2009 p.41). There are enormous sunk costs and economic dependency on long-lived energy intensive transport and fuel infrastructure, including roads, airports and shipping terminals.

Per capita transport emissions in developing countries are low compared to OECD countries, but 90% of the increase of global transport related GHG is expected to take place in developing countries, mostly from private vehicles and freight and in Asia (SLOCAT 2012). There is strong evidence that changing this trajectory will require widespread adoption of the best available technology, development and deployment of new technologies and policies to encourage changes in travel patterns (IEA 2009 p. 103, SLOCAT 2012).

Policies that are effective in reducing greenhouse gas and other emissions (medium to strong evidence) include: mandatory fuel economy standards; biofuel blending; CO2 standards for road transport; taxes on vehicle purchase, registration, use & motor fuels; road and parking pricing; traffic management schemes; influencing mobility needs through land-use regulations and infrastructure planning; and investment in attractive public transport facilities and non-motorised forms of transport (IPCC 2007, CCI 2012, World Bank 2011).

In cities, transportation systems largely define the final shape of the city. Once buildings grow around transportation and service nodes, they are all but locked-in (World Bank 2011). Cities that have not developed effective transport systems generally exhibit heavy traffic congestion that generates significant emissions, reduces worker productivity and can have a major negative economic effect.

The "Avoid-Shift-Improve" (ASI) approach focuses on (a) Avoiding the need for unnecessary travel in providing improved access to goods and services; (b) Shifting travel to the most efficient mode, which in most cases will be either non-motorized or public transport for passenger transport, and to rail or water transport for freight; and (c) Improving existing forms of transport through technological improvements to make engines and fuels less carbon intensive (SLOCAT 2012 p.1).

Biofuels provided 2% of global road transport fuel supply in 2008 (IPCC 2011). World ethanol production for transport fuel tripled between 2000 and 2007 from 17bn to more than 52 billion litres, while biodiesel expanded eleven-fold from less than 1bn to almost 11bn litres (Bringezu 2009 p.15).

Expansion in biofuels production, driven by climate policies and high world fuel prices shows weak to medium evidence in reducing greenhouse gas emissions, and medium to strong evidence of negative social, environmental and economic impacts. There is evidence that biofuels expansion faces several major issues as a mitigation strategy: competition for water resources; increasing use of fertilisers/pest control, trade-offs between intensive versus extensive farming; competition with food and feed production; and uncertainties resulting from climate change (e.g. yields and climate extremes).

So called next generation or second generation biofuels could produce higher greenhouse gas mitigation but are largely pre-commercial (Bringezu 2009 p.16-19 and p.39, IEA 2009 p.36, IPCC 2011 p18-19).

4. Urban Development/Planning

Areas for low carbon urban development/planning are broadly: a) transport options to reduce congestion and support greener modes including mass transit and non-motorised transport such as cycling and walking; b) passively designed buildings; and c) densities that limit urban sprawl.

The principles of passive building design (described in section 2 above) can be applied at a city level. Barcelona is an example of a city planned originally on these principles. The city planning was designed by Cerda, who attempted to maximise solar access and ventilation to every apartment in the city by limiting building height to 16 meters, limiting street widths to 20 meters, limiting building development to only two sides of the city block to ensure the creation of large interior spaces (in city blocks).

Neighbourhoods need to be designed to ensure that people minimise travel by having local access to work, schooling, medical and other social services including green space for recreational purposes and responsible waste management.

Some cities even produce significant portions of their food needs within their boundaries, which may reduce emissions through reduced emissions in transportation and storage[7]. Havana is regarded as the world's leader in urban agriculture with between 50%[8] and 90%[9] of the city's fresh produce cultivated within city limits.

Cities exhibit huge potential for climate change mitigation, with multiple co-benefits.[10] Compact cities are more sustainable than sprawling cities. Such cities use less energy for transportation, which lower transport-related emissions. They also provide access to services at lower cost and implement more energy efficiency measures. As urbanisation continues, a critical challenge is managing urban development, in particular, the twin challenges of urban sprawl and growing informal urban settlements (UN HABITAT 2011b p. 94-95).

Policy tools to improve city design include mainly regulatory measures. These include restructuring land regulations to allow greater densities, reforming approaches to zoning, reviewing floor space ratio regulation, and mixed-use zoning to shorten trip distances. The costs of inaction are very high - delay results in a path that will increasingly diverge from the optimal high density, low-carbon trajectory and make mitigation increasingly expensive and inaccessible. Co-benefits of action are largest in cities and often more than cover the costs (World Bank 2011 p.1, p.33).

DFID is developing a methodology to aid city level decision makers to identify their climate and resource related vulnerabilities and policy options by identifying their city type in order to mitigate these risks and to ensure the most cost effective measures can be implemented. The methodology enables decision makers to identify the best measures that can be adopted to match their circumstances and political economy.

The frameworks that create and regulate carbon markets have not been designed with urban mitigation projects in mind. Legal, technical and financial barriers often appear to be insurmountable for urban projects and case studies suggest that there is overwhelmingly more evidence for buildings and energy projects than for urban planning or transport (Clapp 2010 p.11-14). There is strong evidence municipal and city level leadership is required to support urban development/planning, often with the need for strengthened capacity.

International networks appear to be important for those with a degree of existing capacity to act, leading to a virtuous circle where additional resources and support can be accessed. But such initiatives may do little to build capacity and, in effect, may serve to concentrate resources and attention on cities that are already leading on the response to climate change. (UN HABITAT 2011b p.27).

There is strong evidence on how better urban planning contributes to low carbon development objectives, with examples of urban projects in both developed and middle income developing countries (CCI 2011, UN HABITAT 2011b). But there is an evidence gap on implementation in the growing cities of low income countries.

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[7] See http://archive.defra.gov.uk/evidence/economics/foodfarm/reports/documents/foodmile.pdf for food sustainability indicators, including "food miles"
[8] http://sustainablecities.dk/en/city-projects/cases/havana-feeding-the-city-on-urban-agriculture
[9] According to the Cuban Ministry of Agriculture, see footnote 29 http://en.wikipedia.org/wiki/Urban_agriculture
[10] The Tool for Rapid Assessment of City Energy (TRACE) helps assess energy efficiency and identify sectors to improve: http://www.esmap.org/esmap/EECI

5. Power sector

5.1 Energy Efficiency

Energy efficiency in the power sector offers options for greenhouse gas emissions reductions at low or negative cost (Enkvist 2011, ADB 2009). In large emerging economies, the opportunities are significant and relatively well documented, but national level and broader assessments indicates considerable potential in the electricity sector in poorer economies (UNECA/UNEP 2010, SEI 2009).

There is strong evidence that delivering win-win solutions require a relaxation of binding constraints such as information, knowledge, and technology gaps; market and price distortions; policy, regulatory, and behaviour barriers; lack of necessary finance for upfront investment; and other hidden transaction costs (ADB 2009).

Evidence in Africa - where demand for power invariably exceeds supply - suggests that power sector reform programmes have not addressed energy efficiency and that progress in this area could also open up more small scale RE opportunities at lower cost (UNECA/UNEP 2010 p. 110).

The major mitigation opportunities in large scale electricity generation ("supply-side") are twofold: a) refit of existing power stations; and b) more efficient technology for new power station construction.

The use of best available efficient technology in new power project design and construction is essential given the long life of power projects (IPCC 2007). Energy supply-side efficiency projects have seen high activity under the clean development mechanism (CDM), ranking 5th (own generation) and 10th (power plant) amongst the most numerous CDM project categories to date but with very little activity in Africa (UNEP/RISO 2012).

There is strong evidence of very poor transmission and distribution (T&D) efficiency in developing countries arising largely from design and underinvestment. There is good evidence on the value for money of investing in improved T&D efficiency but much less evidence on appropriate strategies to deliver improvements (Jamasb 2005, Zhang 2006). Barriers to improved efficiency include lack of affordable capital and poor management of largely public utilities that are responsible for power infrastructure (UNECA/UNEP 2010).

5.2 Carbon Capture and Storage (CCS)

Carbon Capture and Storage (CCS) is the practice of capturing CO2 emitted from industries (especially power plants) and sequestering them in geological formations like depleted oil & gas fields, coal bed methane and saline aquifers[11] [12].

There are different methods of capturing carbon dioxide. They are pre-combustion, post-combustion and oxy fuel method[13]. Up to 90% of carbon dioxide (CO_2) from a fossil fuel power station can be captured using CCS technology (ZEP 2012).

[11] CCS can also refer to capture of CO2 and other gases during fossil fuel extraction, such as natural gas fields
[12] There are about 70 planned CCS projects worldwide, but only four operating, none of which are installed on power plants (IEA deputy executive director R Jones, quoted at CEM London, Apr 2012)
[13] The oxyfuel method involves combusting fuel in the power plant with pure oxygen to achieve a high concentration CO2 flue gas

Cost abatement curves (Enkvist 2010, p.8) and recent project experience (ZEP 2012, NZEC 2009), show the relatively high cost but large potential of CCS in power generation. For example, capturing carbon from power plants reduces electricity delivered. For pre-combustion CO2 capture in OECD regions, the net efficiency penalties are between 5.5% and 11.4% - or a relative decrease in net efficiency of 20%[14] (Finkerath 2011 p28-29, MacKay 2009).

No single technology for CO2 capture from coal-fired power generation clearly outperforms the available alternatives. Current CCS demonstration programmes currently cover all capture routes, reflecting the nascent level of CCS research and development. Data for CCS in non-OECD countries is very limited, although deployment in these regions might have to exceed OECD deployment in order to achieve global climate change objectives (Finkenrath 2011 p. 41).

Confidence in the technology is high (medium evidence) with the low price of carbon and other economic uncertainties acting as a major constraint to deployment in all regions (strong evidence) (ZEP 2012). There are serious concerns about future progress of CCS following project cancellations.[15] There is very weak evidence for the poverty impact of CCS and for CCS contribution to growth.

5.3 Renewable Energy (RE)

Renewable energy (RE)[16] replaces fossil and nuclear fuels in four distinct markets: power generation, heating and cooling, transport fuels, and rural/off-grid energy services (REN21 2011). The technologies can be classified into six major groups: bioenergy, direct solar, geothermal, hydropower, ocean energy and wind energy (IPCC 2011 p8-9). All show important potential but ocean energy is by far the least mature amongst them, perhaps 15 to 25 years behind on-shore wind energy, which is the most mature (REN21 2011 p26-27, SEFA 2012 p.9).

Some RE technologies such as hydro, wind, solar PV, tidal depend on natural cycles and are therefore subject to variability on differing timescales. While large hydro, bioenergy, geothermal resources and concentrating solar power (CSP) plant offer comparable levels of firm capacities to conventional fossil fuel based plant, solar PV applications, wind and possibly small hydro resources (and wave energy resources in the future) are more variable. This may affect the degree to which some RE technologies can displace fossil fuel and nuclear capacity. At high penetrations such characteristics pose new challenges for electricity grids. Options sometimes exist to balance the grid using a mix of RETs with different natural cycles, reducing the need for back-up capacity. For instance, large hydro can complement wind power (IEA 2007).

RE helps to diversify the energy supply mix, especially as their risk structure is not related to fossil fuel supply risks, they can reduce the variability of generation costs. RE can also help reduce energy import dependency. Some African countries' electricity sectors are dependent on hydropower and are therefore vulnerable during drought (and future climate impacts). However, hydropower, including small and multipurpose schemes offer major development opportunities including terms irrigation and water supply (DFID 2009),

Renewable energy accounted for half of the estimated 194 gigawatts (GW) of new power capacity added globally during 2009. Renewables delivered close to 20% of global

[14] Typical coal thermal power station efficiency is 33%.
[15] http://www.businessgreen.com/bg/news/2170236/iea-ccs-prove-stillborn-investment-boost
[16] Precisely defining RE is complex: e.g. the IPCC and IEA report large hydropower schemes, traditional biomass and modern biofuels as "renewable" but sustainability is contested, e.g. DFID 2009 p11.

electricity supply in 2010, of which 13% was from hydropower. By early 2011 they comprised one quarter of global power capacity from all sources (REN21 2011 p.11). Despite the global financial crisis cumulative installed capacity grew in 2009, including wind power (32% increase, 38 Gigawatts (GW) added), hydropower (3%, 31 GW added), grid-connected photovoltaics (53%, 7.5 GW added), geothermal power (4%, 0.4 GW added), and solar hot water/heating (21%, 31 GWth added). Biofuels accounted for 2% of global road transport fuel demand in 2008 and nearly 3% in 2009.

RE investment grew less in 2010, but developing countries dominated, particularly in the wind sector. Investment growth was hit by more competitive world gas prices and investor concerns over policy changes (UNEP 2011 p11). By 2010, financial new investment in developing countries overtook developed economies for the first time. New investment in the former totalled $72bn versus $70bn in the latter.

In context, annual investment required from 2011-2035 in energy supply infrastructure is around $675bn[17] with RE taking up 60% of investment in power plants, estimated $227bn annually (see IEA 2011 p193 – new policies scenario). Developing countries host over half of global RE electricity generation capacity (IPCC 2011 p 9).

Deployment of RE technologies is projected to increase substantially even under baseline scenarios and certainly under ambitious mitigation scenarios, including hydro, wind, biomass and solar energy (IEA 2011, p.184-5). This assumes continued demand growth for energy services (virtually certain), the ability of RE to contribute to increased energy access and the limited long-term availability of fossil resources (IPCC p. 20-21).

This positive outlook is tempered due to evidence of rare earth materials supply constraints (Moss et al 2011 p.5), infrastructure constraints, public acceptance and sustainability factors (IPCC 2011 p.11).

While there is a very important role for renewable energy in improving energy access for poor people at least cost, especially in rural areas[18] (World Bank 2007 p. xxix-xxx, IPCC 2011 p.18), the global mitigation potential in the access sector is comparatively small - providing universal energy access[19] by 2030 (without prioritising RE) would increase global CO2 emissions by less than 1% (IEA 2011 p45).

Some RE technologies can be deployed at the point of use (decentralised), and others are primarily deployed within large (centralised) energy networks. Many RE technologies are technically mature and are being deployed at scale (wind, solar PV). Others are pre-commercial or fill specialised niche markets (ocean, wave, pico/micro-hydro).

Some RE technologies are competitive with existing market energy prices – notably large scale wind, biomass, solar and hydroelectric power. Many of the other RE technologies can provide competitive energy services in certain circumstances, for example, in regions that lack low-cost energy supplies.

There is medium evidence that energy subsidies to renewables (USD 66bn globally in 2010) can bring long term economic and environmental benefits - jobs, reducing foreign exchange

[17] Between 41% and 44% of the total is for transmission and distribution infrastructure.
[18] Renewable energy is more economical than conventional generation for off-grid (less than 5 kW) applications. Several renewable energy technologies are potentially the least-cost mini-grid generation technology for 5-500kW applications.
[19] 1.3 billion people have no electricity and 2.7 billion rely on the traditional use of biomass for cooking, accounting for 60% of all global biomass energy use. The UN Secretary General Sustainable Energy for All initiative aims to achieve universal energy access (UEA) by 2030. 55% of all new electricity generated for UEA will need to happen through mini-grid/isolated off-grid solutions (SEFA 2012, IEA 2011 p 487)

drain and local emissions - whereas the costs of subsidies to fossil fuels[20] generally outweigh the benefits (IEA 2011 p.507-8)[21]. In 2010, fossil fuel subsidies were worth USD 409bn around double the record total global investment in renewable power and fuels of 2010: USD 211bn (REN21 2011). Only 8% of global fossil fuel subsidies in 2010 was distributed to the poorest 20% of the world's population.

In most regions of the world, policy measures are still required to ensure rapid deployment of many RE sources (Enkvist 2010, IPCC 2011). Solar energy in particular is perceived by a wide range of sources to have large potential in low-income countries (Jewell 2011, Swadkin 2010).

At least 96 countries now have some type of policy to support renewable power generation. More than half of these countries are developing countries or those considered emerging economies and 17 low- and middle-income countries have adopted feed-in tariffs to support RE (REN21 2011). Additional policies are needed to increase investment in technologies and infrastructure (IPC 2011 p.7).

[20] Although often justified on the basis of helping the poor access basic energy services, in practice the poor only capture a small share of energy subsidies. Only 8% of fossil fuel subsides reach the poorest income group (the bottom 20%) (IEA 2011 p 518-9).

[21] The G-20 and APEC leaders have committed to rationalise and phase out fossil fuel subsidies that encourage wasteful consumption, but implementation is slow. See http://www.iisd.org/gsi/sites/default/files/ffs_g20_firstyear.pdf and http://www.iisd.org/gsi/sites/default/files/synthesis_ffs.pdf

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Review 03

Climate finance

By Shilpa Patel

1. Introduction

This paper provides inputs related to climate finance in the form of an Evidence Review in order to assist in the drafting of an Infrastructure Position Paper (IPP), which is intended to address the role of DFID in financing infrastructure for development. The IPP will examine several infrastructure subsectors, including energy, transport, etc. (see Terms of Reference for the Evidence Review assignment). Climate change mitigation, adaptation, climate resilient design and low-carbon development are specific topics to be addressed by the Review. Climate finance, to the extent that it will be a required element of any low-carbon infrastructure development plan, is addressed as a stand-alone piece but should be seen as a complement to the sectoral pieces being produced separately.

A general caveat is in order. Climate finance is a relatively new area of study and there remain large data gaps in practically all its aspects, starting with an accepted definition of what it is. Project or program level data, where available, tend to be anecdotal. Some of the "evidence" available in the literature consists of authors' views, policy prescriptions and other "received wisdom" which is, in many cases, forward-looking and not backed up by hard data. The paper therefore uses "agreement" when referring to such statements from the literature rather than "evidence."

2. Climate Finance: what is typically counted

As numerous reports have pointed out, there is no precise internationally agreed definition of climate finance (World Bank et al 2011; CPI 2011; OECD/IEA 2011). The term refers broadly to resources that target low-carbon and climate-resilient development, with greenhouse gas mitigation or adaptation as an explicitly stated objective or outcome. More recently, particularly with Rio+20 on the horizon, policy makers are increasingly referring to "Green Growth", which itself has become a subject of international cooperation (GGGI et al 2012). Climate finance can be public or private; international or domestic, can cover adaptation and mitigation, and can encompass investment ranging from research and development through to manufacturing and rollout, with different financing sources and instruments employed at different stages (Pew 2010).

A related question is what should be counted: total investment or incremental costs. An investment may include a renewable technology; in such a case, would the whole investment count or just the additional cost of the renewable component? Additionally, should it be the capital costs of the investment, or some estimate of a lifetime cost, taking into account the differential in operating costs? Similar questions also arise for adaptation investments. Should the extra costs of building in climate resiliency be accounted for as a differential with the "business as usual" costs? There is little or no evidence of any consensus on such questions.

Most climate finance, identified as such, has to date been provided by the private sector and has been largely used for mitigation (CPI 2011). Public climate finance flows to developing countries have to date been mostly ODA (see Section 5). Efforts to track climate expenditures focus on the following:

Renewable Energy (RE): these investments use a range of technologies, and can be both grid-tied and off-grid. RE includes wind, solar, geothermal, small and large hydro, biomass and biofuels, and to a lesser extent, tide and wave energy (REN21 2011).

Energy Efficiency (EE): EE represents a significant emissions-reduction opportunity and also encompasses a wide array of sectors (IFC 2011b; McKinsey 2011). EE improvements can take place on both the demand and supply side, and commonly represent the least-cost option for either freeing up generation capacity or cutting greenhouse gas emissions. The buildings, industrial and transport sectors all offer EE opportunities, as does agriculture (prevention of land degradation and improved irrigation) and the municipal sector (water, lighting) (McKinsey 2011).

Forestry: there is significant emissions reducing potential in the protection and enhancement of forests (UNEP-FI 2011)

Cleantech: Cleantech is generally understood to mean venture and growth capital stage investments in activities that support resource efficiency or pollution abatement (not necessarily limited to emissions reduction). From a climate perspective, cleantech is an important marker for technological innovation, which will clearly be needed for an effective response to climate change. It is a cross-sectoral investment theme that covers a broad range of sectors beyond renewable energy and energy efficiency, such as IT applications for process monitoring and control to support resource efficiency (for example, smart irrigation and smart cold chain management); more efficient water use, waste water treatment, or desalination technologies; sustainable agriculture (for example, sustainable pest control, saline or drought resistant seeds); clean transport; green buildings; bio-chemicals; recycling. However, limited clean technology development takes place in developing countries: three-quarters of the over USD8 billion venture capital financing in 2010 among G-20 countries

took place in the United States, with China in a distant third place at around USD300 million. (Pew 2010; BNEF 2010)

Adaptation: refers to activities that reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience (OECD-DAC 2010). See also Section 4 below.

3. Current Volumes of Climate Investment

The lack of a consistent definition of climate finance, and the multitude of sources of such finance, make it difficult to track investment flows (CPI 2011; World Bank et al 2011; OECD/IEA 2011; and many others). As shown in Table 1, differences in definitions and tracking sources result in a range of estimates that are difficult to reconcile due to lack of comparability. There is, thus, an evidence gap in the systematic measurement and tracking of climate finance.

Better data appears to be available for "traditional" climate change mitigation, i.e., clean energy and energy efficiency. Adaptation overall is either less widely studied, or presents even more difficulty in definition, although a systematic effort to track such flows has recently been launched (OECD 2011). Some of the figures below attempt to measure the size of the total climate-related investment market (HSBC 2010; Pew 2010); others are more narrowly focused on specific sectors such as renewable energy (REN21 2011). Some focus on measuring flows to or in developing countries (CPI 2011; IFC 2011b), while others do so through a bilateral or official sources lens (UNEP 2010; OECD 2011). There is strong evidence of the importance of private flows in climate investment, and some sources provide estimates of the magnitude of such flows (IFC 2011b; CPI 2011; UNCTAD 2010).

Table 1: Annual Climate Finance Flows, USD billions

Source	mitigation		forestry REDD	adaptation	year	remarks
	low carbon energy	energy efficiency				
Pew 2010	243.0				2010	global
CPI 2011	93.0			4	2009/2010	developing countries
HSBC 2010	422.0	317.0			2009	global
IFC 2011	81.0	119.0			2010	developing countries
Climate Strategies 2011	60-160				2008-2010	developing countries
UNCTAD 2010	90 *				2009	FDI; developing countries
REN21 2011	207.0				2010	global
UNEP 2010	8.9			3.96	2009	bilateral; developing countries
OECD 2011	17.6			9.3	2010	OECD-DAC; developing countries
UNEP-FI 2011			0.037		2008	developing countries

* includes investment in manufacturing

4. Barriers to Investment

Investors require an adequate risk/return profile in order to invest in any project. Projects may face risks along technical, financial or policy fronts, in addition to overall country risk, and these risks are typically addressed through mitigating strategies or instruments. However, in the area of low-carbon investment there exist certain barriers to investment such that commonly-used mitigants may not be available. Several reports discuss barriers to investment and address risks (UNEP-FI 2009; S&P 2010; ODI 2011). While different

sources employ somewhat differing typologies, and there is variability in how the risks are "sliced and diced," Table 2 below provides a fairly comprehensive summary.

Table 2: Risks Involved in Securing Climate Change Finance

Policy Risks	
Additionality Risk	Lack of clear environmental additionality
Cannibalisation Risk	Climate budgets are not additive to ODA spending
Enforcement Risk	Rules not fully binding or difficult to enforce
Illegitimate Policy Changes	Nationalisation, confiscation, expropriation, deprivation
Inconsistency Risk	Regional, national, international rules and regulations in conflict
Legitimate Policy Changes	Change in legislation in the ordinary course of government
Longevity Risk	Regulations only in force for a short period compared to investor horizon / capital commitment
Methodology, Reporting &Verification (MRV) Risk	Lack of appropriate methodologies
Multitude Risk	Multiple project types in multiple countries and/or employing multiple technologies
Capacity Risks	
Aggregation/ Commoditisation Risk	Difficulty in aggregating &/or commoditising individual transactions into large-scale investment vehicles
Human / Operational	Lack of well trained work force to implement projects
Infrastructure	Poor physical infrastructure
Institutional - property rights	Lack of property rights and/or legal system
Institutional - Regulatory	Lack of well established and resourced regulator
Policy Development Risk	Lack of understanding within policy development role /civil service
Transactional Risks	
Branding Risk	Public unacceptability of mechanism e.g. market-based solution, securitisation etc.
Complexity Risk	Financial instruments are too complex
Currency Risk	Currency fluctuations
Economic/Commodity Price Volatility	Fluctuation in economic conditions and commodity prices
Fungibility Risks	Lack of fungibility between regimes / environmental instruments
Liquidity Risk	Fragmented measures lead to too many different regimes
Private Sector Funding Shortage	General shortage of funding
Risk/Reward Imbalance	Insufficient returns available given risks involved
Transaction Cost Risk	High transaction costs, including high costs of complying with MRV requirements
Project Risks	
Fraud/Cash Leakage	Investment eroded by leakage costs &/or fraud
Physical Risk	Natural hazards, including fire, explosion, war, machinery breakdown and other material damage
Scale Risk	Individual project size unattractive
Technology Risk	Technology is not efficient and/or too complex and/ornot publically accepted

Adapted from S&P 2010

These risks and barriers can often lead to under-investment in activities that provide strong environmental or social benefits but which lack required and reliable returns, or for which market mechanisms may not provide the required risk mitigation (Grantham 2012; IFC 2011b; BNEF 2010). There is strong agreement in the literature that addressing these risks and barriers requires action on several fronts, including public policy, fossil fuel pricing reform and carbon pricing (World Bank Group 2011; McKinsey 2011; Sullivan 2011; AGF 2010), in addition to creating a conducive environment for investment in general (IFC 2011a).

Low carbon investment faces price risk in two respects. One is the cost of technology and anticipated movements down the cost curve for renewable (and other cleantech)

technologies. The other is the anticipated carbon pricing regime, and the uncertainty introduced by a lack of clarity around the sorts of policies likely to come into effect in both developing and developed countries. It is difficult to gauge the impact of such uncertainties on investment; while investment trends show a steady rise over the years in renewables investments (REN21 2011), who is to say what investment might have been with greater policy certainty and clarity.

Additionally, infrastructure projects in particular will be susceptible to risks associated with climate impacts, such as sea level rise, extreme weather events and water availability, to name just three. For instance, physical infrastructure at ports and port activities may be highly vulnerable to changes in climate, not just through increased flooding affecting movements within ports, but also due to changes in trade flows driven by climate change (IFC 2011c). Some low-carbon energy sources require considerable amounts of water – and given competing demands, resource depletion and projected climate impacts, sufficient water may not always be available to meet all needs in all places (SEI 2012). The uncertainty of future climate impacts and the generally short-term horizon used in many business planning processes can reduce companies' incentives to build greater climate resiliency into investments. Companies appear to be more ready to adapt if they can offset costs, and regulatory environments and government action can play a key role in stimulating private sector engagement in adaptation (OECD 2011c).

5. Sources of Climate Finance

There is a very high degree of agreement in all sources consulted with the AGF 2010 statement that "Funding will need to come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance, the scaling up of existing sources and increased private flows. Grants and highly concessional loans are crucial for adaptation in the most vulnerable developing countries." There is also a strong recognition that the private sector is currently (CPI 2011; IFC 2011b) and will continue to be (AGF 2010; World Bank Group 2011) an important source of finance for climate.

Developing Country Government Support: Government support is provided in the form of conducive policies as well as from budgetary sources. Public policy plays an important role in attracting investment in general (IFC 2011a; UNCTAD 2010). Policy support is particularly necessary for sectors prone to market failures (Grantham 2012; IFC 2011b; GGGI 2011), and so public policy will play an important role in attracting climate investment as well (World Bank Group 2011; Critical Mass 2011).
Public support typically takes the form of regulation or policy to create an incentive or move the market in a desired direction. Domestic budgetary support will depend on national circumstances and domestic fiscal environments, and can be expected to play a key role (AGF 2010).

One key element of public policy concerns fossil fuel subsidies, which distort pricing regimes, energy markets and create disincentives for low-carbon development. There is strong evidence that fossil fuel subsidies are not compatible with encouraging low-carbon development (World Bank Group 2011; Sullivan 2011; UNEP-FI 2012) or poverty reduction, as they are usually regressive. In contrast, energy subsidies to renewables (USD66 billion in 2010) can bring long term economic and environmental benefits - jobs, reducing foreign exchange drain and local emissions - whereas the costs of subsidies to fossil fuels generally outweigh the benefits. If fossil fuel subsidies (USD409 billion globally in 2010 – considerably greater than most estimates of annual climate finance flows) were phased out by 2020, global primary energy demand would be cut by 5% and CO_2 emissions by 5.8% (IEA 2011).

ODA/Bilateral Support: Table 1 shows some estimates of climate finance provided by bilateral sources. OECD-DAC appears to have the most systematic tracking system; they estimate that USD 22.9 billion, or 15% of total ODA, were provided by DAC members in 2010 for climate change mitigation (two-thirds) and adaptation. In addition, DAC members' contributions to multilateral organizations were USD718 million in 2010 (OECD 2011b).

Development Banks: There is strong evidence that multilateral development banks (MDBs) and their national counterparts (NDBs) are an important source of finance for climate-related investment (AGF 2010; World Bank Group 2011), and can leverage multiples of their own financing from other sources. Annual investment by MDBs in mitigation activities amounted to around USD19 billion in 2010, in support of projects worth around USD60 billion (IFC 2011b). Much less information is available for NDBs; one estimate indicates that they accounted for USD5.8 billion of financing for clean energy in 2010 (BNEF 2011).

Private Sector: The private sector provides finance through equity and debt; finance can be structured as direct investment or through a guarantee or insurance structure. Equity may be provided on a company's own balance sheet, or through private equity funds or raised from capital markets through share issues. Debt can be raised through borrowing from a bank, or through capital markets via the issuance of a bond or other commercial paper. Financing plans increase in complexity with an increase in project complexity, and a variety of financial instruments may be used to complete a financing plan. Insurance products are currently deployed mostly to cover political and business risk; however, weather insurance products are a growing market and will only gain in importance as companies seek greater protection against climate risk. Index-based insurance schemes have been shown to increase farm income stability and provide incentives to pursue more high-risk, high return strategies. They also enhance access to rural finance through reduced default rates (World Bank Group 2011)

As previously mentioned, there is strong evidence that the private sector is an important – if not the principal – source of finance for climate-related investment. Ultimately, private firms will need to bear a part of the costs of autonomous adaptation to climate change or go out of business. These costs are likely to defy tracking of the sort noted in Section 3, because of confidentiality issues associated with private sector decision-making and data (a private company is unlikely to reveal the investment alternatives it has considered, nor to divulge any proprietary climate risk information).

Institutional Investors: Institutional investors (such as pension funds, sovereign wealth funds and insurance companies) control large amounts of capital and generally have a longer-term investment horizon, so could play an important role in climate finance (OECD 2011b). This community is increasingly engaged in climate change discussions and there is strong evidence that it has begun to organize in response to climate-related issues (Ceres 2012). One product that holds some appeal for these investors is the Green Bond, issued by the World Bank, IFC and other MDBs. As currently structured, MDB green bonds earmark proceeds for specific environmental activities, but the servicing of the bond is from general revenues, and thus does not carry any concurrent project risk (IFC 2011b). To date, some 28 green bonds have been issued, more than half of which are by MDBs or government entities (CBI 2012).

Carbon Finance: The key externality in the climate space is carbon emissions; there is strong agreement that comprehensive carbon pricing policies such as a carbon charge or emissions trading are an efficient way to raise finance for climate action (World Bank Group 2011; AGF 2010; McKinsey 2011). The market for carbon credits is linked to the outcome of the UNFCCC negotiations; this market is likely to remain depressed for the remainder of the decade since tangible progress is not expected until 2015, and even then will only come into effect in 2020. Furthermore, even though the size of the global carbon market was USD142

billion in 2010 (driven primarily by the European market), primary CDM transactions accounted for only slightly over 1% of this amount (World Bank 2011), so there is strong evidence that the carbon market is not a major financing source for emissions reducing projects in the developing world.

Concessional Finance: The main entities providing climate-related concessional finance are the Montreal Protocol; Global Environment Facility (GEF); and the Climate Investment Funds (CIF) (OECD 2011b).

The Montreal Protocol was set up to protect the ozone layer by phasing out the production of ozone depleting substances, notably chlorofluorocarbons. It entered into force in 1989, and established a Multilateral Fund, which as of 2010 had disbursed around USD2.5 billion towards 6000 activities in 140 developing countries (Montreal Protocol 2010a). Signatory parties phased out fully hydrogenated ozone depleting substances by 2010. Because ozone depleting substances are also global warming gases, the reduction in ozone depleting substances between 1990, when they reached peak levels, and the year 2000 has yielded a net integrated reduction of approximately 25 billion tons of CO_2 weighted global warming gasses. These reductions make the Montreal Protocol one of the prime global contributors to date in the fight against global warming (Montreal Protocol 2010b).

The GEF was established in 1991 to assist in the protection of the global environment and to promote environmentally sustainable development. Since then, it has provided USD10.5 billion in financing towards 2700 projects on 165 countries, making it one of the largest financing sources for environmentally friendly activities globally (GEF 2012). Areas of intervention include biodiversity, persistent organic pollutants and desertification, in addition to climate change. In the specific area of climate change, GEF has to date provided USD3 billion, which leveraged USD23.7 billion for mitigation projects in 156 countries. In addition, more than USD 430 million was provided towards 135 adaptation projects in 90 countries (GEF 2012).

The CIF was set up in 2008 to provide financing to jump-start climate-smart development, and consists of two trust funds – the Clean Technology Fund (CTF) designed to scale-up mitigation action, and the Strategic Climate Fund (SCF), itself embodying three programs on forestry, climate resilience and renewable energy in low-income countries. Total funding available is USD7 billion, of which USD4.8 billion is allocated to the CTF. Approved projects as of 2011 in the CTF amounted to USD1.9 billion, which leveraged USD14.3 billion from other sources for 26 projects. Total approvals under the SCF were USD188 million as of the same date (CIF 2011).

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Review 04

Housing

By Kevin Tayler

1. Introduction

This note summarises available information on housing and its role promoting economic growth and reducing poverty, particularly in developing countries. The note also explores the evidence on the role that appropriately planned, designed and priced housing can play in mitigating the effects of climate change, adapting to a low carbon future and delivering basic services to the poor. The note is structured as follows. Section 2 provides an overview of available information on existing housing provision and the gaps and deficiencies in that provision, mainly drawn from UN sources. Section 3 assesses evidence on the relationships between housing, economic growth and poverty reduction. Section 4 examines the ways in which housing is influenced by and influences climate change, Section 5 summarises existing policies and approaches while Section 6 provides additional information on some important points to be considered in relation to housing policies and programmes.

2. Overview

2.1 Global housing need

Worldwide, inadequate housing is a significant problem. In 2005, the UN Commission on Human Rights estimated that there were 1.6 billion inadequately housed people in the world, of whom 100 million were completely homeless[1]. This compares with a total estimated global population of 6.9 billion in 2010, of whom almost 5.7 billion lived in 'Less Developed Regions'[2]. Taken together, these figures suggest that worldwide more than one person in five is inadequately housed. In the less developed regions, the estimated urban and rural populations in 2010 were about 2.56 billion and 3.11 billion respectively, with the majority of population growth occurring in urban areas so that the urban population was expected to exceed the rural population shortly after 2020. The worldwide urban population is expected to exceed 5 billion by 2030[3] Millennium Development Goal 7, Target 11, to improve the lives of 100 million slum dwellers gives the key dimensions of improved shelter as access to water and sanitation, secure tenure, durable housing and sufficient living area. More generally, housing is influenced by and influences progress towards MDG 1 - to eradicate extreme poverty and hunger.

2.2 Slums and informality

This rapid urban growth is putting great strains on formal housing delivery systems with the result that many people can only find housing in informal settlements, many of which are slums. The terms 'slum' and 'informal' terms are often used interchangeably although their meanings are in fact rather different. UN Habitat defines a slum as a settlement whose inhabitants lack at least one of the basic conditions of decent housing: adequate sanitation, improved water supply, durable housing or adequate living space[4]. Informal housing is that which is developed without regard to official procedures, standards and norms. The term informal relates to housing development procedures rather than the physical and social characteristics of the housing. Most, but not all slums are developed informally[5]. Conversely, not all informal developments are slums. Many slums and informal settlements are developed on land owned by a third party, often government, without the consent of the owners. In other cases, developers and house owners have legal title to land but do not meet official planning and building standards and regulations[6].

The 2011 UN Habitat Global Report on Human Settlements gives figures of 768 million and 828 million for the worldwide slum populations in 2000 and 2010 respectively. The 2010 figure equates to 32.7% of the total urban population. Sub-Saharan Africa has the highest urban and slum growth rates (4.58% and 4.53% respectively in the mid 2000s[7]) and the highest proportion of the urban population living in slums, 61.7% in 2010[8]. As a result, the Africa's slum population is now higher than those in either Eastern or Southern Asia, almost 200 million in 2010 and growing at almost 9 million people per year. Slums are a sub-set of the larger category of informal or unauthorised development. One source gives the unauthorised share of housing in low income countries as 64%[9]. This figure is from 1990 and makes no distinction between rural and urban housing. Despite these limitations, when taken in conjunction with more recent information on the percentage of the urban population

[1] Source http://www.un.org/News/briefings/docs/2005/kotharibrf050511.doc.htm
[2] Figures taken from UN Habitat Global Report on Human Settlements 2011:Cities and Climate Change
[3] See World Bank Urban Papers UP-5, Urban Poverty a Global View, author Judy L Baker, downloaded from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSDNET/0,,print:Y~isCURL:Y~menuPK:64885113~pagePK:7278667~piPK:64911824~theSitePK:5929282~contentMDK:22822852,00.html on 4th April 2012
[4] Definition taken from http://www.un.org/millenniumgoals/pdf/mdg2007.pdf. A more detailed exposition of the points included in this definition is given at http://ww2.unhabitat.org/mdg/.
[5] For instance, in India, some areas now classified as slums were originally planned low-income settlements intended for the 'economically weaker' sections of society.
[6] In Cairo, for instance, some informal developed housing blocks exceed 15 storeys in height.
[7] Figures given in the UN Habitat State of the Worlds Cities 2006/2007
[8] Figure given in The UN Habitat State of the World's Cities 2010/2011: Bridging the Urban Divide, Earthscan, London
[9] Quoted in Arnott (R 2008) Housing Policy in Developing Countries: The Importance of the Informal Economy, Commission on Growth and Development, Working Paper No. 13. The figure is based on data from 1990 and there is likely to have been some change in the intervening years.

living in slums, it does suggest that over half of all housing development in rapidly growing towns and cities in the developing world is informal. In some countries, renting is common, particularly in low-income urban areas. UN Habitat (2003 42-3) noted that in most parts of Africa and the Middle East, small-scale landlords dominate the rental market, many renting out a single room or shack.

The phenomenon of informality appears to be, at least partly, a response to the weakness of formal institutions and in particular their inability to regulate and support urban development and housing markets. It would also appear to be a response to the failure of formal mechanisms to provide housing that is affordable to the urban poor. There are two aspects to affordability, cost and ability to pay. In his detailed study of housing and poverty in the United States of America, Michael Stone produces figures that suggest that, while the percentage varies depending on economic conditions, there has always been a significant 'shelter poor' segment of the US population. If this is true of the US, it is even more likely to be true in low-income countries in which a high percentage of the population lives below the officially accepted poverty line. While some low-income households are no doubt able to address their shelter needs in the rather creative ways described by John Turner 40 years ago, the reality is that most are forced to live in poor quality rented accommodation, paying a high percentage of their income for this doubtful privilege[10].

3. Housing, economic growth and poverty reduction

3.1 The contribution of housing to GDP

It has been estimated that housing contributed 4.5% of India's GDP in 2003/4 at the then (2007) current prices, of which 3.13% was in urban areas[11]. This is comparable with the 5% figure for housing investment in the US prior to the 2008 financial crisis given by the US National Association of House Builders (NAHB)[12]. Further investigations are required to obtain information from Africa, Latin America and other Asian countries.

From an economic perspective, the key question is perhaps whether housing is contributing to growth or, by using resources that could be used for more productive investment, reducing long-term growth potential. The answer to this question may be influenced by the high percentage of informal development in most towns and cities in developing countries and the inverse relationship between the relative size of the informal sector and government fiscal capacity. The diminished revenue-raising capacity associated with high levels of informality restricts the scale and scope of the action that government can undertake[13]. This often ignored factor arguably requires further investigation.

3.2 Housing and employment

Information on employment in the housing sector is not usually disaggregated and may not be accurate, given the high proportion of housing provided informally. India's 2007 National

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[10] See John F C Turner's description of the 'supportive shack' in Housing by People:Towards Autonomy in Building Environments. Marion Boyers Publishers 1976. The reality is that many households pay relatively high rents for very poor quality accommodation. For instance, recent conversations with residents suggest that the going rate for a basic room in Dhaka, Bangladesh is around Tk 1200 (About US$15) per month, increasing to Tk1400 per month if basic water supply and sanitation services have been provided by the landlord. This compares with reported typical household incomes in Dhaka slums ranging from $60 to $82 per month, suggesting that the housing is costing more than 20% of total household income. Figures for household income taken from report on 'Health and Social Income in Dhaka Slums' downloaded from http://www.isuh.org/download/dhaka.pdf.

[11] Stated in India's National Urban Housing and Habitat Policy, based on Indian Central Statistics Organisation (CSO) estimate.

[12] See http://www.nahb.org/generic.aspx?genericContentID=66226, which goes on to say that housing services in the US typically contribute 12 – 13% of GDP. Since 2008, the contribution of housing investment to US GDP has reduced to about 2.5%, confirming the not unexpected fact that, in developed economies at least, investment in housing is strongly affected by general economic performance.

[13] Arnott, R (2006) Housing Policy in Developing Countries: the Importance of the Informal Economy, Commission for Growth and Development, Working Paper No. 13, World Bank, Washington

Urban Housing and Habitat Policy says that 16% of India's workforce is employed in the construction and transport sectors and that indirect employment in materials production pushes the employment contribution of the sector even higher[14]. There is no doubt that the level of housing construction activity is reduces sharply during times of recession and employment levels in the sector must be similarly affected. This is another area that would probably benefit from further research. Much of this employment is likely to be in the informal sector. In a 2003 report, UN Habitat estimated that around 50% of urban employment in countries in the lowest two income quintiles was informal[15]. Most informal sector housing workers are likely to fall within these quintiles. Given that it is unregulated, informal sector employment is likely to be less well rewarded and more hazardous than employment in the formal sector. A probable reason for informal sector housing being cheaper than that provided by the formal sector is its dependence on small unregulated builders who reduce costs by paying low wages and using casual rather than contracted employees[16].

Housing and employment cannot be separated from their overall socio-economic context. So, people living in informal areas are also likely to work in the informal sector and this suggests that their job security will be less than that of people living in more formal areas. Unemployment rates in informal areas tend to be higher than those in formal areas. One organisation working in Cape Town, South Africa reports that unemployment rates in the informal areas in which it works can be as high as 75%[17] or higher. This means that many people living in informal housing also work in the informal sector

3.3 Housing, poverty and poverty reduction

Shelter poverty occurs when the cost of housing plus subsistence-level costs for food, clothing, heating, medicines, transport etc exceed the housing budget[18]. Housing costs are particularly important in determining a household's poverty status because they are usually the highest single item in a household's budget and may 'crowd out' expenditure on other necessities. Poverty patterns are often spatial with concentrations of poor people living in areas where housing is cheap but often crowded and of poor quality. As already indicated in Section 2, the majority of such housing in most rapidly developing cities is informal. Research in the United States shows that house renters are more likely to fall into shelter poverty than house owners and that housing poverty is influenced by family size[19]. Options for reducing shelter-related poverty used in developed countries include providing support to families through mechanisms such as housing benefit and providing housing at subsidised prices or rents. The latter is more widespread than the former but neither is widespread. The informality of much low-income housing means that its occupants fall outside official systems and are often ineligible for formal benefits. In India, for instance, there is a distinction between 'notified' and 'non-notified' slums and services tended to be extended to the first but not the second, despite the fact that non-notified slums are likely to be inferior to notified slums. This was the initial situation with regard to the slum upgrading component of the DFID-funded Andhra Pradesh Urban Services for the Poor project. Eventually, following pressure from DFID's project management consultant, the slum upgrading programme was extended to include non-notified slums but the initial position of

[14] The report gives a factor of 8 but this is clearly too high.
[15] UN Habitat (2003), The Challenge of Slums: Global Report on Human Settlements, London, Earthscan and UN Habitat. The figures were based on data from 1998, collected as part of the Housing Indicators Program, run by the World Bank and UN Habitat.
[16] One prominent proponent of this view is Rod Burgess – see his critique of John Turner's ideas on the informal sector in 'Self Help Housing Advocacy: A Curious Form of Radicalism, A Critique of the Work of John F. C. Turner in 'Self Help Housing a Critique, ed, Peter M Ward, Mansell Publishing 1982.
[17] http://www.street-papers.org/case-studies-africa/ This is not a
[18] Stone M E (1993) *Shelter Poverty: New Ideas on Housing Affordability*. Philadelphia: Temple University Press.
[19] Ibid – Chapter 2

government officials was clear: slums had to go through a formal recognition process before becoming eligible for inclusion in government programmes[20].

4. Climate change and reduction of carbon emissions

4.1 Contribution of housing to greenhouse gas emissions

Annual per-capita greenhouse gas (GHG) emissions in European and North American cities are typically around 10 tonnes CO2 equivalent, although there are variations between individual cities. The figures for South Asian cities are smaller, with most below 1.5 tonnes per capita. Emissions for Chinese cities are similar to those for Europe and North America[21]. While these figures are for all emissions rather than specifically for housing, they do suggest that housing-related emissions for South Asia, and presumably also for Africa, are likely to be less than those for Europe and North America.

Globally, the Intergovernmental Panel on Climate Change (IPCC) estimates that direct and indirect emissions associated with residential buildings contribute 10.6 billion tonnes of CO2 equivalent emissions each year, about 8% of all emissions[22]. Indirect emissions are created in producing, transporting and placing the materials used in construction while direct emissions relate to energy used for heating, cooling, ventilation, cooking, cleaning and washing. In the UK and China, the estimated contributions of residential CO2 emissions are similar at 26% and 25% of total emissions respectively. In China, only 320 million square metres of a total of 40 billion square metres of built area (0.8%) can be identified as energy saving buildings. In India, it has been estimated that fans, lighting and refrigeration account for 34%, 28% and 13% respectively of residential energy use. A large proportion of the 13% for refrigeration is presumably from air conditioning systems since heating, ventilation and air-conditioning systems are estimated to account for 40 – 50% of consumption for buildings with these facilities[23]. The figure would rise significantly if more households could afford air-conditioning, in the absence of which poor people living in poorly insulated and ventilated buildings experience great discomfort.

4.2 Adapting to climate change

Over the years, there have been many attempts to respond to this situation by developing 'natural' approaches to climatic control within buildings. An early example was the building of the village of New Gourna, near Luxor, under the direction of the Egyptian architect Hassan Fathy[24]. Fathy's approach to climatic design in hot dry climates emphasised the benefits to be gained from low-conductivity materials such as sun-dried bricks. When combined with the judicious use of other traditional features such as wind catchers and courtyard designs, such materials could create housing that was both climatically appropriate and low-cost. Another pioneer was Otto Koeningsberger, the main contributor to the 1974 Manual of Tropical Housing and Building: Climatic Design[25]. Following a similar philosophy, the Indian architect Charles Correa developed housing designs suitable for the

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[20] See Tayler K (2005), Two Participatory Projects in South Asia, Proceedings of the Institution of Civil Engineers, Municipal Engineer, 158, pp 37 - 43

[21] Figures given in Table 3.5 on page 37 of the 2011 UN Habitat Global Human Settlements Report. The table gives no figures for African cities. The report notes that while there is an agreed protocol for measuring emissions, boundary conditions remain problematic so that absolute comparability of figures cannot be guaranteed.

[22] See http://www.ipcc.ch/publications_and_data/ar4/wg3/en/tssts-6.html - Figure from 2004.

[23] Gupta, R. and S. Chandiwala (2009) 'A critical and comparative evaluation of approaches and policies to measure, Benchmark, reduce and manage CO2 emissions from energy use in the existing building stock of developed and rapidly-developing countries – case studies of UK, USA, and India', Paper prepared for the Fifth Urban Research Symposium, Cities and Climate Change: Responding to an Urgent Agenda, 28–30 June, Marseille, France, Http://siteresources.worldbank.org/INTURBAN DEVELOPMENT/Resources/336387-1256566800920/gupta.pdf , last accessed 12 October 2010

[24] Fathy H (1973) Architecture for the Poor, University of Chicago Press, Chicago, USA.

[25] Koenigsberger O, Ingersol T, Mayhew A and Szokolay S (1974), Manual of Tropical Housing and Building:Climatic Design, Longman

hot humid climate found in cities such as Mumbai. He emphasised the importance of through ventilation and private and semi-private open spaces that could be used for sleeping, relaxing, entertaining and cooking for much of the year. He used these principles in the development of the Belapur low-income housing scheme in Navi Mumbai and his designs for high density apartment block housing for the Maharashtra Housing Development Board.

These pioneering initiatives had little or no influence on mainstream housing construction approaches and methods. In Cairo, as in other cities, the most common construction type uses reinforced concrete foundation, frame and floors with brick infill walls, usually only 100mm thick[26]. No consideration is given to energy conservation and such units provide very poor insulation. Mud continues to be used for rural housing in Africa and Asia. There is some evidence that many people aspire to the use of 'permanent' construction materials such as burnt brick. In Egypt, for instance, most new housing in cities, towns and villages is multi-storey and uses the concrete frame and brick infill construction technique found across the developing world. Fathy's advocacy for the use of traditional materials and construction methods has largely been ignored. Certainly, galvanised steel sheeting has replaced grass roofing over much of Africa, particularly in urban areas. The latter has better insulation qualities but requires more maintenance, which is likely to be an important factor for many house owners.

The climate impact of housing construction is also influenced by the location of that housing in relation to employment opportunities and this in turn means that there is a link with planning and the transport services extended to residential areas. Again, the preponderance of informal sector housing reduces the scope for planning although the relatively high density of informal settlements reduces distances. The principles of 'compact city planning'29 incorporated within the municipal ordinances of cities such as São Paulo (Brazil) and Cape Town (South Africa)[27], although, in practice, it is not clear that such principles can actually be implemented in an effective way. One way forward is suggested by the Brazilian city Curitiba, with its integrated transport system, which provides good transport services even to outlying residential areas. Curitiba's land policies and Housing Company might provide models for a more general approach to land and housing provision.

4.3 Policy responses and 'green' housing initiatives

To date few developing country governments have made much progress in developing policy responses to climate change. Government policies do refer to the need for 'green' buildings. For instance, the Indian National Urban Housing and Habitat Policy states that '*the concept of 'green' and 'intelligent' buildings would be put in place on the ground*'. To date, there appear to be fairly few examples of efforts to implement such policies. In Latin America, both Rio de Janeiro and Buenos Aires enforce the adoption of solar water heaters in municipal ordinances but these are presumably not enforceable in informal areas[28].
It is unlikely that the most ambitious 'green' development initiative, Dongtan Eco-City on Chongming Island near Shanghai, which was intended to ultimately house 500,000 people will be built[29]. Tianjin, another purported eco city development in China appear to be fairly conventional[30] while the Hacienda project in Mombasa, Kenya, which aims to provide 7000 housing units in a self-sufficient township[31] appears to have run into financial problems.

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[26] See Sims D (2010), 'Understanding Cairo: The logic of a city out of control' published by American University of Cairo Press for a typology of housing in Cairo.
[27] Referred to in 2011 UN Habitat Global Report on Human Settlements 2011, Chapter 5
[28] Ibid
[29] See http://news.bbc.co.uk/1/hi/6756289.stm for a general description
[30] See http://www.tianjinecocity.gov.sg/events/2012/20120305.htm for basic information on the public housing being built in Tianjin.
[31] The township website is at http://www.haciendakenya.com/ecocity.html. No information is given on the housing layout or the measures taken to conserve energy.

Regardless of this, its units are clearly targeted at middle and higher income households and will not be affordable to the poor. The same appears to be the case with the T-Zed project in Bangalore, India. Piloting the use of energy-efficient materials is reported from Buenos Aires in Argentina and Rio de Janeiro in Brazil. The Argentinian Ministry of Infrastructure has been working with the Housing Institute, the National University of La Plata and the National Institute of Industrial Technology since 2009 on a pilot project to deliver a social housing scheme providing 'bioclimatic' houses in Buenos Aires[32].

The Argentina case referred to in the last paragraph is an example of the involvement of academic and research institutions in the development of 'green' approaches to housing. One option for DFID will be to explore the options for encouraging such activities and also advocating for changes in university and technical institute curricula to reflect a 'greener' approach to housing. This should be done in a way that recognises the importance of the informal sector.

One possibility to be further explored is the relevance of the approaches adopted in developed countries, including regulation, provision of information and use of grants as incentives might be transferable to developing countries. An example is the UK Government's Low Carbon Buildings Programme[33].

A recent WHO publication sets out the potential health benefits to be achieved through climate change mitigation measures in the housing sector[34]. This concludes that the right mix of mitigation policies can lead to large health co-benefits. Policies and measures might include the use of low-energy and climate-friendly designs to improve natural ventilation, limit vector and pest infestation and improve access to safe drinking water and sanitation, cleaner home energy, the use of healthier substitutes for hazardous materials and smart growth strategies that integrate land use with climate-friendly housing. The challenge will be to implement such policies and measures in situations characterised by large-scale informality. The report describes some case studies, including (a) the campaign by the Indian NGO Energy and Resources Institute (TERI) to introduce low energy LED bulbs recharged by solar energy to villages throughout the country, thus reducing dependence on unhealthy and potentially dangerous kerosene and paraffin lanterns and (b) the Kuyasa project in Khayelitsha Township, Cape Town, South Africa, which aims to retrofit existing houses with solar water heaters, ceiling insulation and low-energy, long-life compact fluorescent light bulbs. These examples show that adaptation to climate change can be about house fittings as well as the structure of the house itself.

5. Polices and approaches

5.1 Government policies and programmes

Many national housing policies assume that Government should take a major role in assembling land, providing services and building housing units, often in the form of walk-up apartments. An example is provided by the Indian Urban Housing Policy's reference to participative slum rehabilitation, meaning construction of new housing units on land previously occupied by slums[35]. Policy is reflected in programmes such as the JNNURM, with participating cities producing schemes for slum redevelopment rather than upgrading.

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[32] Much of this work has been initiated by the architect Carlos Levinton and his colleagues at the Centro Experimental para la Produccion.

[33] See http://www.bre.co.uk/page.jsp?id=1332

[34] WHO (2011) Health in the Green Economy: Health co-benefits of climate change mitigation, housing sector - http://www.who.int/hia/hgehousing.pdf.

[35] Policies do appear to allow for the possibility of in-situ services upgrading but the normal approach is to construct new housing.

The Maharashtra Slum Rehabilitation Authority (SRA) only considers high-density redevelopment, requiring that developers provide a minimum of 500 tenements per hectare[36]. In Africa, development is more likely to be low-rise and in, the past at least, programmes involved nothing more than clearing and levelling land and providing unserviced plots[37].

Housing policies and programmes often involve subsidy. For instance, South Africa's 1994 Housing White Paper led to the provision of over 2 million subsidised units, accounting for 15% of all formal housing units. However, by 2006, delivery was reported to have stalled[38]. India's National Housing Policy seeks to assist the poorest of the poor by providing them with '*access to reasonably good housing on a rental and ownership basis with suitable subsidisation'*. Supporting programmes such as Valmiki Ambedkar Awas Yojana (VAMBAY) provide subsidised housing for slum dwellers[39].

Governments often see informal sector housing as a necessary evil rather than a resource. Some, for instance Pakistan, set a cut-off date, saying that only settlements occupied before that date can be regularised and provided with services. Sri Lanka's Million Houses Programme (MHP), which, with its successor the 1.5 Million Houses Programme, ran from 1983 to 1994, took a more positive approach to informality and incremental development. The MHP provided relatively small loans for families to build or improve their own houses. It aimed to use available funds to provide basic improvements for the majority rather than high standard housing for a minority. Its approach was participatory, involving close collaboration between administrators, politicians and people. Most of the loans given for housing were small, with a quoted average of $178 per family, and participating families contributed between 60 and 90% of the total value of the accommodation built, either in cash or labour. The programme was unusual in that it did not rely on strictly enforceable standards, while providing guidance materials to participating households to help them to plan for their house improvements. The programme covered both rural and urban areas, with about 87% of loans going to rural households[40].
Some countries, for instance Egypt, have strong rent controls[41]. Many economists believe that rent control is an inefficient policy instrument, reducing the size of the rental market and leading to widespread use of illegal practices such as the charging of 'key' money to prospective tenants[42]. In general, national policies do not say much about renting. South Africa's 1999 Rental Housing Act is mainly concerned with protecting the rights of tenants but does refer to Government's responsibility to promote rental housing[43]. India's National Housing Policy refers to the need to create adequate rental housing stock but does not say anything further on how this is to be achieved. There is arguably a need to incorporate the findings of studies such as that of Kumar on rental housing in Bangalore and Surat into policy dialogue and eventually policy[44].

5.2 The approach of international agencies

From the mid-1970s onwards, partly influenced by the ideas of John F C Turner, the World Bank and other international agencies were advocates for services upgrading and the sites

[36] See point 8 at http://www.sra.gov.in/htmlpages/RehabSchemes.htm.
[37] For example, see Mghweno, J. (1984) Tanzania's Surveyed Plots Programme, in Payne G K (ed) Low-Income Housing in the Developing World: The Role of Sites and Services and Settlement Upgrading, Wiley, Chichester
[38] Based on Rust, K (2006) Analysis of South Africa's Housing Sector Performance
[39] Indian National Urban Housing and Habitat Policy 2007, p8.
[40] Information taken from http://www.alliance21.org/2003/article2211.html.
[41] Cairo's rent law, which led to many rents being uneconomical for the property owner, was relaxed for new properties in 1996 but old properties are still governed by the old rules – See Sims 2010 – p146-8)
[42] See http://www.arts.cornell.edu/econ/CAE/rentcontrol.pdf for a theoretical discussion of the economics of rent control
[43] The Act can be downloaded from http://www.info.gov.za/view/DownloadFileAction?id=70618.
[44] See Kumar, S (2001), Social relations, rental housing market and the poor in India, final report on ENGKARS project R6856, downloaded from http://siteresources.worldbank.org/INTURBANPOVERTY/Resources/social-relation-kumar.pdf

and services approach to low-income housing. More recently, international and bilateral agencies have promoted a more market –based approach[45]. The World Bank has shifted its attention away from small sites and services and upgrading loans that targeted the poor directly to large scale policy-related loans covering housing finance and privatisation of public institutions and services. Loans for upgrading accounted for only 5% of shelter spending from 1992 to 2005 and the figure for sites and services was only about 2% if the $358 million allocated to the Middle East and North Africa (MENA) is discounted. Conversely, housing policy and housing finance loans accounted for 15.6% and 39.9% respectively of total sector lending over the period. In addition 32% of loans were for disaster relief activities. Geographically, Latin America and the Caribbean and MENA took 40.8% and 19.7% of total funding respectively. Only in sub-Saharan Africa was the emphasis on direct interventions maintained, with almost 75% of the $81.26 million expenditure being for upgrading and sites and services projects. Overall, expenditure on the sector was fairly low.

A similar change in emphasis can be seen in DFID's urban projects, from the strong infrastructure focus of the early Indian slum improvement projects (SIPs) through the participatory approach promoted in the 1990s (later SIPs and the Faisalabad Area Upgrading Project), to increased emphasis on city and regional governance in the Andhra Pradesh Urban Services for the Poor (APUSP) and the projects that followed it[46]. None of these projects were concerned with improving housing fabric.

More recently, there has again been an increased focus on in-situ redevelopment of slum areas, either by the construction of walk-up apartment blocks or by reblocking and replacement of existing houses. The Community Led Infrastructure Finance Facility (CLIFF) and the Slum Upgrading Facility (SUF) take the redevelopment approach. The need now is to develop guidelines on choosing between incremental upgrading of existing houses, replacement of unsatisfactory housing and complete redevelopment of unsatisfactory settlements.

5.3 Housing rights

In theory, many countries have strong commitment to housing rights. Article 11 of the 1976 International Covenant on Economic, Social and Cultural Rights, which is theoretically binding on the 149 countries that signed it, says that '*the State parties to the present Covenant recognise the right of everyone to an adequate standard of living for himself and his family including food, clothing and housing*'[47]. Many national constitutions recognise the right to housing either directly or indirectly. The Indian Constitution, for instance, recognises a 'right to life', which the Indian Supreme Court has ruled includes the right to housing. . Brazil's 'City Statute' includes regulatory instruments for the use of and access to urban lands occupied by low-income people. Ecuador is said to be the first country in the world to recognise the right to (i) adequate and dignified housing under the explicit heading of the right to the city, and (ii) a secure and healthy habitat[48].

Unfortunately, there is generally a large gap between constitutional theory and practice on the ground. A recent report, undated but produced in the last 5 years and drawing on UN sources, states that 4 million people were evicted from their homes between 2003 and 2006, that 100 million people were homeless and that more that a billion are inadequately housed.

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[45] See http://www.rff.org/Publications/WPC/Pages/03_17_08_Housing_Policies_Buckley.aspx. Also, Buckley R and Kalarickal J (2006) Thirty Years of World Bank Shelter Lending: What have we learnt? , World Bank, Washington.
[46] For discussion of participatory aspects of APUSP and the slightly earlier Faisalabad Area Upgrading Project, see Tayler K (2005) 'Two participatory projects in South Asia', Institution of Civil Engineers, Municipal Engineer, 158, pp37-43.
[47] Quoted in Habitat for Humanity report at http://www.downloads.habitatforhumanity.org.uk/AP_Poverty_Housing_Report_Part1.pdf
[48] See http://www.hic-net.org/news.php?pid=59 The Constitution itself is available in Spanish.

It estimates that 3 billion people will be living in slums by 2050[49]. One point to be further explored is the extent to which widespread informality makes it difficult for governments to implement housing rights laws and regulations.

5.4 Housing in disaster and post-conflict situations

Provision of shelter or housing is a critical component of survival and recovery in a disaster or post-conflict situation. In humanitarian actions, a right to adequate housing is recognised in human rights law and key national legal instruments[50].

Following a disaster or conflict situation, the national government has the primary responsibility for the development and implementation of a sector strategy, including housing or shelter[51]. Programme coordination will vary depending on the size of the response and can involve the international humanitarian community, private sector organisations, governments and UN representation.

Disasters are likely to continue to become increasingly urban. The 2010 World Disaster Report[52] states the significance of urban risks. “Far more attention needs to be given to urban risk in a world which is urbanising rapidly and where, for the first time, over half the world’s population lives in cities and towns. More than one billion people today live in appalling conditions in urban areas and their numbers are growing.”

Over the last decade the aid community has recognised that there is a quality and accountability deficit in emergency projects and a growing tendency to move away from standard emergency relief actions. As a result international NGO’s launched several initiatives to introduce minimum standards, such as the Sphere Project[53]. The Sphere Handbook, which sets out minimum standards to be achieved when planning for facilities and services for disaster response, includes a chapter on shelter and settlement. This states that everyone has a right to minimum provision in terms of space, services, acceptable environmental conditions and culturally appropriate design. It advocates an integrated, or ‘settlement approach’, using a participatory methodology, whereby programmes also consider other sectors such as, water, sanitation and hygiene, education, livelihoods, and also cross-cutting issues such as HIV, gender, age, mental health and the environment[54]. ‘Building Back Better’ is a desirable programme objective, whereby reconstruction is used as an opportunity to improve standards[55]. It is recommended that communities should also have ownership of any reconstruction programme.

Approaches to shelter or housing reconstruction will vary depending on the scale of disaster or conflict, whether affected populations are displaced or non-displaced, and whether they are owners, tenants, or have no legal status for example[56]. Housing programmes can take many forms, from planned and unplanned camps to permanent reconstruction. There are a

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[49] The Right to Housing http://www.cetim.ch/en/documents/bro7-log-A4-an.pdf, written by Christophe Golaym advisor to the United Nations Special Rapporteur on the Right to Food and Melik Ozden, Director of CETIM’s Human Rights Programme and permanent representative of CETIM at the and __, part of a series of the Human Rights Programme of the Europe-Third World Centre

[50] The key national instruments can be seen in The Sphere Handbook, p284.

[51] IOM, DFID, Shelter Centre (2012) Transitional Shelter Guidelines, Geneva, Shelter Centre, p31.

[52] IFRC – International Federation of Red Cross and Red Crescent Societies (2010) World Disaster Report 2010 – Focus on urban risk, Geneva.

[53] See point 49. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response,

[54] An approach promoted in numerous sector guidance documents also including the 2012 publication: Skat – Swiss Resource Centre and Consultancies for Development, International Federation of Red Cross and Red Crescent Societies (2012) Sustainable Reconstruction in Urban Areas. A Handbook, IFRCS, SKAT, Geneva.

[55] For examples of implementing ‘building back better methodology’, refer to DEC and Ove Arup Partners Ltd (2010) Lessons from Aceh: Key Considerations in Post-Disaster Reconstruction, Rugby, Practical Action Publishing. Participatory approaches covering disaster risk reduction include IFRC, 2011. PASSA: Participatory Approach for Safe Shelter Awareness, Geneva.

[56] Further explanations of these definitions can be seen in The World Bank (2010) Safer Homes, Stronger Communities: A Handbook for Reconstructing after Natural Disasters, Washington.

number of other approaches including transitional shelter, 'core housing', repairs, or semi-permanent shelter[57]. There are also a number of initiatives such as owner-driven reconstruction, designed to achieve sustainability and meet wider project objectives[58].

6. Some specific issues and initiatives

6.1 Land

Land is a key input to the housing delivery process. Buckley and Kararickal argue that public sector ownership or control of large amounts of serviced land leads to reduced responsiveness to demand, high land prices and higher housing costs[59]. There are some cities, for instance Cairo and Karachi, where the public sector does own large tracts of land while in others, for instance Lahore, it has purchased large areas of land for its, usually middle to higher income, housing developments. However, it is likely that limited land supply elasticity is more often a result of restrictive rules and regulations for land assembly, subdivision, sale and development. The non-responsiveness of formal procedures does not mean that no new housing is built but rather forces more developers and purchasers into the informal sector, where they are free of formal sector constraints. In almost all cities, the poor are squeezed into small areas, not primarily because of restrictive rules but because of market forces[60].

6.2 Standards

Restrictive planning, building and infrastructure standards increase the cost of formal housing and put it beyond the reach of the poor. Both were comprehensively studied in the early 2000s with DFID EngKars funding[61]. Building standards define the materials and construction methods to be used while planning standards define setbacks, minimum floorspace requirements, rights of way and provision for public open space among others. One rationale for strict building standards is the need to prevent catastrophic building collapse although one of the most common causes of collapse is vertical extension of buildings beyond the height for which permission has been granted[62]. Similarly, it has been argued that the majority of collapsed buildings during the 1992 Cairo earthquake were either in dilapidated older parts of the city or of formal sector buildings that had exceeded their permitted height[63]. Standards can vary considerably between countries. For instance, the minimum allowable plot size in Mumbai is 25m^2 while the minimum standard in many African countries is 400m^2. One challenge is to bridge the gap between what are considered acceptable standards in the formal and informal sectors. There is perhaps a tendency in the NGO community to assume that the informal standards are always right but there is evidence that low initial standards can lead to poor performance and shorten the life of buildings and facilities[64]. The challenge is to continue a dialogue that leads to the incorporation of good informal sector practice into official building and planning codes. One option is to create special zones, such as Brazil's 'zones of special interest', which allow some deviation from norms and standards used elsewhere and make it possible to provide services to slums[65].

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[57] See point 51. Transitional Shelter Guidelines
[58] IFRC (2010) Owner-driven Housing Reconstruction Guidelines, Geneva.
[59] See http://www.rff.org/Publications/WPC/Pages/03_17_08_Housing_Policies_Buckley.aspx.
[60] See for instance Nairobi, where the Pamoja Trust estimate that 60% of the population is packed into the 5% of the land area occupied by slums (http://www.irinnews.org/pdf/nairobi_inventory.pdf).
[61] See Payne G and Majale M (2004, The Urban Housing Manual: Making Regulatory Frameworks Work for the Poor, Earthscan, London
[62] An example is given at http://www.newstimeafrica.com/archives/10200.
[63] See Sims D (2010), Understanding Cairo: The logic of a city out of control, American University in Cairo Press
[64] For instance, the manhole design advocated by Pakistan's Orangi Pilot Project is rightly unacceptable to engineers because the covers are weak and easily broken and the benching provided does not adequately channel the flow through the manhole.
[65] See http://citiscope.org/2010/no-excuses-slum-upgrading for a brief description of this.

One further point on this is the need to encourage experimentation on new materials. Compressed block technology has developed since the invention of the Cinva Ram in the 1950. Interlocking blocks, which use less cement and are easy to lay, have been used in some African countries, including several examples in Uganda[66]. The main focus has been on reducing cost but components such as compressed mud blocks also have good thermal properties. A more radical approach, involving the use of discarded tetrabrik cartons and PET bottles in construction, has been taken by Carlos Levinton and his colleagues at the Center of Experimental Production at the University of Buenos Aires. The approach combines recycling with the use of low conductivity materials.

6.3 New towns

New towns are frequently proposed as a response to the difficulties and costs associated with development in existing cities. For instance, Egypt has had a policy of providing new towns and settlements on desert land since the mid 1970s. The Indian National Urban Housing Policy refers to the need to develop new integrated townships, which should generally be located on comparatively degraded land, at a reasonable distance from medium or large existing towns. In Africa, several countries have new capital cities, including Tanzania (Dodoma), Nigeria (Abuja) and Botswana (Gaborone).

Most new towns have grown slowly. Egypt provides a good example. Its 2006 census results revealed that the combined population of the eight new towns around Cairo was about 610,000, significant but only 4% of the total population of Greater Cairo at the time. The largest of the new towns, Sixth of October, had 157,000 inhabitants in 2006 and no less than 142,000 dwelling units. The low overall occupancy rate is explained by the fact that no less than 63% of units were closed or vacant[67]. In Egypt, it is arguable that investment in new towns has diverted funds away from more pressing housing and infrastructure needs. Maharashtra's Navi Mumbai (New Mumbai) appears to have been rather more successful, with a provisional 2011 census population of 1,119,477, about 6% of the population of the whole Metropolitan Mumbai region[68]. However, Navi Mumbai's experience illustrates another feature of new towns and settlements. They have been unable to provide for the housing needs of all and so informal settlements and slums have developed, in much the same way as in older cities. A 2003 report quotes figures of 32% and 9% respectively for non-formal and slum housing stock respectively[69].

6.4 Access to finance

One of the biggest challenges faced by poor people in developing countries is the lack of access to finance. Mortgage markets are rarely developed with many people relying on loans from family members to finance the purchase of property[70]. Both the DFID-supported Community Led Infrastructure Finance Facility (CLIFF) and UN Habitat's Slum Upgrading Facility (SUF) aim to support efforts to develop financial instruments and products designed to increase poor people's access to housing finance. An original stated objective of CLIFF was to provide bridging loans and guarantees to allow the extension of commercial credit to the financing shelter-related initiatives intended to benefit the urban poor. In fact, only four CLIFF sub-projects have been supported by a loan guarantee[71]. This may be due to the

[66] See UN Habitat (2009), Interlocking stabilised earth blocks, Appropriate earth technologies in Uganda, UN Habitat, Nairobi
[67] Sims (2010) P171 and 177
[68] Figures taken from http://www.census2011.co.in/census/city/368-navi-mumbai.html.
[69] Shekdar, D and Adusumilli U REGULATORY GUIDELINES FOR AFFORDABLE SHELTER – THE INDIAN CASE STUDY paper presented at workshop organised by G Payne and Associates as part of a workshop on Regulatory Guidelines for Urban Upgrading, as part of a DFID-funded ENGKARS project.
[70] For instance, a comparison of the Mortgage Finance to GDP ratio places India at the foot of the table with a penetration rate of less than 2% , lower than the 9% of Thailand, 36% of Singapore and 51% of USA – quoted in www.naredco.in/article/pdfs/**Housing**%20and%20GDP.doc.
[71] Source Porfolio Overview table on Page 6 of the CLIFF 2011 Annual Review

severe delays experienced with some projects, which must have tied up funds that were to have been quickly recycled to finance follow up schemes.
In Mumbai, an innovative approach to financing new development has been the development of a market in Transferable Development Rights (TDR) based on the sale of unused floor space index (FSI) allowances[72]. This relies on the action of the Mumbai Slum Rehabilitation Authority in setting allowable FSI values for different parts of the city. One important question to be answered is how it works in periods of recession.

6.5 Going to scale

The biggest challenge in the housing sector is go to scale with initiatives that facilitate provision of good, energy efficient housing in locations and at prices that are convenient and affordable to poor people. This is a challenge that neither governments nor international agencies have met until now. UN Habitat's 2010/11 State of the World City Report states that the lives of around 227 million slum dwellers worldwide have been improved, in part through access to durable and less crowded housing. Of these, around 75% were in Asia, with no less than 125 million claimed for India and China alone. Unfortunately, the report says that slums are still growing as demand for housing exceeds the rate at which adequate housing can be provided. Given the emphasis on conventional housing in both India and China, it seems that their successes have largely resulted from investment in conventional housing. In the case of India, some of the success can be attributed to the innovative use of transferable development rights, based on allowable floor space index (FSI). One question that appears to require further research is the extent to which such apparent successes are reaching the poorest households. Efforts to achieve this through upgrading and sites and services schemes have had limited success. To date, the achievements of initiatives such as the Community Led Infrastructure Finance Facility (CLIFF) and the Slum Upgrading Facility (SUF) have been even more limited[73].

One option to be further explored is the role of associations of slum dwellers in housing provision. The various shack and slum dwellers associations form a loose network across the World, which could be a potential resource for both lobbying for housing rights and engaging in initiatives to improve housing conditions. The challenge will be to link their efforts into the mainstream. One issue is the difficulty of integrating informal procedures into formal structures. Perhaps the greater challenge is to develop the political and institutional conditions necessary to provide such organisations with the strength and legitimacy to challenge vested interests, particularly as these relate to land.

[72] See McCleod, R (2000) Bridging the Finance Gap in Housing and Infrastructure; India:SPARC a case study. http://www.ucl.ac.uk/dpu-projects/drivers_urb_change/urb_infrastructure/pdf_shelter_settlements/HI_McLeod_Bridging_Gap_India.pdf

[73] In Mumbai, where the CLIFF programme was most advanced, the 3,943 low-income housing units to be provided through CLIFF projects was only about 5% of the total of 77,000 units provided through the Slum Rehabilitation Authority (SRA) to 200673. The number of housing units provided by SUF to 2011 was insignificant and will clearly need to make a step-change in its rate of implementation if it is to achieve worthwhile results.

Review 05

Water and sanitation

By Kevin Tayler

1. Introduction

This note summarises available information on water and sanitation and its role in promoting economic growth and reducing poverty, particularly in developing countries. The note also explores the evidence on the role that appropriately planned, designed and priced water and sanitation policies, programmes and projects can play in mitigating the effects of climate change, adapting to a low carbon future and delivering basic services to the poor. The note considers the role of infrastructure in delivering water for both domestic and productive purposes, recognising that the second can contribute directly to economic growth and poverty reduction while the improved domestic water supply and sanitation can have important secondary impacts on poverty, economic growth and well-being.

Improving water supply and sanitation services is essential if the Millennium Development Goal (MDG) targets are to be achieved and ultimately exceeded. In addition to the Goal 7, which includes targets that require that the proportions of people without access to adequate water and sanitation are halved by 2015, improved water and sanitation services also contribute indirectly to Goal 1, the eradication of poverty and hunger, in ways that will be explored in this note, Goal 2, achieving universal access to primary education, through efforts to provide adequate water and sanitation facilities in schools, Goal 3, the promotion of gender equality, because water collection is often a task deputed to women and children and

because they suffer more than men from the absence of sanitation facilities, Goal 4, reduction of child mortality, because improving water, sanitation and hygiene awareness reduces the burden of faecal-oral diseases, Goal 5, improving maternal health, because improved water and sanitation facilities reduces women's burdens during pregnancy and allow better hygiene during and after pregnancy and Goal 6, combating HIV/AIDS, malaria and other illnesses, because improved water and sanitation, because people with water and sanitation related illnesses may succumb more quickly to the HIV virus and develop AIDS-related illnesses[1].

The note recognises that access to water requires both adequate water resources and robust systems to ensure that water can be made fit for human or agricultural consumption and delivered to consumers. Section 2 deals with water resources, reviewing the available evidence on water availability and the effect of climate change on likely future availability. Section 3 is concerned with the equally important challenges associated with the production, treatment and delivery of water. It includes sub-sections on rural and urban water supply, the latter including a review of evidence on informal sector providers. Section 4 deals with sanitation and wastewater management and includes a sub-section on hygiene promotion. Section 5 provides an overview of evidence relating to the role of the sector in relation to economic growth and poverty reduction while Section 6 is concerned with policies and approaches.

2. Water Resources

2.1 Existing situation

Demographic growth and increased per-capita water use are putting unprecedented pressure on renewable water resources, especially in arid regions[2]. FAO estimates that 1800 million people will live in countries with absolute water scarcity, which they define as less than 500m^3 per person per year. No less than two thirds of countries could be under 'stress conditions (between 500 and 1000m^3 per person per year)[3]. Water scarcity is particularly problematic along the west coast of North and South America, southern Spain and north-west Africa , southern and eastern Africa, the Middle East, a swathe of countries across Central Asia, from Turkey to northern China, including Iran and extending into parts of northern India and Pakistan, and southern India [4]. The FAO classifies other parts of Northern India, much of the Sahara region and further areas in Southern Africa as having moderate water scarcity. The World Bank estimates that one half of the population in the Middle East and North Africa (MENA) lives under conditions of water stress. The future situation will be particularly acute in regions containing large cities, particularly those in water scarce areas. Moreover, with the population expected to grow from around 300 million today to around 500 million in 2025, per capita availability is expected to halve by 2050[5].

Another measure of water scarcity is the water footprints, which includes 'virtual water', water used in producing crops, commodities and services produced in other countries. The

[1] Based on http://www.wateraid.org/uk/what_we_do/the_need/3045.asp
[2] See http://www.fao.org/nr/water/topics_scarcity.html (2012)
[3] The FAO figures are slightly different form those used for the Falkenmark Water Stress Indicator, which also defines absolute scarcity as less than 500m3/yr availability, defining scarcity as availability between 500 and 1000m3/yr and water stress as availability between 1000 and 1700m3/yr.
[4] Information taken from FAO (2011) The State of the World's Land and Water Resources for Food and Agriculture: Managing Systems at Risk, Summary Report, Rome, FAO. Downloaded from http://www.fao.org/nr/water/docs/SOLAW_EX_SUMM_WEB_EN.pdf The information on areas with particular water scarcity issues is based on Map 3 from this publication. The FAO figures for what constitutes chronic water stressed
[5] See http://siteresources.worldbank.org/INTMNAREGTOPWATRES/Resources/Water_Sector_Brief--Fall2010.pdf

water footprint can be divided into blue, green and grey components, representing surface water and groundwater resources used and water resources polluted by effluents respectively. It has recently been estimated that the global water footprint over the period 1996 to 2005 was 9087 Gm3 per year, of which 74% was green, 11% was blue and 15% is was grey. At 2320 Gm3 per year, international virtual water flows contributed over 25% of overall use, with 76% attributed to trade in crop products and 12% each to animal and industrial products. Global water saving as a result of trade in agricultural products between 1996 and 2005 was 369 Gm3/yr, which is equivalent to 4% of the global water footprint related to agricultural production[6]. Assessed per-capita water footprints over the period varied from Congo's 552m3/yr to the USA's 2842m3/yr with most being above 1000m3/yr. While all countries with per-capita use less than 1000m3/yr could be classified as developing, many developing countries have water footprints clustered round the global average per-capita figure of 1356m3/yr[7]. The percentage of this footprint consisting of virtual water imported from outside the country is typically smaller than that for developed industrial countries but the figures do confirm the fact that many countries are in or approaching water stress conditions.

A high proportion of water is used in agriculture. Globally, 40% of the increase in food production over the last 50 years has come from irrigated areas, which have doubled in size over that period. Continued expansion is required to meet the requirement to double food production in developing countries by 2050. Agriculture, which already accounts for 70% of all water abstraction from aquifers, rivers and lakes, will need increasing amounts of water although options in some countries will be constrained by limited water resource availability. Over-exploitation of groundwater resources is an issue both for agriculture and for large cities. In many cases, poor people living outside formal reticulation systems rely on pumped groundwater, which is dropping rapidly and becoming increasingly difficult and expensive to access[8]. Lowering groundwater tables also increase costs for peri-urban farmers who rely on groundwater to irrigate their crops.

Cross-border groundwater-related disputes are likely to increase with increased water stress. There is consensus among major development institutions that there is a need for improved river basin management. The AfDB is supporting the Niger Action Plan and the Lake Chad Basin Commission, while working with the riparian countries of the Congo River Basin to establish a river basin organisation for integrated water resources management. The Nile Basin Initiative has been supported by the World Bank since its inception in 1999. The World Bank administers the multi-donor Nile Basin Trust Fund, to which DFID has been a major contributor. In South Asia, DFID is one of the contributors to the South Asia Water Initiative (SIWI), which starts from the assumption that the challenges and opportunities arising in the management of South Asia's water resources are shared by all of the countries dependent upon them and that the potential rivers systems – to sustain ecosystems, livelihoods and cultural values, and to produce food and clean energy –can only be realized when there is greater knowledge and cooperation among the countries and stakeholders that share them. Its stated aim is to strengthen water resources management within and between the countries of South Asia, with an emphasis on regional cooperation and adaptation to climate change. At the river basin level, SAWI supports countries that share

[6] See Mekonnen M, M and Hoekstra A Y (2011), National water footprint accounts: The green blue and grey footprint of production and consumption - http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf.
[7] See http://www.waterfootprint.org/?page=cal/waterfootprintcalculator_national. Figures for individual countries include Ghana 1207m3/yr, Sri Lanka 1256m3/yr, South Africa 1255m3/yr, Lesotho 1640m3/yr, China 1071m3/yr, India 1089m3/yr and Sudan 1736m3/yr.
[8] See for instance, http://www.un-igrac.org/dynamics/modules/SFIL0100/view.php?fil_Id=190 on Nairobi, http://pecongress.org.pk/images/upload/books/Ground%20Water%20Extraction%20and%20Waste%20Water%20Disposal%20Regulation%20.pdf on Lahore Pakistan, which relies entirely on groundwater, and http://www.deccanchronicle.com/channels/cities/hyderabad/hyderabad-faces-groundwater-crisis-797 for a report on the situation in Hyderabad, India.

river basins, through strategic basin assessments of water systems and economic dynamics in order to build a better understanding of the impacts of current management, and of future scenarios under a cooperative, benefit-sharing approach and under climate change. The early focus has been on the Ganges Strategic Basin Assessment and other activities include the development of Nepal's first geo-referenced **(**GIS) Water Resources Knowledge Base and completion of a major groundwater study in India[9]. A related initiative is the Indian Government's formation of the National Ganga River Basin Authority, which aims to reduce pollution in the Ganga through improved planning and regulation[10].

2.2 Impacts of climate change[11]

Both water availability and water quality are likely to be affected, often adversely, by climate change. The 2000 Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SREC) assessed the likely effects of the different scenarios on climate change. Its original assessment was that the average global temperature might rise by 1.8°C by 2100 under one of the more favourable scenarios. Further assessment suggested that, due to the fact that warming over land will be greater than that over sea, the rise in temperature by 2100 might reach 3 - 4°C over Africa and 3 - 5°C for South Asia. Based on observational evidence since 2000, there is an emerging view that a global mean temperature rise of 4°C by 2100 is more likely than not. Recent modelling work suggests that this could result in a rise in near-surface temperatures in Africa of between 5.0 to 7.5°C by 2100. There is growing consensus that there is a need to plan for greater climatic uncertainty, based on the 4°C rise in mean global temperature.

Global warming will result in a rise in sea levels, up to 70% of which will be due to thermal expansion rather than the melting of ice caps. It has been estimated that a 2°C temperature rise will increase the area of Bangladesh affected by floods by at least 23%[12]. Increased sea level will also tend to increase saline penetration into estuaries with potential consequences for surface water supplies to some coastal cities[13]. Effects on rainfall are important but difficult to predict exactly although the indications are that rainfall will become more seasonal, with increased intensity of individual rainfall events and prolonged dry periods between events. Higher intensity rainfall will increase pressure on sewerage and drainage systems. Global climate models (GCMs) based on the SRES scenarios predict that rainfall will decrease by up to 20% in northern Africa and 30% in southern Africa, while increasing by approximately 7% within central and eastern Africa. The models also predict changes in the distribution of rainfall over the year, with much of the projected reduction in northern and southern Africa occurring in the spring. Similarly increased variability is predicted for South Asia with a 25% increase in precipitation during the summer monsoon and a reduction of around 15% during the summer months by 2100.

Precipitation over the Himalayas is critical to the lowland hydrological systems across South Asia, both in terms of the timing and quantity of high altitude precipitation. There is some doubt as to the effect of climate change on these systems. There is likely to be an initial increase in river flows as glaciers melt but current the 'best estimates' of GCMs suggest that river flows in South Asia may reduce by as much as 20% by 2100[14] [15]. These changes have

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[9] Taken from http://www.ausaid.gov.au/Publications/Documents/sawi-anrep-fy10.pdf.
[10] See http://moef.nic.in/modules/recent-initiatives/NGRBA/index.html.
[11] This section summarises key points made in ODI Working Paper 337, Climate Change, Water Resources and Wash: A Scoping Study (2011), downloaded from http://www.odi.org.uk/resources/docs/7322.pdf
[12] Mirza, M. M. Q., Warrick, R. A. And Ericksen, N. J. (2003) The implications of Climate Change on floods of the Ganges, Brahmaputra and Meghna Rivers in Bangladesh, Climatic Change 57: 287–318.
[13] For instance, Chittagong's existing surface water intake is at a location that has occasionally suffered from high salinity water in the past. Likely future scenarios are currently being explored as part of the World Bank Chittagong Water Supply Improvement and Sanitation Project.
[14] Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment

to be put into the context of the fact that major river basins in both Asia and SSA have already been strongly influenced by human interventions. One impact of further changes associated with both climate change and human activity is that rural water supplies, already highly dependent on groundwater, are likely to become even more so in the future. Groundwater storage comprises approximately 100 times the surface water storage and provides an important buffer against climate variability and change[16]. However, existing data on groundwater conditions and trends is limited, and present quantities and patterns of recharge are uncertain. Moreover, long term projections of rainfall and temperature reveal little about how recharge may change. Hydraulically effective rainfall that contributes to groundwater recharge is affected as much by within-year rainfall variation, and the timing, intensity and duration of rainfall events, as it is by total seasonal or annual amounts. There is a clear need for long-term monitoring of both river and groundwater levels in SSA and South Asia to better understand resource conditions and links with climate (ibid). Information on land-use change and its impact on recharge rates is also critical.

ODI Working Paper 337 suggests that the 2000 IPCC projections were conservative and that temperature increase by 2000 will be higher than the most probable figure originally predicted. IPCC's Fifth Assessment of Climate Change, due to be published in 2013, will be based on a revised set of emissions scenarios and will include some simulation of feedback between increased emissions, potential climate change and adaptation[17].

Bearing in mind the uncertainties, one response to climate change should be to strengthen existing good practice and water safety planning18. This is important not least because in many of the poorest countries, particularly in SSA, coping with existing levels of climate variability is a more immediate and greater challenge than managing incremental and uncertain future change. However, countries are being encouraged to produce National Adaptation Programmes of Action (NAPAs), intended to identify priority activities that respond to a country's urgent and immediate needs with regard to climate change adaptation. The NAPA process requires that Least Developed Countries (LDCs) synthesise available information on the adverse effects of climate change, based on this synthesis assess vulnerability to current climate variability and extreme weather events, and assess whether climate change is causing increases in associated risks. One issue already identified is the lack of good quality information for decision-making. The Least Developed Countries Fund (LCDF) has been set up under the United Nations Framework Convention on Climate Change (UNFCCC) to assist LDCs in NAPA implementation. The challenge now is to move from production to implementation of NAPAs.

3. Water infrastructure

Absolute physical scarcity of water is only one dimension of water scarcity. Even in areas with adequate water resources, many people do not have good access to water because the infrastructure required to deliver water to them is lacking or inadequate, the cost of water is too high for them, available water is 'captured' by better-off or more influential sections of the

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Report of the Intergovernmental Panel on Climate Change M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK.

[15] Bates, B, Kundzewicz, Z., Wu, S. and Palutikof, J (eds) (2008) IPCC: Climate change and water, IPCC Working Group II, Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva,

[16] MacDonald, A. M., Bonsor, H. C., Calow, R. C., Taylor, R. G., Lapworth, D. J., Maurice, L., Tucker, J. and O Dochartaigh, B. E. (2011). Groundwater resilience to climate change in Africa, British Geological Survey Open Report, OR/11/031, pp 31.

[17] This statement referenced to van Vuuren et al (2009) in the original but there is no van Vuuren paper for this year.

[18] This statement based on studies by Pritchard, M., Mkandawire, T. and O'Neill, J. G. (2008), Assessment of groundwater quality in shallow wells within the southern districts of Malawi, Physics and Chemistry of the Earth, doi:10.1016/j.pce.2008.06.036 and Taylor, R., Callist Tindimugaya, C., Barker, J., Macdonald, D.and Kulabako, R. (2009), Convergent Radial Tracing of Viral and Solute Transport in Gneiss Saprolite, Ground Water, doi: 10.1111/j.1745-6584.2008.00547 but see discussion of institutional and information constraints on implementation of water safety plans in 'Crossfire' section of Waterlines, Vol 30, No.3, July 2011.

population or some combination of all of these. Overall, much remains to be done to ensure universal access to adequate amounts of clean drinking water. Despite JMP's estimate that over 2 billion people have gained access to clean drinking water since 1990 and the reported achievement of the MDG target for improved drinking water supply coverage, 783 million people still do not use an improved source of drinking water[19].

The people suffering from poor access include slum and per-urban dwellers and rural dwellers without access to water for irrigation. As the 2006 UNDP Human Development Report makes clear, this is often a result of inequity rather than any absolute scarcity of water[20]. These factors are partially taken into account in Seckler et al's distinction between physical and economic water scarcity, in which the latter occurs when a country has adequate physical water resources but needs to make significant improvements in existing infrastructure to make resources accessible for use[21]. Based on this distinction, a 2008 International Water Management Institute (IWMI) report shows areas of physical water scarcity that are similar to those shown in by FAO. Areas of economic water scarcity include almost all of Africa south of the Sahara and South Asia that are not already physically water scarce and extend into parts of Indo-China, Central America and the Andean region in South America.

3.1 Rural and small town water supply

JMP estimates that eight out of ten people who do not use an improved drinking water source live in rural areas and four out of ten live in sub-Saharan Africa. Even where water is available it may be difficult to provide the minimum 20 litres per capita per day (l/cd) for domestic purposes recommended in the 2006 UNDP Human Development Report. The report states that most of the 1.1 billion people with inadequate water supply use only about 5 l/cd. The report does not give evidence for this figure but it is in line with information from Ethiopia, where use in rural areas is reported to be 5l/cd or less while that in small and medium-sized towns often does not exceed 10l/cd[22]. There are variations between countries with average per-capita use lower in many African countries and, apart from Cambodia, generally higher in Asia[23].

Even where water supply facilities are installed, operation and maintenance is often problematic. For instance, a recent study in Mozambique for the Japan International Cooperation Agency (JICA) revealed that many projects constructed as recently as two years previously had already broken down; only 21 percent of JICA-financed water points in Mokuba were considered to be operating as designed, with similar results in Ile (20 percent), Alto-Molocue (32 percent), and Gurue (17 percent)[24].

The predominant response to this situation has been to advocate a demand-based approach combined with community management. The World Bank reports success with a community

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[19] UNICEF and WHO (2012) Progress on Drinking Water and Sanitation: 2012 Update, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Downloaded from http://www.wssinfo.org/fileadmin/user_upload/resources/JMP-report-2012-en.pdf.

[20] See the 2006 Human Development Report: Beyond Scarcity, Power, poverty and the global water crisis, http://hdr.undp.org/en/media/HDR06-complete.pdf, page 2.

[21] Seckler, David, David Molden, and Randolph Barker. *Water Scarcity in the Twenty-First Century.* Water Brief 1, International Water Management Institute, Colombo, Sri Lanka: IWMI, 1998.

[22] Based on information obtained in the course of field investigations for pre-appraisal report on options for DFID support to the water and sanitation sector in Ethiopia, 2006. A WSP study of a piped water system in the Rift Valley found very low per-capita usage – typically around 4l/cd, with demand being restricted by the cost of water. No doubt, in this case, people were using water from other sources for non-drinking purposes.

[23] See http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757 for data from a number of countries, taken from the 2006 HRD.

[24] Information quoted in USAID summary document – see http://pdf.usaid.gov/pdf_docs/PNADO935.pdf.

management approach adopted in 11 of India's States[25]. Nevertheless, there can be problems with community management, even when there is demand and efforts have been made to prepare the community to take a management role. For instance, a recent evaluation, covering about 10% of the approximately 1100 schemes provided through two ADB-funded rural water supply projects in Pakistan, revealed that only 80% of the schemes investigated remained functional while only 43% of the community organisations formed to manage the schemes were still partly or fully functional[26]. A WaterAid report on a study covering 38 villages in the Dodoma and Singida regions in Tanzania revealed that only 45% of water distribution points were operational, although the figure for WaterAid-provided waterpoints was 67%[27]. Both studies revealed a positive correlation between age of scheme and likelihood that it would be non-functional. The ADB study report identified a positive relationship between scheme functionality and a lack of alternative water resources, suggesting that demand is important[28]. However, there is little doubt from these and other studies that weak management is also a factor. The WaterAid report identified weak revenue collection and the absence of regulation at village level as key causes of scheme failures. Similar problems emerged from investigation of schemes in Faisalabad District in Pakistan, with few adding new connections after the initial scheme had been completed[29]. In both cases, schemes tended to fail when a major component broke down, suggesting that the resources required to deal with such emergencies were not available.

There are some examples of private sector involvement in rural water supply management[30]. For instance, several rural schemes in Chakwal District, a water scarce area on the Potohar Plateau, are managed by an individual who could be described as a community entrepreneur[31]. The challenge with such one-off initiatives is to replicate them and take the approach to scale. This has been achieved in Uganda for the management of small town water supplies. Individual towns form water supply authorities, in effect water boards, each of which enters into a performance contract with the Ministry of Water, Lands and Environment and a management contract with a private sector organisations that operates the water supply system. Both performance contracts and management contracts are short, three years in the case of the first and two years in the case of the second. The approach was initially introduced in 11 small towns in the course of a World Bank project and has since spread to cover around 80 towns with 20 operators[32].

Whatever, the potential role of the private sector, it does not remove the need for oversight and regulation. The Tanzania study referred to above identified a need for support and, in the case of schemes run by the private sector, a strong contract and a supportive asset holder. The challenge for the future is to develop structures and systems that will provide the necessary support, oversight and regulation.

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[25] Twenty years of World Bank involvement in rural water supply in India – forthcoming. Information provided by one of the authors.
[26] See http://www.adb.org/documents/impact-evaluation-study-rural-water-supply-and-sanitation-punjab-pakistan for summary. Download of full report also available.
[27] See WSP (2010) Private Operator Models for Community Water Supply: A global review of private operator experiences in rural areas, http://water.worldbank.org/publications/global-review-private-operator-experiences-rural-areas-private-operator-models-communit for an overview based on a literature review.
[28] Confirmed by studies undertaken in the course of DFID's Strengthening Decentralised Local Government in Faisalabad District project, which revealed that no government implemented rural water supply schemes in areas with non-saline groundwater were functioning.
[29] See Tayler K (2007) Options for Private Sector Involvement in Rural Water Supply Provision in Pakistan, Journal of International Development, 19, 829 – 839.
[30] See http://www.wsp.org/wsp/sites/wsp.org/files/publications/Private_OperatorModelsforCommunity_WaterSupply.pdf.
[31] Written information on this scheme is limited – For more details see box in paper by Salman Yusuf Deputy Secretary Punjab PHED on pages 41 and 42 of http://pecongress.org.pk/images/upload/books/Issue-43-Vol-9_Part4.pdf
[32] See Kayaga, S (2003), *Public Private Community Partnerships for the Poor: The Case of Small Towns Water Supply in Uganda*', Paper presented to the 3rd World Water Forum, Osaka, Japan, 19th March 2003 and http://www.undp.org/content/dam/undp/library/Poverty%20Reduction/Uganda_webVersion928.pdf. The first describes the early experience and the second summarises the situation in 2011.

Another interesting concept is the Multiple Water Use Services (MUS) paradigm, which argues that the benefits of systems that deliver sufficient water to provide for a range of personal and productive uses in an integrated way, outweigh the increase in cost over 'traditional' single use systems[33]. The MUS approach recognises that rural communities have always managed water in an integrated manner and aims to strengthen the often informal ways in which communities already develop and manage their own water sources. Livelihoods must be the starting point for design. The approach may involve the modification of irrigation systems to allow for multiple uses (Irrigation Plus) or enhancement of domestic systems to allow for productive uses, including kitchen gardens and small-scale enterprises[34]. MUS systems include single access point systems, systems with distribution networks to common standpipes and systems with distribution networks to individual homesteads[35] although it should be emphasised that the MUS concept does not refer only to single source systems. Guidelines on the approach have recently been produced[36]. One challenge in the coming years will be to gather the evidence to assess how the MUS principles work in practice and modify the approach in the light of experience. Water quality is clearly an issue, particularly for modified irrigation systems and here it would seem necessary to link MUS with Point of Use water treatment. Another important challenge is likely to be that of ensuring effective management of systems and here the points already made regarding the management of rural water supply systems apply.

3.2 Urban water supply

JMP estimate that 1 billion people in urban areas gained access to improved drinking water from 1990 to 2010 but that, because of population growth, the percentage of the population in developing regions with access only increased from 93% to 95%, while the absolute number without access remained almost unchanged. There is evidence that the situation in low income urban areas and peri-urban areas is less satisfactory than suggested by these figures. Figures for individual municipal water supply systems suggests that few provide water to anything like 95% of the people in their supply areas and that supplies to low-income areas are often characterised by low pressures and short supply periods[37]. In some cities, particularly in South Asia, supply periods are very short, much shorter than 20 years ago[38]. A recent UNDP report stated that access to water supply in Nairobi's low-income areas actually decreased from 91% to 83% between 1991 and 2008[39]. Given that Nairobi's population is growing at a rate of around 4.5% per annum, the UN figures suggest a significant increase in the population without access to a safe water supply although absolute figures are nor available. Some peri-urban areas lie outside official urban boundaries and so are not included in the 'urban' statistics[40]. Standpipe coverage can be

[33] Adank, M., Jeths, M., Belete, B., Chaka, S., Lema, Z., Tamiru, D. And Abebe, Z. (2008) The costs and benefits of multiple uses of water: The case of Goroguto woreda of East Hararghe zone, Oromiya Regional States, Eastern Ethiopia: RiPPLE Working Paper 7. www.rippleethiopia.org.

[34] For a recent review of MUS systems, including assessment of their strengths and possible weaknesses see http://www.pacinst.org/reports/MUS/full_report.pdf

[35] Van Koppen B, Moriarty P and Boelee P (2006) Multiple Use water services to advance the Millenium Development Goals, IWMI Research Report 98.

[36] See Adank M, van Koppen B and Smits S (2012) Guidelines for Planning and Providing Multiple Use Water Services, IRC, the Netherlands, available at www.musgroup.net

[37] See for example http://clpmag.org/article.php?article=Waiting-for-Water_00315, which describes conditions in Hyderabad, India. Conditions in Kolkata's slums are described in http://www.expressindia.com/latest-news/struggling-for-survival-slums/314573/, which states that while in theory there is one tap for 39 slum dwellers, 35% of the taps are not in a working state. Bapat, M and Agarwal I (2003) Our needs, our priorities: women and men from the slums in Mumbai and Pune talk about their needs for water and sanitation, Environment and Urbanisation, Vol 15, No. 2, Oct 2003, pp71 - 86, shows that the quality of service experienced by slum dwellers is often very poor. In

[38] See Savage D and Dasgupta S, Governance framework for delivery of urban services, in India Infrastructure Report 2006, Chapter 3, http://www.iitk.ac.in/3inetwork/html/reports/IIR2006/Goveranance.pdf.

[39] See http://www.undp.org/content/undp/en/home/librarypage/poverty-reduction/inclusive_development/small-scale_waterprovidersinkenyapioneersorpredators.html.

[40] For instance, over 40% of the population of Sialkot, Pakistan lives beyond the old municipal corporation limits and so are not officially classified as urban – figure taken from the Sialkot Water Supply, Sewerage and Drainage Strategy and Action Plan produced for the Asian Development Bank and the Government of Punjab by GHK International, June 2010.

overestimated, for example an independent study in Dar es Salaam found coverage as low as 4% as compared with a figure of 45-58% in national Demographic and Health Surveys[41].

Low levels of service can pose particular problems for the poor, for example in the widespread incidence of 'pit taps', public taps located below ground because water pressure is too poor to allow water delivery to a conventional tap, in Indian towns[42]. Poor pressure and intermediate supplies inevitably lead to contamination of mains water as polluted water is drawn into them through poor quality joints. This is a particular problem in low-income areas if, as observed in many low-income locations in South Asia, water mains are laid through and across drains and, on occasion through sewer manholes[43].

In many countries, only the larger cities provide any form of training to their operational staff[44]. This lack of training is one reason for operational deficiencies. Those observed in many locations throughout Africa and Asia include non functioning alum dosing facilities, failure to regularly desludge clarifiers, injection of chlorine directly from gas cylinders into the water flow, non-operable sluice valves and low power factor due to the failure to either install or maintain capacitors, which results in low power factors and higher than necessary power costs..

Operational planning is difficult where, as is frequently the case, system records are not maintained and updated. In some towns and cities, there are no bulk meters and so no accurate record of how much water is being produced. Even where meters exist, there may be no attempt to record meter readings and use them as the basis for monitoring system performance. Lack of metering is common in South Asia and may be linked to the fact that most systems are intermittent, which can lead to meter malfunction and inaccurate readings[45].

The management challenges related to water and sanitation services are magnified if responsibilities for planning and design and operation and maintenance are split. In South Asia, systems are often provided by specialist line agencies and handed over to municipal organisations for operation and maintenance, which often have very limited financial and technical resources. Another constraint is created by management structures that concentrate sanctioning powers at senior levels of management mean that repairs can take a long time to effect or else are effected informally with the required paperwork put into place after the event[46].

Responses to this situation include awarding of long-term concession contracts (Manila, Maputo, Ghana), the formation of public companies (Sindh, Pakistan) to the implementation

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[41] Quoted in Keener, S, Luengo M and Banerjee, S (2009), Experience with Water Standposts and the Informal Sector, AICD Working Paper No. 13, World Bank, Washington, http://www.infrastructureafrica.org/system/files/WP13_Standpost_0.pdf

[42] See, for instance http://www.siasat.com/english/news/water-board-bury-pit-taps

[43] This point is based on widespread observation. There is arguably a perception issue here, with engineers laying mains along the drains because it is the easy option and paying little attention to the potential health implications

[44] For instance, a report on the Status of water Treatment Plants in India, by that country's Central Pollution Control Board, http://cpcb.nic.in/upload/NewItems/NewItem_103_statusofwaterqualitypackage.pdf, identifies the need for training of plant operators.

[45] These statement based partly on observation of water supply systems and partly on written sources. Observations relate to Andhra Pradesh and Mahdya Pradesh in India and Punjab and Sindh in Pakistan. The Indian CPHEEO Manual on O&M of water supply systems notes that 'though most of the major towns ave been provided with domestic and bulk water meters, 20-50% of installed meters remain defunct while repair facilities for water meters are not adequate in most Urban Local Bodies and Water Supply Boards. In the absence of working meters, billing for water consumed is often estimated'. The situation is probably better in Africa but there are issues. For instance, A USAID profile of the water sector in Mozambique notes that non-revenue water averages 50% in urban areas due to poor metering, physical losses and illegal connections and states that human resource development has not received the attention required to increase urban WSS capacity. See http://pdf.usaid.gov/pdf_docs/PNADO935.pdf.

[46] This situation is common in South Asia. One option for overcoming it is to introduce term contracts through which a local workshop workshop quotes prices for carrying out specified repair tasks as and when these are required. This system has been introduced in towns in Punjab, Pakistan under the World Bank-funded Punjab Municipal Services Improvement Project.

of delegated management arrangements. In Manila, the concession approach appears to be working well but other concessions, for instance that for Dar es Salaam in Tanzania, have failed. Experience in Pakistan reveals that the public company model does lessen political interference and can improve staff quality through market-based recruitment. However, significant barriers to improvement remain, including the lack of experienced managers and operators and the poor state of facilities and equipment, which makes effective operation and improved service delivery difficult and at times impossible[47].

In Manila, the concessionaire has succeeded in extending water supply and sanitation services to many low-income areas[48]. The more general experience has been that service providers struggle to extend their systems to peripheral communities. In Lusaka, CARE International responded to this situation by facilitating the formation of Water Trusts, community-based organisations which provide water via both house connections and standposts to peri-urban settlements[49]. These Water Trusts receive support from the Peri-urban Unit of the Lusaka Water and Sewerage Company. On the outskirts of Maputo, as already noted, the private sector has built and operates similar systems.

The cases described in the last paragraph are examples of local company involvement in urban water supply provision. Formal examples of local private sector involvement in water supply provision are also found in Uganda and Paraguay among others[50]. In Paraquay, it has been estimated that local private sector providers supply no less than 9% of the country's population. Involvement in sanitation-related services is less common and mainly relates to pit and tank emptying enterprises. It will probably be worthwhile to explore the ways in which such systems might be linked to government systems through lease-type contracts. Delegated management models have also been piloted, for instance in Kenya [51]. However, the World Bank notes that shifting to delegated management models without complementary regulation or consumer information can result in a decline in service levels and increased prices[52].

Sustainable management of water supply services is difficult if charges do not cover costs so that water providers have to rely on often uncertain and inadequate subsidies from government to maintain services. Most urban water supply systems in Africa are metered. A recent study quotes an average price of US$0.49 per cubic metre but with wide variations between countries, from 5 cents per cubic metre in South Africa and DRC to US$2.67 per cubic metre in Cape Verde. The median charge from the 23 countries surveyed was US$0.37 per cubic metre[53]. Charges in South Asia are generally lower, typically of the order of the equivalent of US 1 -2 per month although some are less. For instance, charges in cities in North Sindh, Pakistan are as low as about 40 US cents per month[54]. Political resistance to increased water charges is widespread and some commentators have noted

[47] Based on ongoing experience with the Asian Development Bank funded Sindh Cities Improvement Project.
[48] For an early (2001) appraisal see http://environment.yale.edu/hixon/files/pdf/2000_SRosenthal_Manila.pdf. A more recent presentation, claiming significant increases in service provision to low-income communities is at http://www.unece.org/fileadmin/DAM/ceci/documents/2012/ppp/TOS_PPP/Abon.pdf.
[49] http://www.unhabitat.org/bestpractices/2008/mainview.asp?BPID=2068 provides information on the Chaisa Water Trust, the first to be established.
[50] Information in this paragraph drawn mainly from McGranahan G and Owen D, Local Water Companies and the Urban Poor, IIED Human Settlements Discussion Paper, Theme Water: 4. http://pubs.iied.org/pdfs/10530IIED.pdf.
[51] See WSP publication Improving Water Utility Services through Delegated Management: Lessons from the utility and small-scale providers in Kisumu, Kenya at http://water.worldbank.org/publications/improving-water-utility-services-through-delegated-management-lessons-utility-and-small
[52] See http://water.worldbank.org/publications/provision-water-poor-africa-experience-water-standposts-and-informal-water-sector.
[53] Keener et al, (already referenced).
[54] Figures for Indian cities based on information collected in course of APUSP and MPUSP projects. Figures for Sindh collected in course of ADB –funded Sindh Cities Improvement Project.

that the problem with water and sanitation services is often lack of willingness to charge as much as lack of willingness to pay[55].

In the absence of adequate municipal services, many urban dwellers rely on shallow groundwater and water bought from informal service providers. Quality is often perceived to be a problem with the former, particularly in areas where faecal wastes are discharged to pits[56]. However, this must be set against the strong likelihood of contamination in poorly constructed distribution systems and while carrying water from a remote water point to the home. A study in Maputaland, KwaZulu Natal, South Africa found that E.coli concentrations fell away rapidly with horizontal distance from pit latrines[57]. In this case, the water table was at depths between 5m and 20m and so below most if not all the pit latrines. E.coli levels were significantly greater in unprotected than in protected public wells, suggesting that pollution is occurring mainly at the well rather than via polluted groundwater. Guidelines for assessing the risk to groundwater from on-site sanitation have been produced by the British Geological Survey while a shorter summary, partly based on the BGS material and partly on an earlier note by Cave and Kolsky is available on the WELL website[58] These documents suggest that on-site sanitation can be combined with use of local groundwater provided that there is some vertical distance between the bottom of latrine pits and the water table and the ground material is fine[59].

The role of the local informal sector in providing water to those without access to official piped water supply systems has long been recognised. Most researchers and commentators have focused on water vendors, who either take legal or illegal connections from the municipal system and sell water from standpipes or transport water in carts and vehicles before selling to customers. Such systems are obviously prone to contamination while water is being transported. However, there are examples of privately operated water supply systems in peri-urban areas and small towns[60]. An overview of the information available on small scale suppliers and gaps in the evidence base is provided by Opryszko et al (2009)[61]. Some services to areas outside the official water provider's reticulation system rely on supply from that system. Options include small piped networks, privately run but purchasing water from the water provider's system, standpost connections and water tanker and water vendor services that take water from 'official' water supply points. Investigations in Africa show average mark-ups for such services varying from 214% for small piped networks through 336% for standposts, 402% for household resellers and 811% for water

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[55] This observation is not new. See for instance WSP (1999) Willing to pay but unwilling to charge: Do willingness to pay studies make a difference, downloaded from http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2002/05/14/000094946_02042604075127/Rendered/PDF/multi0page.pdf. For a more positive example of willingness to charge, albeit in a rural context, see http://www.wsp.org/wsp/sites/wsp.org/files/publications/global_wtp_china.pdf.

[56] For instance, it was generally assumed that cholera outbreaks in peri-urban areas in Lusaka were associated with drinking water from shallow wells. This led to a drive to fill shallow wells – see http://maravi.blogspot.co.uk/2009/03/lusaka-dc-bemoans-cost-of-burying.html. In this case, the fact that the cholera occurred in areas subject to flooding suggests that the pollution in the wells was caused by entry of polluted surface water and could have been reduced or avoided by appropriate design of the well-head and surround.

[57] See http://www.sswm.info/sites/default/files/reference_attachments/STILL%20and%20NASH%202002%20Groundwater%20contamination%20due%20to%20pit%20latrines%20located%20in%20a%20sandy%20aquifer.pdf

[58] The Guidelines can be downloaded from http://www.bgs.ac.uk/downloads/browse.cfm?sec=9&cat=37. The WEDC briefing document is at http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/Contamination.htm.

[59] The Guidelines do not refer to the depth between the pit latrine base and the groundwater table but only indicate the likely risk of contamination for different depths from ground level to the water table. Presumably, these guidelines assume the latrine pit depth although this assumption is not explicitly stated – they are unlikely to be applicable with the 20 metres and more deep pits that have been reported from Khartoum and coastal towns of Yemen.

[60] See for instance the systems on the outskirts of Maputo, described in Chaponniere E and Collignon B (2011), PPP with local informal providers aimed at improving water supply in the peri-urban areas of Maputo, Mozambique, paper presented at 35th WEDC Conference, Loughborough.

[61] Opryszko M, Huang H, Soderlund K and Schwab K (2009) Data gaps in evidence-based research on small water enterprises in developing countries, Journal of Water and Health, 07, 4, IWA Publishing, http://www.iwaponline.com/jwh/007/0609/0070609.pdf

vendors up to 1103% for water tankers[62]. The same source suggests that the percentage of Africa's poor having access to piped water is very low, almost zero for the poorest quintile and less than 10% for the next two quintiles.

4. Sanitation and wastewater management

4.1 Sanitation – challenges and approaches

The most recent UN estimate is that worldwide, 2.5 billion people are without improved sanitation and that around 1.1 billion practice open defecation. At the current rate of progress, sanitation coverage is predicted to be 67% in 2015, 580 million people short of the MDG target[63]. Coverage is particular low in Southern Asia and sub-Saharan Africa, with reported coverage figures of 41% and 30% respectively. In sub-Saharan Africa, 45% of the population use shared or unimproved facilities and 25% resort to open defecation. The proportion of the Southern Asia's population using shared or unimproved facilities is much lower and open defecation, practiced by an estimated 41% of the population or almost 700 million people, is the highest of any region[64]. More than half the people without access to improved sanitation live in India or China. In 2006, seven out of ten people without adequate sanitation lived in rural areas. This does not mean that urban sanitation problems can be ignored. Indeed, it can be argued that, due to high population densities and the need for complete waste disposal systems, the impacts of poor sanitation on health, wellbeing and the environment are greater in urban than in rural areas.

In recent years, there has been considerable interest in three approaches to sanitation provision, ecological sanitation, sanitation marketing and community-led total sanitation (CLTS), each of which is considered in turn below. The key concept underlying the ecological approach is that of closing the loop so that nutrients are retained rather than being lost in pits or via rivers to the ocean. In particular, it has been argued that there is an absolute need to conserve and reuse the phosphate that is contained in urine since modern agriculture is dependent on phosphate containing fertilizers and world stocks of phosphate are finite[65]. Whatever the situation with regard to phosphate availability, there have as yet been few examples of ecological sanitation initiatives going to scale. One example is that in Guangxi Province in China, where a 70 unit pilot project in 1997 is claimed to have led to the installation of 10,000 units in 1998, 100,000 units by 2002 and over 685,000 toilet units in 17 provinces by 2003. The evidence for the success of this apparently successful initiative is thin, with the only reference to the 685,000 toilet units being in a Wikipedia entry. Most other references to the initiative are from 2002 or before and may be assumed to relate to what was meant to happen rather than what actually happened in practice. Systems to recover nutrients may come into their own in the future but their influence on sanitation practice to date has been very limited. Over 75000 Urine diversion dry toilets have been installed in peri-urban areas in eThekwini (Durban), South Africa[66]. However, construction and pit emptying are subsidised by the eThekwini Municipality and no attempt is made to reuse urine. One issue with ecological toilets is their fairly high cost, which is likely to make them

[62] See AICD document ' Water Supply: Hitting the Target, http://www.infrastructureafrica.org/system/files/WB147_AIATT_CH16.pdf, Table 16.4, which is based on Keener et al (2009).
[63] Quoted in 2012 WHO publication Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage, http://www.who.int/water_sanitation_health/publications/2012/globalcosts.pdf.
[64] Figures taken from http://www.un.org/waterforlifedecade/sanitation.shtml.
[65] For an overview of thinking on phosphate availability see http://www.phosphaterecovery.com/news/current-news/phosphate-stocks-probably-larger-than-expected/891
[66] Ssee Roma, E., Holzwarth, S., Buckley, C. (2011). Large-scale peri-urban and rural sanitation with UDDTs, eThekwini Municipality (Durban), South Africa - Case study of sustainable sanitation projects. Sustainable Sanitation Alliance (SuSanA) http://www.susana.org/docs_ccbk/susana_download/2-791-en-susana-cs-south-africa-ethekwini-durban-uddts-2010.pdf for an overall view of this project

unaffordable to the poorest without significant levels of subsidy[67]. For rural areas, the fossa alterna approach to ecological sanitation appears to be a promising and relatively low-cost approach to ecological sanitation[68].

The CLTS approach was developed by Dr Kamal Kar and was pioneered in Bangladesh. Recognising that providing toilets does not guarantee their use, it rejects the use of subsidies for sanitation facilities, instead focusing on the need for behaviour change and a shift in emphasis from toilet construction for individual households to the achievement of open defecation-free environments for whole villages[69]. One of the fundamental assumptions of CLTS is that people, particularly poor people, improve their sanitation incrementally, moving up the 'sanitation ladder', starting with a basic pit latrine and later upgrading to 'higher' forms of sanitation. In theory, the focus is on all aspects of sanitation although in practice there appear to be few examples of CLTS initiatives going beyond the toilet. There is perhaps a need for more research on how CLTS approaches situations in which there is already high sanitation coverage.

Sanitation marketing applies social and commercial marketing approaches to scale up the supply and demand for improved sanitation facilities, starting from assessment of the products that the target population desires and the price that they are willing to pay for those services[70]. It draws heavily on the concepts of social marketing, seeking to apply commercial marketing techniques to change behaviours in order to improve health and protect the environment. A key aspect of sanitation marketing is its emphasis on developing awareness and thus creating a demand for the facilities and services required to enable changed behaviour. The Water and Sanitation Program (WSP)'s 'Scaling up Rural Sanitation' programme seeks to combine aspects of CLTS and sanitation marketing in order to increase the rate at which rural populations adopt improved sanitation and hence move towards the MDG sanitation target[71]. Another promising approach, which also introduces some aspects of the CLTS approach into a sanitation marketing programme, has been piloted by the organisation IDE in Vietnam and Cambodia[72].

In recent years, there has been an increased emphasis on the need to identify new technologies, particularly for sanitation. In many cases, this renewed focus on technology has been accompanied by recognition of the need to develop new business models. Examples include the Bill and Melinda Gates Foundation's encouragement to efforts to 'reinvent the toilet'[73] and the IDEO/WSUP pilot scheme in Kumasi to introduce a containerised approach to faeces storage and transport, rather like an improved bucket latrine but with a private operator providing the toilets and disposing of the contents in return for a payment from users[74]. The Gates Foundation says that the 'reinvented toilet must be off-grid, affordable to the poorest members of society, and something that people will want to use'. Its stated objective is to replace sewered systems as the 'gold standard' for sanitation. Systems must recover energy and nutrients so as to make the process self-sufficient.

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[67] For instance, urine diversion toilets installed in peri-urban settlements around Lusaka with CARE and WSUP funding initially cost over $1000 per unit and even after rationalisation of the design was still over $600 per unit.
[68] See http://www.sswm.info/category/implementation-tools/water-use/hardware/toilet-systems/fossa-alterna.
[69] See http://www.communityledtotalsanitation.org/topics/non-negotiable-principles for an introduction to CLTS and its principles. One possible danger with the use of CLTS in areas with high sanitation coverage is that the emphasis on eliciting feelings of disgust may tend to lead to stigmatization of the poor, who are probably the most likely not to have installed sanitation. There is very little literature on this and it is a subject requiring more research.
[70] See http://www.wsp.org/wsp/sites/wsp.org/files/publications/WSP-Introductory-Guide-Sanitation-Marketing.pdf for an introduction to sanitation marketing
[71] See http://www.wsp.org/wsp/global-initiatives/global-scaling-sanitation-project/Sanitation-core-components#monitoring for more details.
[72] See Rosenboom, J W, Jacks C, Phyrum M R and Baker T (2011), Sanitation Marketing in Cambodia, Waterlines, Vol 30, no. 1 pp23 -40, Practical Action Publishing, This issue of Waterlines focuses on sanitation marketing.
[73] See http://www.gatesfoundation.org/press-releases/pages/safe-affordable-sanitation-110719.aspx and http://www.gatesfoundation.org/watersanitationhygiene/Documents/wsh-reinvent-the-toilet-challenge.pdf .
[74] See https://www.ideo.org/stories/ghanasan-ahuman-centered-approach-to-sanitation-in-ghana

Whether such initiatives really offer hope of a way forward remains to be seen. There is clearly a place for such 'blue-skies' thinking but it should arguably not divert attention away from efforts to improve the existing sanitation systems that serve most urban residents[75]. In rural areas, the fossa alterna approach removes the need to deal with sanitation-related wastes but such approaches are only possible where there is space on the plot to dig a second pit when the first pit is full. Twin pit and twin vault ecological systems are theoretically able to produce a harmless sludge that can be used locally for agriculture. In all other circumstances, there is a need to remove liquid or solid wastes and, in many cases, both. This requires consideration of all the elements of a sanitation system[76]. In the case of off-site systems, these elements include the sewers and sewage treatment while on-site systems require sludge transport and treatment.

4.2 Off-site systems – wastewater collection, treatment and reuse

Many towns and cities in Asia have off-site systems, often comprising a combination of sewers, covered drains and open drains. In most cases, sewers carry combined storm and foul flows, in practice if not in theory[77]. Conventional sewerage is often considered to be too expensive for low income areas but there is potential for installing lower-cost sewers using 'appropriate' standards, in particular the use of shallow depths, allowing inspection chambers rather than conventional manholes in narrow streets and lanes[78]. Maintenance can be a problem with sewers designed to carry solids, particularly where the topography is flat and the system is combined so that silt, grit and uncollected solid waste are carried into the sewer with storm flows[79]. Even where sewerage exists, it is common for some wastewater flows to continue to discharge to drains. This may be because sewers are under-sized but often relates to inadequate operation and maintenance, lack of funds and interconnection between sewer and drain systems[80]. Efforts to improve wastewater management need to take account of all of these factors.

Wastewater treatment can be equally problematic. In 2007, India's Central Pollution Control Board reviewed the performance of wastewater treatment plants in the country. Of 84 plants examined in some detail, the performance of only 8 was rated as good, while no less than 45 were rated either poor or very poor. The remainder were classified as satisfactory[81]. Analysis of the report findings suggests that there was no particular relationship between type of treatment and level of performance. Engineers in developing countries often favour

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[75] As pointed out in Tayler et al (2003) Urban Sanitation, A Guide to Strategic Planning, Practical Action Publishing, plans need to be grounded what already exists, recognising that the problem in urban areas is often inadequate sanitation rather than an absolute absence of sanitation.

[76] See WASTE's Smart Sanitation booklet, downloadable from http://www.ecosan.nl/page/869.

[77] For instance, unpublished studies for the World Bank relating to the proposed work to upgrade the condition of the Ganga River found that many streets in older areas have both a sewer, carrying 'black' water and open drains carrying sullage water. These were normally interconnected. In Varanasi, large areas of the city are covered by sewers, apparently constructed with funds provided by elected representatives, which connect to drains and channels rather than 'official' sewers, and therefore discharge wastewater directly to the river without treatment. In Chittagong, there is no formal sewerage and observation suggests that it is common practice to provide a septic tank on multi-storey properties, with the effluent discharged to the nearest open drain.

[78] This 'simplified sewerage' approach has been codified in some states in Brazil. For an introduction to the approach see http://www.sswm.info/category/implementation-tools/wastewater-collection/hardware/sewers/simplified-sewers. The best evaluation of the approach, now rather old but still relevant is Gabrielle Watson's Good Sewers Cheap – downloadable from http://www.wsp.org/wsp/sites/wsp.org/files/publications/global_goodsewerscheap.pdf.

[79] For instance, work by the consulting firm Carl Bro in Lahore in the early 1990s revealed that some old sewers were 85% full of consolidated silt. In

[80] For instance, recent work by the consultants Grontmij on Dhaka's wastewater services suggests that less than 6% of all wastewater generated is reaching the Pagla wastewater treatment plant, that none of this 6% is carried through the main outfall sewer, which is blocked and that most wastewater is discharged to the drainage systems, with much of it polluting water bodies in and around the city. A 2005 study of wastewater systems in Kanpur India revealed that a significant percentage of the wastewater generated was not reaching treatment works because of (a) blockages in sewers (b) failure to operate pumping stations during the lengthy periods when the electricity supply was cut off. (Diesel was provided for generators but detailed studies suggested that it was often not used for operating pumps). Further information is available at http://ecofriends.org/reports/quarterly_monitoring.htm. These are just two examples of situations that are very common throughout South Asia.

[81] See CPCB Evaluation of Operation and Maintenance of Sewage Treatment Plants in India – 2007 – Downloaded from http://www.cpcb.nic.in/upload/NewItems/NewItem_99_NewItem_99_5.pdf

'high-tech' approaches to wastewater treatment. Some relatively simple upward flow anaerobic sludge blanket (UASB) plants were installed during the Ganga Action Plan but the many engineering design departments in India now favour the much more sophisticated sequencing batch reactors (SBRs). The advantage of SBRs is their relatively small footprint but they are energy dependent and, like other conventional treatment processes, are not very good at removing pathogens. In an era of increasing energy prices, there appears to be a strong case for focusing on less energy-intensive technologies.

While some wastewater is discharged to watercourses, much of it is used either directly or indirectly for irrigation. Much of this wastewater is untreated. Indeed, a study carried out in the early 2000s concluded that 26% of all vegetable production in Pakistan relied on irrigation with mostly untreated wastewater. A later in-depth study of the town of Haroonabad in south Punjab found that wastewater was being used to irrigate vegetables, cotton and fodder crops[82]. Use of untreated wastewater in irrigation has health implications. Clearly, irrigation with untreated wastewater does not meet the WHO Guidelines for safe use of wastewater and it is not surprising that the IWMI studies in Pakistan found that most agricultural workers working in wastewater-irrigated fields were infected with hookworm and other helminths[83]. Even with conventional treatment, it is unlikely that pathogen removal will be sufficient to produce effluents with pathogen levels that meet WHO standards. This is an area that requires more research. The old WHO Guidelines suggested retention on waste stabilization ponds as the only way to remove health risks associated with pathogens. The current Guidelines[84] are based on analysis of risk and could in theory allow other forms of treatment, when combined with other measures. In practice, analysis of risk may not be easy because of a lack of relevant information with the result that designers may fall back on the old 'safe' design guidelines. However, it is often difficult for towns and cities to find the space required for waste stabilisation pond systems.

In recent years, some decentralised approaches to wastewater treatment have been piloted. The Decentralised Wastewater Treatment Systems (DEWATS) developed by the German NGO BORDA (Bremen Overseas Research and Development Association) are a promising example. These combine anaerobic primary treatment, in anaerobic digesters baffled react ors and upward flow filters, with aerobic secondary treatment in planted gravel filters. They have been introduced in a number of countries in South and South East Asia and Africa[85].

4.3 On-site systems – sludge collection and disposal

The biggest challenges for urban on-site sanitation systems relate to the removal, transport, treatment and reuse of sludge. The 'conventional' approach to sludge collection combines removal from pits with transport in sludge tanker trucks fitted with vacuum pumping equipment. Such trucks are common in South-East Asia and Africa but less so in South Asia, perhaps because many pits and septic tanks discharge effluent to the drainage system and so continue to function, albeit without providing any treatment, even when the tank or pit is full of sludge[86]. Even here, newspaper reports show that there is clearly a need to occasionally empty pits and tanks. Conventional sludge-tanker based systems are often too

[82] Information on wastewater in Pakistan taken from IWMI reports. IWMI also conducted research in Mexico. For an overview of their work, see Water Policy Briefing, Issue.9, Confronting the Realities of Wastewater Reuse in Agriculture, http://www.iwmi.cgiar.org/Publications/Water_Policy_Briefs/PDF/wpb09.pdf

[83] The WHO Guidelines on the use of wastewater in agriculture are available at http://whqlibdoc.who.int/publications/2006/9241546832_eng.pdf. These use quantitative microbial risk assessment (QMRA) to establish likely health risks associated with wastewater reuse. This requires data and the ability to interpret those data. The challenge is arguably to convert the detailed eoovercome the lack of for the In theory, these allow a more nuanced approach to the assessment of risk thantake a more nuanced approach to the assessment of health risk than the previous guidelines

[84] http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html

[85] For further information, see Ulrick A, Reuter S and Gutterer B (2009), Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries: A Practical Guide, Loughborough, WEDC

[86] Recent observation in Chittagong, Bangladesh, revealed that even multi-storey apartment buildings dealt with their wastewater in this way.

expensive for lower-income people, who turn to manual pit emptiers[87]. Manual emptying is clearly unsatisfactory, not least because of the risks to the health and safety of the pit emptiers. Again, newspaper reports show that deaths during manual pit emptying are not uncommon. Solutions intermediate between conventional and manual emptying have been piloted but to date have not gone to scale. One of these is based on the use of the vacutug, a downsized version of conventional tanker[88]. Another is the 'gulper', a manually operated system consisting basically of a long pipe fitted with a piston pump and discharging through a side pipe to a suitable container[89]. One point about both these technologies is that they are concerned mainly (wholly in the case of the gulper) with pit emptying and require separate provision for transporting sludge to treatment. The Gates Foundation is funding a study of faecal sludge collection and transport systems in 10 countries but the results of this have not yet been published.

In 2010, the Gates Foundation commissioned a scoping study for a book on decentralised faecal sludge treatment. The study found that there are few if any examples of operational decentralised faecal sludge treatment. Centralised systems exist in West Africa and technologies suitable for implementation at a decentralised scale have been piloted at the Asian Institute of Technology. In Southern Africa, faecal sludge is normally co-treated with wastewater.

4.4 Hygiene promotion

To a greater degree than with water supply and sanitation, evidence on the cost and effectiveness of hygiene promotion interventions is limited. Still less is evidence available on the relative cost-effectiveness of different approaches to the design of such interventions[90]. Esrey's review of the relatively few epidemiologically sound studies studies suggested a median figure of around 35% for diarrhoea morbidity reduction following hygiene promotion interventions[91]. Hand washing, in particular, can have significant benefits. One systematic review of the literature on hand washing concluded that hand washing with soap could reduce diarrhea morbidity by 43 percent and life-threatening diarrhea by 48 percent[92]. One important question is the extent to which people continue to apply the lessons learnt from hygiene promotion and continue to apply those lessons over time. A study carried out with partner organisations in six countries in Africa and South Asia provides a positive response to this question[93]. Target populations of previous hygiene promotion projects were visited at 12 month intervals. In four countries, it was possible to compare results from relatively recent interventions and those in which the last intervention had occurred several years previously. In only 3 out of 46 cases examined was there any evidence of falling off in hygiene practices since the intervention had been completed and in one of these cases the falling off could be attributed to the poor state of the latrines. These findings suggest that hygiene promotion activities can lead to lasting behaviour change, at least when they are well planned and executed.

A later study in slum areas in Karachi produced less conclusive results. This involved comparison of practices by households that had received free soap and hand-washing

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[87] For overview of pit emptying methods and costs, see Thye et al (2009) Pit Latrine Emptying: Technologies, Challenges and Solutions, downloaded from http://www.ewb-uk.org/system/files/Yoke+Thye+report.pdf.
[88] See http://www.unhabitat.org/categories.asp?catid=548
[89] See http://www.sswm.info/category/implementation-tools/wastewater-collection/hardware/cartage/human-powered-emptying-and-tran
[90] Caincross S and Valdmanis V (2006), Chapter 41, Water supply, sanitation and hygiene promotion in Disease Control in Developing Countries ed Jamison D T, Washington, World Bank – accessed from http://files.dcp2.org/pdf/DCP/DCP41.pdf
[91] An early comparative study (Esrey et al 1991) found only six epidemiologically sound studies on this subject and they gave a median reduction of 33 percent. A subsequent review by Huttly, Morriss, and Pisani (1997) arrived at a similar result— a median reduction of 35 percent.
[92] Curtis,V., and S. Cairncross. 2003. "Effect ofWashing Hands with Soap on Diarrhea Risk in the Community: A Systematic Review." *Lancet Infectious Diseases* 3 (5): 275–81.
[93] Cairncross S and Schordt K (2003) – Still clean: do hygiene practices continue after promotion programmes end?

promotion for a period of 9 months with those in areas in which there had been no intervention. Eighteen months after the end of the intervention, households in the intervention areas were still significantly more likely to use soap and water to wash their hands than those in control areas. After a further 2 years without intervention, the original intervention households showed better hand washing technique than the control households but their soap purchases and diarrhoea experiences did not differ significantly from those of the controls[94].

One reason for failure to maintain good hygiene practice may be the lack of a reliable water supply. A recent article in the Lancet suggests that, while the official figures for connection to water supply in Pakistan and Bangladesh are of the order of 70%, the reality is that less than 20% are connected to a water supply that is factors that constrain changes in hygiene practice, including consistently free from chemical or sewage contamination[95]. This point is reiterated in a recent review in the Lancet, which notes the lack of adequate water and sanitation, the absence of easily cleanable hard surfaces, unavailability of soap and other cleaning materials and local practices and cultural norms that help to lock unhygienic practices in place[96].

One challenge for planners and policy makers is to find an appropriate institutional home for hygiene promotion. Water and wastewater utilities rarely consider it to be one of their responsibilities and it is often a peripheral concern for health departments and ministries. The Lancet review cited in the previous paragraph notes the need for government investment in hygiene promotion, for hygiene promotion to feature in the job description for health agents, for massive efforts to train health agents and for research to fill gaps in knowledge. It suggests that each country needs a focal point to coordinate hygiene promotion efforts.

5. Sector influence on economic growth and poverty reduction

It is widely accepted that improved water supply and sanitation facilities contribute directly and indirectly to poverty reduction. A study commissioned by WHO concluded that for every US dollar invested in reaching the MDG targets for water supply and sanitation, the return on investment would be $3 – 4 depending on region[97]. More recently, WSP has commissioned a series of studies, starting in East Asia, and later encompassing South Asia, Africa and, most recently and still in progress, Latin America. Both the WHO and the WSP-EAP studies considered a wide range of economic impacts, including health, water resource, environmental, tourism and other welfare impacts. Health impacts considered included costs associated with loss of productivity, increased cost of health care and premature death. The study found that the economic cost of poor sanitation and hygiene in South-East Asia was US$9.2 billion dollars per year and no less than US$53.8 billion dollars per year for India. Kenya's calculated cost of US$324 million per year was fairly typical for Africa while the cost for Nigeria was estimated to be US$3 billion per year. Based on the findings of the study,

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[94] Luby S, Agboatwalla M, Bowen, A, Kenah E, Sharker Y and Hoekstra R (2009)Difficulties in maintaining improved handwashing behaviour, Karachi, Pakistan, Am. J. Trop. Med. Hyg., 81(1), 2009, pp. 140–145 Downloaded from http://www.ajtmh.org/content/81/1/140.full.pdf

[95] Quoted in article on Stephen Luby in the Lancet Volume 374, Issue 9706, Page 1961, 12 December 2009 http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)62110-3/fulltext. The figures may not be exact but certainly tie in with evidence from other sources – see for instance Shar et al (2010), Drinking water quality in Rohri City, Sindh, Pakistan, African Journal of Biotechnology Vol. 9(42), pp. 7102-7107, 18 October, 2010, http://www.academicjournals.org/ajb/pdf/pdf2010/18Oct/Shar%20et%20al.pdf

[96] Curtis V, Schmidt W, Luby S, Florez R, Touré O and Biran A (2011) Hygiene: new hopes, new horizons, ***Lancet*** *Infect Dis* 2011; 11: 312–21, http://www.cleaning-for-health.org/files/2011/08/Hygiene-new-hopes.pdf

[97] Figures quoted in http://www.who.int/water_sanitation_health/wsh0404summary/en/. The full report by Guy Hutton and Laurence Haller is available at http://www.who.int/water_sanitation_health/wsh0404.pdf. This gives a break-down of likely levels of benefit by region.

WSP calculated that the economic impact of poor sanitation can be as high as 7% of GDP for some Asian countries (Bangladesh 6.3%, Cambodia 7.2% and India 6.4%) and typically in the range 1 – 2% of GDP for African countries[98].

A recent World Health Organisation (WHO) report[99] estimates benefit to cost ratios of interventions to attain universal access to improved sanitation varying from a maximum of 8 in East Asia to 2.8 in South Asia with a mean global benefit-cost ratio of 5.5. For drinking water, estimated benefit to cost ratios varied from 3.7 in South Asia to 0.6 in Oceana with an average of 2.0. The global economic losses associated with inadequate water supply and sanitation were estimated as $260 billion per year or 1.5% of the GDP of the countries included in the study. The worldwide benefits of reaching the MDG targets are calculated to be $60 billion per year, of which sanitation accounted for no less than $54 billion. At present, the majority of global costs of poor water supply and sanitation are incurred in three regions, Sub-Saharan Africa, South Asia and East Asia. Achieving universal sanitation alone would reduce global economic losses by around $220 billion annually.

The report stated that in all regions time savings contributed at least 70% of total benefits, reaching 80 – 90% of benefits in most regions. The corresponding figures for water supply were almost 70% for all regions and around 80% in Caucasus and Central Asia, Latin America and the Caribbean and North Africa. In SSA, S Asia and E Asia the health improvements contribute to at least 35% of overall benefits while health care savings account for more than 10% of total benefits in all regions, rising to as high as 25% in East Asia.

The global picture on sanitation benefits is dominated by E Asia and S Asia, with over US$ 30 billion combined benefits. SSA contributes an important saving with US$ 10 billion annually. In terms of overall value, benefits from improved drinking water global picture of drinking-water benefits are dominated by the SSA region, with over US$ 3.2 billion, followed by N Africa with US$ 1 billion, W Asia with US$ 0.6 billion and LAC with US$ 0.5 billion.

The capital cost of achieving the MDG sanitation target is estimated as US$115, US$ 23 billion for each year from 2010 to 2015, with 54% of the estimated cost incurred in urban areas and the majority of costs incurred in Sub-Sharan Africa, South Asia and East Asia. The corresponding figure for water supply is US$ 6 billion per year with 59% of costs incurred in urban areas. Recurrent operation and maintenance costs over the same period are estimated as $16 billion, approximately 10% of the total cost incurred to meet the MDG targets[100]. The regions with the greatest drinking water investment needs are SSA, SE Asia, W Asia, and LAC, with rural needs dominating in SSA and urban needs dominating elsewhere. Taken together, SSA's investment needs, $145 billion over the period 2010-2015, represent more than one-third of global investment needs. The combined figure for achieving 100% water supply and sanitation coverage globally are higher at around $535 billion.

There are many uncertainties and approximations in these calculations. The WHO report notes that the results are sensitive to the approach used to estimating time value. The figures given in the report are based on the assumption that time is valued at 30% of the GDP per capita and will increase if a higher value is used. The calculations assume average

[98] Figures quoted in Rijsberman F and Zwane A P (2012) Challenge Paper, Water and Sanitation, Bill and Melinda Gates Foundation. Available at http://sanitationupdates.wordpress.com/2012/05/02/a-challenge-paper-on-water-and-sanitation/.
[99] World Health Organisation (2012), Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage, Geneva, downloaded from http://www.who.int/water_sanitation_health/publications/2012/globalcosts.pdf.
[100] This figure appears to be based on the O&M cost of new facilities provided to meet MDG goals. There is arguably a need to consider the cost of maintenance of existing facilities, recognising that present maintenance procedures and hence maintenance expenditure are less than ideal.

savings of 0.5 hours per household per day for external water supply access and 1 hour per household per day when a piped water supply is available. Higher figures, 1 and 1.5 hours per day are assumed for SSA. Average time saving when moving from open defecation to private toilet is estimated as d 0.5 hours per person per day.

Overall, the economic returns on water supply and sanitation services estimated in the WHO report are more conservative than those from previous studies. These reductions result mainly from the higher investment cost estimates used in the study, the more complete inclusion of operation and maintenance costs and the relatively conservative assumption that the economic value of time should be taken as 30% of GDP per capita. Nevertheless, the benefits from investments in water, sanitation and particularly hygiene promotion compare well with those from other types of investment. It has been estimated that the number of disability-adjusted life years (DALYs) avoided per $1000 spent could be as high as 333 for the reduction in diarrhoeal disease resulting from effective hygiene promotion, compared with 91 for sanitation promotion, 59 for malaria insecticide treated bed nets and only one for oral rehydration therapy[101].

Poor people suffer disproportionately from poorly performing water supply and sanitation services. A survey in a low-income neighbourhood in Delhi, revealed that each household on average spent 5.5 times as much to cope with unreliable water supply as they were paying the municipality for their annual water consumption[102]. Similar figures are found for other cities. A study in Dar es Salaam found that the price per unit of water obtained from kiosks was approximately 4 times that charged by the water operator for water from a piped water connection. The ratio was at least 13 for water obtained from pushcart vendors and over 22 for water obtained from tankers[103]. In Kibera, Nairobi, a WSP study found that the price charged at kiosks, Ksh2 for a 20 litre container, was about 8 times the water company's minimum domestic tariff[104]. Purchase from neighbours can provide a service intermediate between having a full house connection and purchasing from a standpipe or kiosk. Studies in Maputo and Quelimane, Mozambique found that water was being resold from yard taps at 219% and 686% respectively of the price charged by the utility to the yard tap owner[105]. As a general rule, water supplied from privately operated standpipes and boreholes is generally much cheaper than supplied by carters and carriers[106]. There is an important institutional aspect to poor supply to low income areas in that those responsible for controlling piped supplies direct water to higher income communities who pay them to do so[107].

As already indicated earlier in this note, poor reliability is a common problem in improved drinking water supplies, both rural and urban. It can result in a significant reduction in the benefits of investment in improved water supply schemes. A recent Quantitative Microbiological Risk Assessment (QMRA) on the impacts on health when people are forced to revert to drinking raw water because of unreliability of the improved water source found that the health benefits associated with consumption of water from an improved water supply

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[101] Figures adapted from World Bank (2006) *Disease control priorities in developing countries* (Second edition) by Cummings O (2008) Tackling the Silent Killer, the Case of Sanitation, London, WaterAid – accessed at (http://www.wateraid.org/documents/tacking_the_silent_killer_the_case_for_sanitation_web.pdf

[102] Based on Zerah M H (2000), Water:Unreliable Supply in Delhi, New Delhi, Manohar Publishers.

[103] See Kjellen M and McGranahan G (2006), Informal Water Vendors and the Urban Poor, IIED Human Settlements Working Paper No. 3. http://pubs.iied.org/pdfs/10529IIED.pdf

[104] See WSP (2005) Rogues No More, Water Kiosk Operators Achieve Credibility in Kibera. http://www.wsp.org/wsp/sites/wsp.org/files/publications/3282007104808_afRoguesNoMore.pdf.

[105] Quotes in Keener et al (2009). See above for full reference.

[106] For an overview see Kjellen M and McGranahan G (2006), Informal Water Vendors and the Urban Poor, IIED Human Settlements Discussion Papers, Theme: Water 3.

[107] See, for instance, Akbar et al (2007), Community water supply for the urban poor in developing countries, the case of Dhaka Bangladesh, Habitat International, 31 (2007) 24-35 – wnloadable from https://netfiles.uiuc.edu/wnichol2/shared/Helpful%20Resources/EWB-Article%20on%20Bangladesh.pdf

will be almost all lost over the course of a few days of raw water consumption[108]. At present, limited information is available on the cost of introducing improved management systems for small rural water supplies[109].

6. Policies and approaches

For the last 20 years or so, the predominant paradigm for water and sanitation delivery has been based on the following principles:

- Higher levels of government should have an enabling rather than provider role, focusing on passing appropriate legislation, providing support and ensuring that incentives are right.
- Responsibilities for service provision should be devolved to lower levels of government, community organisations and the private sector
- Supply-based approaches should be replaced by demand-responsive approaches[110].

In practice, applying these principles has not always been easy. Government engineers, who have always been responsible for providing services are likely to have little knowledge of how to play an enabling role and are likely to resist changes that deprive them of opportunities to take illegal payments from contractors[111]. Lower levels of government, NGOs and community organisations often lack the skills required to plan, design and execute schemes to the required standard. Devolution of responsibilities may lead to increased political influence over appointments and scheme selection[112].

Many internationally funded projects are designed to cover both water and sanitation but in practice focus mainly on water supply. This is partly due to the fact that water supply facilities are more likely to be networked and in the public sector whereas sanitation is largely dealt with by individual households and does not fit so well into large scale programmes. Also, programmes tend to be located within a water ministry or department, paying insufficient attention to the fact that water and sanitation are often the responsibility of different government ministries and departments[113]. There is an argument for delinking sanitation from water supply, particularly where sanitation is on-plot[114]. A related point, already covered earlier in this note, is that hygiene promotion often lacks an institutional home.

In some countries, policy requires that rural water supply and sanitation facilities are managed by community-based organisations. As already indicated, the experience with community management has been mixed at best and there is arguably a need to explore models involving the local private sector. The challenges is to develop policies and

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[108] See Hunter, P, Zmirou-Navier D and Hartemann P (2009), Estimating the impact on health of poor reliability of drinking water interventions in developing countries, Science of the Total Environment, Vol 407, Issue 8, pp2621 -2624 . The study examined the results of exposure to three water-borne pathogens common in Africa, Rotavirus, Cryptosporidium and Enterotoxigenic E.Coli

[109] Hunter P, Pond K, Jagals P, Cameron J (2009) An assessment of the costs and benefits of interventions aimed at improving rural community water supplies in developed countrie, Science of the Total Environment, Vol 407, Issue 12, pp3681 to 3685.

[110] In this context, demand is taken to mean not just a desire for a service but also willingness to pay for it.

[111] See for instance David J (2003) Corruption in Public Service Delivery: Experience from South Asia's Water and Sanitation Sector, World Development, Vol 32, NO.1, pp53 – 71.

[112] For an examination of this effect see the chapter on the appointment of health care workers in NOTHE East Brazil in Tendler L (1997), Good Governance in the Tropics, Johns Hopkins University Press, Baltimore and London. The experience of DFID's Strengthening Local Governance in Faisalabad District project in Pakistan was that devolution had led to the implementation of many small schemes, many poorly conceived and executed

[113] For instance, the World Bank has worked through the Community Water Supply and Sanitation Agency (CWASA) in Ghana, which falls under the water ministry, despite the fact that responsibility for sanitation officially lies with the Ministry of Local Government. REFERENCE FROM WEDC SANITATION POLICY WORK.

[114] For further information see http://wedc.lboro.ac.uk/docs/research/WEJEH/Briefing_Note_Overview_-_Sanitation_policy_(pdf).pdf

associated legislation that provide (a) a legal basis for private sector involvement in rural service provision, (b)for effective oversight of their activities and (c) effective support systems for both community and private entrepreneurial entities[115].

More generally, efforts are needed to increase awareness of sector benefits, particularly those associated with good sanitation. Following on from the point made in the last paragraph, there is an argument for separate sanitation policies. Combined water and sanitation policies tend to focus on water, sometimes advocating institutional arrangements that are appropriate for water but much less so for the very different arrangements required for sanitation[116]. Even where sanitation policies have been produced, there is a need to provide the resources required to implement them. This points to the wider challenge of ensuring that policies are implemented. A related challenge is to ensure that policies are not static but rather are reviewed and amended at regular intervals in the light of evidence of what does and does not work.

One response to the challenge of policy development and implementation is the Sanitation and Water for All (SWA) initiative[117]. This aims to increase political prioritisation for sustainable sanitation and drinking water and address the barriers presented by weak sector capacity and lack of coordination within the sector. It aims to provide a common vision and a set of values and principles for a transparent, accountable and results-oriented framework for action to address these obstacles to global progress. In April 2012, 70 countries and agencies discussed concrete commitments to improve access to sustainable sanitation facilities and improved drinking water sources to millions more people in developing countries.

[115] WSP Field Note (2010) Private Operator Models for Community Water Supply: A global review of private operator experiences in rural areas.
[116] WEDC briefing notes on sanitation policy (2005) – details at http://www.wedc-knowledge.org/wedcopac/opacreg.dll/fullnf?Search_link=AAAA:M:456045604744.
[117] For further details, see Sanitation and Water for All website at http://www.sanitationandwaterforall.org/.

Review 06

Land transport including rural roads

By Rob Petts

Summary

There is considerable evidence linking Land Transport provision to economic growth, social development and poverty reduction in developing and emerging economies, and in support of the Millennium Development Goals (MDGs).

This Evidence Review summarises some characteristics of the Land Transport sector before focussing on the key component of **Rural Transport** which offers the greatest potential for cost effective support for economic and social development, and poverty reduction in developing and emerging economies. The evidence is drawn from leading researchers and eminent institutions to provide a solid foundation for sector review and recommendations.

Section 2 reviews some of the strong evidence of the role of transport infrastructure in growth and poverty reduction.

Section 3 reviews community engagement and accessibility issues.

Section 4 focusses on technology options and the need for improved use of local resources.

Section 5 raises the issue of maintenance of infrastructure, which is possibly one of the greatest challenges still to be effectively addressed in the sector.

Section 6 considers the sector's carbon footprint and potential for reducing the high energy dependency of the sector. It also reviews issues relating to climate change resilience.

Section 7 reviews service provision to the poor, and highlights the need to provide complementary initiatives to ensure that road infrastructure investments are truly beneficial to the target communities.

The Evidence Review finally provides recommendations (Section 8) for priorities for DFID support for the sector to maximise the impact of the already considerable vital research and knowledge investment that DFID and its predecessors have contributed to the Land Transport sector. However, it is noted that considerably more resources are required to be invested in Land Transport Infrastructure and Services knowledge creation and dissemination.

1. Introduction

This Review focuses on the **Road Transport** sector. Air transport and water transport are driven principally by the private sector, and along with rail transport, generally have limited direct linkages with the urban and rural poor in developing and emerging economies, compared to Road Transport. There are some exceptions; water transport has an important role in some regions such as Bangladesh, Indonesia and the Mekong Delta, and mass transit systems are being developed in some cities.

The Road Transport sector can be characterised by four distinct components with relevance to growth and poverty reduction; climate change mitigation, adaptation and low carbon development; service delivery to the poor', namely:

- Transport Services
- Main roads
- Urban roads
- Rural Roads

It is important to include **Transport Services** in the Review as the transport infrastructure is provided to a significant extent to enable Transport Services to be delivered for social cohesion and to stimulate growth. The nature of Transport Services needs to be understood, and they need to be appropriate and affordable to the urban and rural poor.

Infrastructure provision should match the current and future transport needs, however the typical characteristics of the three subsectors are:

Main roads: Strategic Links, High investment/km, Equipment Intensive, Cement/Bitumen/Steel intensive, International/National contractor implementation. Opportunities for local enterprises, employment and low carbon footprint materials are limited in the construction phase.

Urban roads: High Potential for local enterprise development and employment and low carbon footprint if local resource based paving options are considered.

Rural Roads: Rural or Low Volume Roads (LVR) are generally viewed as those carrying less than 300 motor vehicles (equivalent) per day (VPD) in a developing country context.

These routes comprise most of the classified network lengths in developing countries. There are also extensive unclassified road networks (roads and tracks), which provide tertiary access and can be of similar or greater extent than the national classified networks. High Potential for local enterprise development and employment and low carbon footprint if local resource based paving options, Intermediate Equipment, Environmentally Optimised Design, and Low cost Structures options are considered.

Experience has shown that Poor Maintenance capacity, Inappropriate Standards and Lack of Stakeholder involvement can severely impact on the performance and intended benefits of all road infrastructure investments and these issues are particularly investigated.

Therefore the Evidence Review focuses on **Rural and Urban road infrastructure and Transport Services**. The Review contains specific sections on:

- Infrastructure's role in growth and poverty reduction
- Community engagement and Accessibility
- Technology Options and use of Local Resources
- Road Maintenance
- Climate change resilience and low carbon development
- Service delivery to the poor
- Suggested Priorities for DFID support.

2. Transport infrastructure's role in growth and poverty reduction

Transport accounts for nearly 6 per cent of global gross domestic product (IEG 2007). However in Sub-Saharan Africa, a mere 15% of an anyway low density network is paved or all-weather; with South Africa accounting for 40% of all paved roads in the region. At the extreme, South Sudan (area 620,000 km^2 – similar in land area to France) has almost no paved roads (Faiz 2011).

Viewed against the vastness of the subcontinent, the road network of Sub-Saharan Africa is sparse. Certainly, it is much less dense than the networks of other developing regions. But viewed against the region's population and income—and hence its ability to pay for maintenance—road density begins to look rather high. In several countries (Madagascar, Malawi, Mozambique, Niger), the asset value of the road network exceeds 30 per cent of gross domestic product (GDP), an indication of the magnitude of the maintenance problem (Gwilliam 2008). The same document advises "Spending on roads in Sub-Saharan Africa averages just below 2 per cent of GDP, with substantial variance across countries. This compares with the 1 per cent of GDP that is typical in industrialized countries, and the 2–3 per cent of GDP found in fast-growing emerging economies. Although the level of effort is high relative to the size of Africa's economies, it remains little in absolute terms, with low-income countries spending an average of about US$7 per capita per year."

The wide variation in provision of access to populations in Sub-Saharan Africa is shown in Table 1, with data for the UK also indicated for comparison.

Table 1 – Accessibility in Africa

Country	Classified Road Network: Km Paved	Classified Road Network: Total km	Percentage Paved	Population (millions)	km of paved road / million pop

South Sudan	200	20,000	1%	8	25
Ethiopia	7,476	149,177	5%	83	90
South Africa	70,000	754,000	9%	50	1,400
UK	394,000	394,000	100%	62	6,355

Notes

1. South Sudan network not yet classified or inventoried, estimate only, World Bank estimate 2011

2. Ethiopia: Federal, Regional, Community: Source Ethiopian Road Authority, 2010

3. South Africa Government, 2012

Any review of the mass of documentation relating to the Millennium Development Goals (MDGs) could be excused for concluding that there is little linkage between transport, and development and poverty reduction; transport is hardly mentioned. It is necessary therefore to evidence the transport-poverty linkage that implicitly underpins general development agency and national policies and programmes and the very substantial investments in transport infrastructure. Indeed, it can be argued that the available evidence should be better presented to accord transport interventions appropriate priority and ensure that programmes are designed and implemented to be more effective and sustainable with respect to the performance of these considerable investments.

UNHabitat (2011) do actually argue that roads contribute significantly to lowering transaction costs (MDG I), raising girls' school attendance (MDG II/III), improving access to hospitals and medication (MDG IV/V/VI), and fostering international connectivity (MDG VIII). Taken in this context, infrastructure makes valuable contributions to all the MDGs (Willoughby, 2004). The many benefits of infrastructure have also been confirmed by the United Nations Millennium Project (2005), which advocates for a major increase in basic infrastructure investments, to assist countries (especially in Africa) escape the poverty trap.

Poor transport is often the main constraint on economic progress and poverty reduction in rural areas, denying access to health and education facilities, goods, markets, information and a range of vital services. Improving access to markets encourages rural farmers to modernize with fertilizers, mechanized equipment, and new seed varieties, which, in turn, raises yields, lowers unit costs, and increases demand for inputs and credit. Rural transport also provides access to labour markets and thus the opportunity to earn non-farm income. Moreover, the same road that provides access to products, service, and labour markets often provides the right of way for electricity lines and water pipes (World Bank 2008).

The Bank reports "Poor transport restricts opportunities to trade even within local markets. It raises the costs of production and distribution, reduces the profit margin from sale of produce that can be traded, and limits production yields to levels below their potential. It thereby slows efforts to migrate from subsistence to income-producing agriculture. The economic impacts of improved access can be cumulative and far-reaching. When road access is improved to remote rural areas, the economic effect can be dramatic".

The Bank cites:

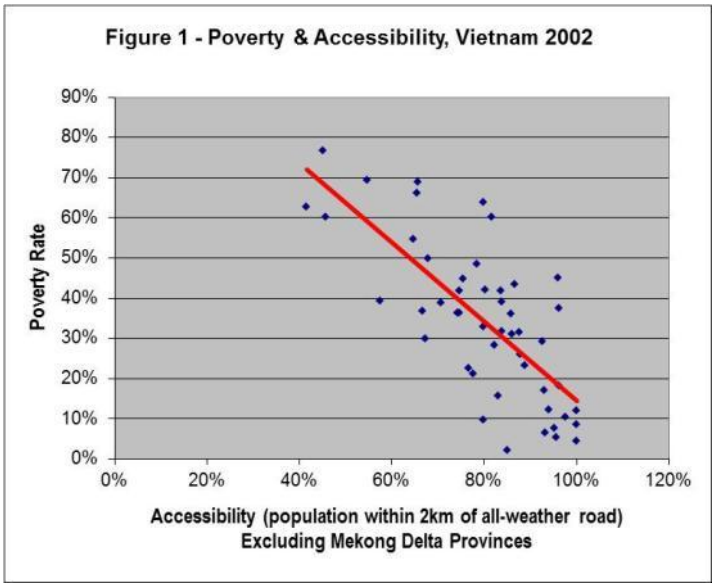
Guinea: In areas where rural roads had been provided, the area sown with crops doubled compared with other areas. Output sold to market for cash almost quadrupled. In areas where no such access improvements were made there was no change: citizens remained locked into traditional subsistence living (République de

Guinee Ministère des Transports 2005).
Colombia: An improvement of rural roads in areas previously inaccessible to vehicles reduced travel times and transport costs by 80 percent. Farmers responded by increasing production of goods for market (particularly perishables) by between 50 per cent in one area to 200 per cent for some products in others (Evans 1990).

Improved and reliable rural access and transport services also support reduction in food insecurity, increase in girls' enrolment and pursuit of education, and reduction of maternal mortality (Mitiku 2009). Rural transport also provides access to labour markets and therefore creates the opportunity to earn non-farm income. Studies in **China** examined the factors which contributed to the exceptional growth and to the reduction of poverty in China during the past thirty years. These indicated that investment in improving low-category roads generated 1.57 yuan of agricultural GDP for every yuan invested, but generated more than 5 yuan of nonfarm GDP (Fan and Chan-Kang 2004). Investment in rural roads, achieved about four times greater benefit/cost ratio than did the expressways. Evidence from Bangladesh, India and Ghana also shows that investments in rural roads provide a high share of benefits to the poor (Ahmed and Hossain 1990). Research for improved African Food security for International Food Policy Research Institute (Diao et al 2009) concluded that improving rural road networks is essential to promote social and agricultural development and reduce transaction costs. Furthermore "The importance of rural roads can scarcely be overemphasized. Roads are literally the foundation of rural development in that good road networks lower the costs of everything else: rural electrification, irrigation, fertilizers, education and health services, agricultural extension services, financial services, output markets, and a whole host of other goods and services, all of which produce dynamic linkages to new opportunities for migration, investment, and trade. Physical infrastructure investments in rural Africa are a necessary condition for agricultural growth and overall rural development."

IFPRI (2008) found that improving rural road networks is essential to promote social and agricultural development and reduce transaction costs. Only through well-maintained roads can rural areas become less isolated. While many studies have shown public expenditure on agriculture, especially on agricultural R&D, to yield high returns, the similar literature also finds high returns from infrastructure investments, especially in rural roads. According to Fan (2008), in India roads had the largest poverty reduction impact per million rupees spent (lifting 123.8 people out of poverty); agricultural R&D was second (84.5), education a distant third (41), and no other expenditure came close (including antipoverty programs). The same three foci are found to have similarly high returns in China in terms of rural GDP growth and agricultural GDP growth; roads and education also brought high returns in nonfarm GDP. Similar results were found in Thailand for roads and agricultural R&D. Studies in African countries show a similar picture. For example, a study in Uganda found that a million shillings spent on agricultural R&D lifted the most people out of poverty (58.39), followed by feeder roads (33.77), while education again came a distant third (12.81). Fan, Nyange, and Rao (2003) report similar results for Tanzania. A study by Bird, McKay, and Shinyekwa (2007) also found that physical isolation and poor infrastructure are leading causes of poverty in Uganda.

3. Community engagement and accessibility



It is therefore not surprising that poor people in rural areas view isolation as a major reason for their poverty. The World Bank has attempted to quantify this problem. The results are summarized in a **Rural Access Index** that measures the proportion of rural dwellers who live within 2 kilometres (typically equivalent to a walk of 20-25 minutes) of an all-season road; that is motorable all year round by the prevailing means of rural transport; occasional interruptions during heavy rainfall excepted (Roberts and Shyam 2005 and Appendix 1). Measures of this indicator show a significant difference between 32 Sub-Saharan African countries (aggregate average of 30%), IDA (aggregate average of 64%) and IBRD countries (aggregate average of 93%). Globally, about 1 billion rural dwellers are estimated to lack access to an all-weather road. RAI could potentially be a useful indicator of poverty impact of transport interventions and even infrastructure management performance over time. An application of the RAI in Vietnam (Figure 1) from Government of Vietnam (2002) national data shows the very strong correlation between poverty and road access.

The use of the RAI as a monitoring tool has not been as widely adopted as intended. This may be partly due to the considerable resources required to carry out the necessary regular household surveys. Ways of capturing the RAI data inter alia by satellite imagery methods are being investigated. Its use as a tool is also limited by its simplistic approach and the inability to accommodate travel time, climate and terrain factors and the availability, safety (especially for female passengers) and affordability of transport services (Faiz 2011).

The provision of transport infrastructure alone will not ensure poverty reduction. By providing access to transport (both roads and services), raising productivity of farms and of the rural transport, both an increase in the incomes of rural workers/farmers and a reduction in food prices for the urban poor can be achieved (World Bank 1994), facilitating a ‘win-win’ situation. It is clear that the road construction must be accompanied by other initiatives with respect to transport services to make affordable transport services available, along with initiatives to support the agricultural sector. The DSRP in Nepal provides an example of successful complementary non-road initiatives with the target communities, for example with transport services, life skills, saving, and income earning initiatives, that particularly ensure female and disadvantaged group participation (Government of Nepal 2010). More pro-poor investments in the future require genuinely integrated project components that offer the poor,

too, some opportunity to diversify and broaden livelihoods, and thus strengthen the accumulation of capital with which to make use of improved rural roads. For this, linkages with complementary activities and services, which support the broadening of livelihood opportunities for the poor, are needed. Simply improving a road is not enough; the poor also require support in being able to safely make use of it (ADB 2006). Given the right complementary activities, projects can broaden livelihood opportunities.

The potential for complementary activities is indicated by ADB's (2006) analysis of the 5 main causes of poverty in a rural Indonesian community as:

- low quality of produce/commodity due to farmers' lack of skill in cultivation, pest control, and postharvest handling;
- lack of access to market information and competitive power with other markets;
- lack of roads and mode of transportation, which prevented farmers from having access to markets; thus they were taken advantage of by intermediaries;
- farmers' inability to plant high-value crops; and
- limited sources of income; the absence of irrigation systems further limited farmers from planting other viable food crops.

The construction of roads, particularly by large non-local enterprises, can have negative impacts on local communities (ADB 2006). Project designers should consult with local communities and other stakeholders to include programme measures to minimise the impacts of environmental degradation, dust or noise pollution, traffic accidents, loss of land, disrupted or concentrated drainage, spread of HIV/AIDS and other diseases, vulnerability of certain groups (e.g. school children, women), corruption etc.. The Construction Sector Transparency Initiative (CoST) is an international multi-stakeholder initiative designed to increase transparency and accountability in the construction sector (CoST 2010). DFID has been working with the World Bank and national stakeholders to develop this important anti-corruption initiative.

4. Technology and improved use of local resources

Technology is an important consideration for road works in developing countries where capital (and credit) is scarce and expensive, and labour costs are a fraction of those in developed countries. It makes sense to make a better use of **local resources**. In capital-intensive road technology options, equipment typically represents 80% of the total cost, while labour costs are only 10–12%. With labour-based options, equipment would typically be 30–40% of the total cost, while labour costs would be 50–60%. Labour would be mainly unskilled or semi-skilled, often providing jobs for local women. An International Labour Organisation (ILO) review of labour-based road construction in countries as different as Cambodia, Ghana, Laos, Lesotho, Madagascar, Rwanda, Thailand and Zimbabwe showed that the labour-based option is typically 10–30% cheaper than the capital-intensive equivalent, while creating between three and five times the amount of employment for the same investment. It has been estimated that if 20% of public investment and 10% of private investment in infrastructure in Ghana were in labour-based projects, this would create 50,000 direct and 75,000 indirect jobs more than with conventional construction. Source: Islam and Majeres (2001).

In Indonesia it was also demonstrated that large structures of equal engineering integrity built using labour-intensive methods could cost about one-third less than equivalent works constructed through government agencies. In the Philippines it was proven that small infrastructure works such as foot trails, spillways, and hanging bridges could benefit large numbers of people (37,000 households in this case). Improvements of farm-to-market roads in India (Assam) showed that cropping intensity improved by as much as 45 per cent, which led to a substantial increase in employment.

Labour based road works provide opportunities for employment for females and other disadvantaged groups (ADB 2006). In Africa it has been shown that there can be significant cost savings (between 30 and 60%) of labour over equipment intensive gravel road construction and maintenance (ITT 1998 & 2003). Gravel roads suffer from considerable challenges and sustainability issues regarding gravel loss and maintenance (Cook et al 2005). However, recent research on alternative low cost paving, surfacing and maintenance in Asia and Africa indicate considerable potential for increased use of local construction materials, local employment creation, intermediate equipment (Intech 2012), SME involvement, durability and affordable maintenance through sensible use of different surface options throughout routes (Environmentally Optimised Design). The approaches use techniques encompassing Engineered Natural Surfaces (ENS), gravel , natural stone, brick, concrete and bitumen, each depending on local and environmental factors (Cook et al 2012). Adaptions to local policies, standards, specifications and contract arrangements usually need to be made to facilitate these savings (O'Neill et al 2010). All year Basic Access using spot improvements; basic drainage structures (Larcher et al 2010) and the above surfacing techniques, can be provided at a fraction of the cost of fully paved roads (World Bank 2001).

DFID's own previous benchmark document (Making Connections, 2002) advises "While the evidence is broadly positive, spending on infrastructure has not always contributed to pro-poor growth. Benefits have often been less than anticipated, especially because of inadequate attention to governance and institutional frameworks. 'White elephant' infrastructure projects are far from unknown. And high levels of personal and political corruption, facilitated by weak systems, have hindered a demand-led approach, distorted public investment choices, diverted benefits from the poor and encouraged neglect of maintenance."

5. Maintenance

Maintenance is the range of on-going activities to keep the roads within an acceptable band of serviceable conditions so that these assets perform the function they were designed for in a cost effective way. There are serious maintenance deficiencies in many developing and emerging economies. The need, practical arrangements, and good practice for maintenance are well documented (TRRL 1985, TRL 2003, PIARC 1994 et al). However, the 'enabling environment' for arranging and delivering cost-effective maintenance is lacking in many countries (O'Neil et al 2010).

The World Bank's World Development Report 1994 advised that 'in Africa and elsewhere, costly investments in road construction have been wasted for lack of **maintenance**' The report cites that "Inadequate maintenance has been an almost universal (and costly) failure of infrastructure providers in developing countries. For example, a well-maintained paved road surface should last for ten to fifteen years before-needing resurfacing, but lack of maintenance can lead to severe deterioration in half that time. The rates of return from World Bank assisted road maintenance projects are nearly twice those of road construction projects. Timely maintenance expenditures of $12 billion would have saved 4 x road reconstruction costs of $45 billion in Africa in the past decade." Long-term benefits from roads are threatened by neglect of periodic maintenance. (ADB 2006).

Despite the fact that 27 road funds have been established in Sub-Saharan Africa, the efficiency of these funds is highly variable. In only one-third of the cases are the funds able to cover routine maintenance needs (IEG 2007). Periodic maintenance will usually require even more resources than routine. The Bank has found that lack of capacity impedes reform and performance. The almost universal maintenance problem was previously highlighted by the World Bank in 1981 and again in 1988. However, this serious sector deficiency has

continued to blight the performance of many investment programmes. The conclusion should be that ways must be found as a priority to reduce the overall maintenance burden (as discussed previously regarding appropriate surface selection etc.), and improve maintenance capacity and performance (including local resource approaches) to avoid the substantial on-going wastage of investments and assets. More attention is required to be paid to making realistic whole life cost assessments of road investments. The quality assurance regime of the construction phase also requires more attention to ensure that designs are constructed as intended to meet the economic life and benefit streams expected. Reviews of sector projects have enabled a comprehensive list of 'prerequisites' to be identified for effective asset management and maintenance of the road networks (O'Neil et al 2010).

The issues discussed in the foregoing sections have focussed on Rural Roads. Urban Roads share many of the issues and challenges, although many of these are ameliorated by simpler logistics and high density population catchments making the economics more attractive. The Urban scope for alternative local resource based paving, labour based methods and SME development is particularly substantial. On the other hand there are greater challenges regarding traffic and use management, utility services, road margin encroachment, safety and land take.

6. Climate change adaptation and low carbon development

The continued growth in rural roads is predicated by many factors, the foremost being the food requirements of a projected 9 billion global population by 2050. The required increase in food production will require massive improvements in the agricultural supply and marketing systems, with the rural road providing the first value-enhancing link, as agricultural produce moves up the value chain from the farm to the market and on to the consumer (Faiz 2011). There will therefore be undoubted pressure and economic justification to further develop and upgrade the road networks in many regions of the developing countries.

Considering **Carbon Footprint**; the current commonly used technologies for road works are very 'carbon hungry' with reliance on fossil fuels, imported equipment, bitumen, cement and steel. There is potential to reduce the carbon footprint of both network expansion and maintenance by developing alternative industry sealers and binders (Lennox et al 2008), use of intermediate rather than heavy equipment and local resource based surfacing and paving options (Sturges 2010) and structures (Larcher 2010); for example using clay bricks burnt with agricultural waste (Dzung 2009). The potential benefits and (carbon and real) cost savings justify further research, dissemination and application in this area.

Integrated Rural Accessibility Planning (IRAP) can be used to work with communities to optimise travel patterns and investments in road improvement, maintenance, or in other infrastructure such as schools, clinics, markets etc. to reduce transport movements (Donnges 2003). However, these tools need to be further developed to enable planners to minimise the overall carbon footprint of the community activities.

Measures to minimise Carbon Footprint in the Road Transport Sector (ADB 2009) include:

- Ensuring road users pay the full (including environmental) costs associated with their travel
- Expanding feasibility studies to include a calculation of the proposed project's energy-use consequences
- Expanding the public transport system to continue to provide a high quality of local service at lower pollution and energy consumption levels.

Considering **Climate Change** resilience; water being the enemy of roads in terms of softening and weakening construction materials, causing erosion and landslides, will mean that in some regions the standards, specifications and designs will need to be adapted to greater duration and intensity of rainfall and flooding, with obvious cost consequences (ADB 2012). Fragile low volume (and cost) rural roads will be particularly affected. Routes may be impassable for greater periods due to more extensive flooding, and embankments and structures may need increased erosion protection or raising. Waterborne debris removal may require increased maintenance resources. In coastal areas roads and bridges could be affected by rising sea levels. Cross drainage structures that are under-designed for flood conditions can cause back-up flooding that can affect poor communities and enterprises living nearby. Washouts or collapse of road structures can have serious consequences for communities with severed links.

7. Service delivery to the poor

Efforts to enhance mobility for the rural poor are a vital component of poverty reduction, but such enhancement cannot be achieved by road improvements alone. The poor require better access to wheeled or motorized transport to utilize a road – a simple but grossly overlooked fact (Bryceson 2006).

Research in Ethiopia by Dercon (2008) found that roads have a key facilitation role; "Receiving at least one extension visit reduces headcount poverty by 9.8 percentage points and increases consumption growth by 7.1 per cent. Access to all-weather roads reduces poverty by 6.9 percentage points and increases consumption growth by 16.3 per cent."

Roads are normally provided through public funding and the vehicles by both the public and private sectors. Intermediate Means of Transport (IMT) and Non-motorized transport (NMT) in a wide variety of forms play an important role in many countries. This poses a challenge for development agencies regarding how to effectively support improved transport services, often provided by small rural enterprises. In many countries effective forums for transport services representation are lacking. AFCAP have recently commissioned research to develop useful Transport Services Indicators.

In Sri Lanka, 81% of the road network is paved, a figure comparable to high income European countries but a massive backlog of maintenance and rehabilitation has resulted in very rough roads with average speeds of 10-20 km/hr. Transport providers are reluctant to operate on these roads and the frequency and affordability of rural transport services has diminished (Faiz 2011).

An assessment of the impact of transport and energy infrastructure on poverty reduction by the Asian Development Bank showed that improvements in rural roads and transport services reduced transport costs for the poor, resulting in increased farm incomes and off-farm employment opportunities especially for landless poor households (especially for women as labourers, small contractors, social workers .in local road construction and maintenance programs), improved access to health care, education services and common property resources, as well as improved personal security and participation in the community. A highly significant finding of this study is that time savings are of great importance to the poor, implicitly valued at more than the opportunity cost of labour. Time savings from road improvements expand the radius of off-farm employment opportunities accessible to the poor and reduce the time deprivation faced by poor rural women (Cook C. et al 2005).

There is a need to re-examine the concept of rural accessibility - it must embrace the vast network of enclave roads and rural trails, paths, and tracks as a viable and seamless

extension of classified public rural roads, with NMT and IMT fully integrated with motorized transport to improve rural mobility. This will require development of technical guidelines and standards and appropriate technology (including specifications) for engineered trails, bridges and other structures suitable for NMT/IMT, including small all-terrain vehicles for ambulatory and other emergency services (Faiz 2011).

Based on research in four African countries (Starkey 2007), Transport Services were found to be a vital component of social and economic development for the rural poor. Recommendations were made regarding ways to support and improve this important rural transport component included:

- Understanding of rural transport systems (poverty implications, infrastructure needs, hubs, fluctuations, low investment in motorised services, importance of IMTs)
- Regulating rural transport (transport associations, control barriers, routes, timetables, safety and enforcement)
- Promoting rural transport services (transport firms, mixed transport, consolidating demand and participatory planning, reducing prices of IMTs)
- Crosscutting issues in rural transport (education, health services, gender, HIV/Aids and mobile phones).

There has been undoubted success and beneficial impact of IMTs in China and elsewhere in Asia, to bring affordable rural transport services to the rural poor (Sperling et al 2004). Many of these vehicles are extremely low cost compared to 'western' types of motorised transport. They are reasonably easy to maintain and support if there is a critical mass of numbers on the local market to support spares availability and development of the necessary mechanical skills. Many IMTs can transit roads in poor condition and even reach farmers' fields. In many locations they are available for hire to poor farmers who do not have the capital to purchase their own transport vehicles (Dzung 2008). It would be sensible to explore the possibility of taking and adapting these experiences for Sub Saharan Africa where the variety and use of IMTs is very restricted in comparison.

There is a lack of research on the Vehicle Operating Costs of IMTs relating to road conditions, which limits the effectiveness of assessment of rural transport infrastructure.

8. Suggested priorities for DFID support

The World Bank assesses the asset value of the road infrastructure in their client countries to be in the order of US$2 trillion. For decades DFID has been the leading international development agency investing in transport sector knowledge research and mainstreaming (e.g. funders and custodians of ORNs etc.). This investment has amounted to more than £100 million (Petts 2011). DFID contributes about 0.0004% of the developing country road asset value each year to knowledge generation and dissemination. However, few governments and developing agencies provide similar levels of support. National road agencies and other development organisations however do recognise this unique and vital contribution to the sector.

It is informative to note that by contrast, the private sector heavily funds R&D for vehicles. For example; Toyota spent about 6% of Market Capitalization on R&D each year (2009).

This unbelievably meagre investment in Land Transport knowledge may help to explain the current relatively poor state of transport infrastructure in developing countries, and lack of easy access to knowledge for essential policy and decision making.

From the foregoing review, the Key areas requiring support and further research include:

- An overdue attention to improving road maintenance priority and capacity, and to include its assessment and improvement as an integral part of the policy, planning and design processes, and realistic whole life costing assessment.
- Further development of cost effective impact, planning and monitoring tools such as the RAI, CoST, Integrated Rural Accessibility Planning (IRAP) and Transport Services Indicators.
- Rural Road projects should maximise economic use of local resources and Environmentally Optimised Design (EOD), including use of a range of paving and surfacing options, low cost structures, Intermediate equipment, and local participation and enterprise development to achieve and sustain affordable basic access for poor communities.
- Road projects should be designed with complementary pro-poor, non-road initiatives to ensure that the target beneficiaries can take early advantage of the improved access, and complementary impact with other development and poverty initiatives is maximised.
- Support is required to ensure that appropriate transport research is identified (need), promoted, resourced, disseminated and mainstreamed into policies, road authorities and with practitioners; localised to help countries develop their own culture of knowledge generation and application.
- Continued support to define international good practice and promote its national application.
- Assistance is required to help road authorities to review, adapt and incorporate research in their policies, standards, specifications and practices, and for supporting education and in-career training.

DFID could improve the performance of these vital knowledge activities by increasing cooperation and leverage with the other sector stakeholders.

Footnote

World Bank Business Strategy (2008) asks - Why is it so difficult to measure the contribution of transport interventions to economic growth? There are four main reasons:

First, there are many steps between cause and effect: (a) transport infrastructure (which forms the majority of Bank-supported investment) facilitates (b) further supply activity (freight and passenger transport services) which serves (c) market demands (distribution of goods and personal travel) which are themselves at least one (and usually more) steps away from (d) economic growth.

Second, the supporting conditions and actions necessary to trigger these various steps are not fully understood.

Third, the time lags involved between cause and effect are not known, but may sometimes be very long.

Fourth, there are reverse links from growth back into transport demand and investment that are difficult to disentangle.

Therefore, to define a point at which the growth impact of a specific transport project can be said to have occurred, isolate it from the impacts of many other policy or economic changes that may (or may not) have taken place, and then measure its unique contribution to economic growth is a formidable research challenge that has not yet been, and will probably never be, fully met.

One of the most thorough reviews of evidence concerning the relationship between transport and economic growth concluded that it is “dependent on the context within which transport interventions take place—the state of economic development, the degree of integration of markets, the extent to which there is already a well-developed transport infrastructure, the strength of competitive forces in the areas affected by transport change; the capacity (of beneficiaries) to respond to the opportunities and threats of wider markets, and on the incidence of congestion” (SACTRA 1996).

The distributional impacts of transport projects and their effects on poverty are relatively under-researched and are often anecdotal rather than results-based. This is an area where DFID’s access to leading UK expertise could benefit the sector.

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Appendix 1

Rural Access Index Data, World Bank

Rural Access Index (RAI)

RAI: proportion of population who live within 2km(20-25 minutes walk) from all-weather road

Country	until 2005			Updated			Region	Income group	Lending category
	Year	RAI	Survey / Method	Year	RAI	Survey / Method			
Angola	2003	42%	model				Sub-Saharan Africa	Low income	IDA
Benin	2003	32%	CWI				Sub-Saharan Africa	Low income	IDA
Burkina Faso	2003	25%	SSATP				Sub-Saharan Africa	Low income	IDA
Burundi	1998	19%	PS				Sub-Saharan Africa	Low income	IDA
Cameroon	2001	20%	PS	2002	22%	ISR	Sub-Saharan Africa	Lower middle income	IDA
Chad	2001	5%	**				Sub-Saharan Africa	Low income	IDA
Congo, Dem. Rep.	2003	26%	SSATP				Sub-Saharan Africa	Low income	IDA
Ethiopia	2005	17%	ISR	2005	17%	ISR	Sub-Saharan Africa	Low income	IDA
Gambia, The	1994	77%	PS				Sub-Saharan Africa	Low income	IDA
Ghana	1997	44%	CWI	2003	61%	CWI	Sub-Saharan Africa	Low income	IDA
Guinea	2004	22%	SSATP	2005	37%	ISR	Sub-Saharan Africa	Low income	IDA
Kenya	1997	44%	PS				Sub-Saharan Africa	Low income	IDA
Madagascar	1997	25%	PS	2007	22%	ISR	Sub-Saharan Africa	Low income	IDA
Malawi	1997	38%	IS				Sub-Saharan Africa	Low income	IDA
Mali	2003	14%	model				Sub-Saharan Africa	Low income	IDA
Maurtius	2003	70%	model				Sub-Saharan Africa	Low income	IDA
Namibia	2001	57%	**				Sub-Saharan Africa	Lower middle income	IBRD
Mozambique				2007	12%	ISR	Sub-Saharan Africa	Low income	IDA
Niger	2003	37%	SSATP	2005	17%	ISR	Sub-Saharan Africa	Low income	IDA
Nigeria - 8 states	2002	47%	CWI++				Sub-Saharan Africa	Low income	IDA
Siiera Leone	2003	65%	model	2006	22%	ISR	Sub-Saharan Africa	Low income	IDA
South Africa	1993	21%	IS				Sub-Saharan Africa	Upper middle income	IBRD
Tanzania	2000	38%	PS	2006	16%	ISR	Sub-Saharan Africa	Low income	IDA
Uganda	2003	27%	model				Sub-Saharan Africa	Low income	IDA
Zambia	2003	64%	model	2007	51%	ISR	Sub-Saharan Africa	Low income	IDA
Cambodia	1999	87%	IES	2003	81%	IS	East Asia and Pacific	Low income	IDA
China	2003	97%	*				East Asia and Pacific	Lower middle income	IBRD
Indonesia	2003	94%	PODES				East Asia and Pacific	Lower middle income	Blend
Lao PDR	2003	59%	**	2002	64%	ECS	East Asia and Pacific	Low income	IDA
Mongolia	2003	36%	**				East Asia and Pacific	Low income	IDA
Papua New Guinea	1996	68%	IS				East Asia and Pacific	Low income	Blend
Timor-Leste				2001	90%	IS	East Asia and Pacific	Low income	IDA
Vietnam	2002	76%	IS	2004	84%	IS	East Asia and Pacific	Low income	IDA
Albania	2002	31%	IS				Europe and Central Asia	Lower middle income	Blend
Armenia	2003	80%	model				Europe and Central Asia	Lower middle income	
Azerbaijan	2002	67%	IES				Europe and Central Asia	Lower middle income	Blend
Belarus	2001	64%	IES				Europe and Central Asia	Lower middle income	IBRD
Bulgaria	2001	98%	IES				Europe and Central Asia	Upper middle income	IBRD
Croatia	2003	84%	model				Europe and Central Asia		
Czech Republic	2003	97%	model				Europe and Central Asia		
Estonia	2003	86%	model				Europe and Central Asia		
Georgia	2003	82%	model				Europe and Central Asia		
Kazakhstan				2001	77%	HBS	Europe and Central Asia	Upper middle income	IBRD
Kyrgyz Republic				1998	76%	IS	Europe and Central Asia	Low income	IDA
Latvia	2001	90%	**				Europe and Central Asia	Upper middle income	IBRD
Lithuania	2003	97%	model				Europe and Central Asia		
Romania	2001	89%	**				Europe and Central Asia	Upper middle income	IBRD
Russian Federation	2001	81%	**				Europe and Central Asia	Upper middle income	IBRD
Tajikistan	2003	74%	IS				Europe and Central Asia	Low income	IDA
Turkey	2003	69%	model				Europe and Central Asia		
Uzbekistan	2000	57%	IES				Europe and Central Asia	Low income	Blend
Bolivia	2003	48%	model				Latin America and Caribbean	Lower middle income	Blend
Brazil	2001	53%	**				Latin America and Caribbean	Lower middle income	IBRD
Chile	2003	76%	model				Latin America and Caribbean	Lower middle income	IBRD
Costa Rica	2003	82%	model				Latin America and Caribbean	Lower middle income	IBRD
Ecuador	2003	73%	model				Latin America and Caribbean	Lower middle income	IBRD
Guatemala				2000	55%	IS	Latin America and Caribbean	Lower middle income	IBRD
Nicaragua	2000	28%	IS				Latin America and Caribbean	Lower middle income	IDA
Peru	2001	43%	**				Latin America and Caribbean	Lower middle income	IBRD
Bahrain	2003	99%	model				Middle East and North Africa		
Morocco	2003	36%	model				Middle East and North Africa		IBRD
Syria	2003	49%	model				Middle East and North Africa		IBRD
Tunisia	2003	39%	model				Middle East and North Africa		IBRD
Yemen, Rep.	1999	21%	IES				Middle East and North Africa	Low income	IDA
Bangladesh	2000	37%	IES				South Asia	Low income	IDA
Bhutan	2003	47%	IS				South Asia	Lower middle income	IDA
India	2001	60%	***				South Asia	Low income	Blend
Nepal	1995	15%	IS	2003	17%	IS	South Asia	Low income	IDA
Pakistan	1998	77%	IS	2004	61%	CWI	South Asia	Low income	Blend

Notes

++	The Nigeria CWI is based on an eight state sample which represents 34,742,392 of the rural population. Thus, the rural access indicator refers to the portion of the rural population represented in the survey. Both total and rural population figures are for 2003.
*	Based on the Poverty Monitoring Report for Rural China, 2003, a publication by the Chinese Government. The figure represents that 97% of Chinese villages （which include rural townships & administrative villages） are accessible by road.
**	The rural access indicator has been established using mapped information and GIS information.
***	Based on the Pradhan Mantri Gram Sadak Yojana （PMGSY） Briefing Book, 2006, a publication by the Indian Government. The figure indicates that 61% of habitations with population more than 250 people are within 0.5 kilometers of all weather road.

Review 07

Road safety

By Jeanne Breen

1. Introduction

Low and middle-income countries (LMICs) currently account for nearly half of all cars on the world's roads and 90% of fatalities in road traffic crashes. Over the first 30 years of the 21st century, more cars will be produced than in the first 100 years of motorisation and the majority of these will be used in LMICs.[1] As with the rate of motorisation in these countries, the accompanying increase in deaths and serious injuries is unprecedented, involving premature death and disability in catastrophic numbers predominantly amongst vulnerable road users.

Economic development makes an important contribution to increased mobility and motorisation and increased exposure to risk of fatal injury. In a study of data from 88 countries between 1963-1999, road death rates increased sharply as gross domestic product (GDP) per capita increased, peaking between $6100 and $8600 (using 1985 international dollar values), Modelling for the World Bank of this relationship, taking account

[1] Bliss T (2011), *Producing Road Safety Interventions: the Institutional Dimension*, MUARC Annual Transport Safety Lecture, Monash Conference Centre, 30 June 2011

of trends in income, population and traffic, has been used to forecast road traffic deaths globally to 2020. It indicates that if LMICs follow historic trends, it will take many years for them to achieve the motor vehicle fatality rates of high income countries (HICs).[2] If LMICs choose to follow the costly, evolutionary path of HICs in reducing deaths and serious injuries rather than going straight to effective practice, then the road death toll is likely to grow by approximately 83% in LMICs by 2020 (almost 92% in China and 147% in India).[2] LMICs now have access to a substantial body of scientific knowledge built up globally over the last 60 years which can be adapted as necessary to suit local needs and following monitoring of effects.[3]

Despite the rapid growth in motorised traffic, most families in low-income and middle-income countries are unlikely to own a car within the next 25 years. In terms of exposure to risk, the main modes of travel in these countries in the foreseeable future are likely to remain walking, cycling and public transport. This emphasises the importance of planning for the safety needs of these road users who bear a high proportion of the burden of road traffic injuries as well as integrating safety into developing LMICs' road networks for cars, vans, buses, and trucks.[3] Country capacity reviews reveal that the majority of these deaths and serious injuries occur on a relatively small proportion of the road network, which is amenable to targeted action, where traffic volumes and vehicle speeds are high and where there is a mix of motorised traffic and non-motorised users and mixed speed road environments.[4,5]

This evidence review outlines the current and future safety challenges presented by the impact of motorisation in developing countries. It also reflects the alignment of the main international development and health organisations in understanding the problems, systematic evidence-based approaches and solutions for the long-term and the need for scaled up investment in road safety management to help bring safety outcomes under control.

NB The review draws heavily from the following published international, evidence-based reviews: World Report on Road Traffic Injury Prevention (2004) World Bank Road Safety Management guidelines (2009),OECD/ITF Towards Zero: Meeting Ambitious Road Safety Targets (2008), forecast reports carried out for the World Bank and WHO (2004-2012); Meeting the management challenges of the Decade of Action for Road (Bliss/,Breen IATSS 2012). Reference is also made to unpublished World Bank country road safety management capacity reviews , training material and resource papers (2006-2012).

2. Road safety is a development priority

Improving road safety in low, middle and high-income countries is being linked with the broader vision of sustainable development, the improvement of public health and poverty reduction. Development aims to promote higher living standards for all, with an emphasis on improved health, education and people's ability to participate in the economy and society. It seeks to foster an investment climate conducive to increased growth, productivity, and employment, and to empower and invest in people so that they are included in the process.[6.]

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[2] Kopits E, Cropper M. *Traffic fatalities and economic growth*. Washington, DC, World Bank,2003 (Policy Research Working Paper 3035).
[3] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva
[4] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC
[5] World Bank (2006-2012), *Unpublished country road safety management reviews in low and middle income countries*,
[6] Stern S, Dethier J-J, Halsey Rogers S (2005). *Growth and Empowerment: Making Development Happen*, The MIT Press, Cambridge Massachusetts, London.

The current and projected scale of serious health loss and associated socio-economic costs resulting from road crashes make road safety an urgent development priority.[7] [8]

2.1 The global public health crisis of road traffic injury and its socio-economic cost

The World Health Organisation estimates that around 1.3 million people die each year with many more suffering permanent disability and between 20 and 50 million suffering non-fatal injuries in road traffic crashes.[9] This represents a significant burden on the health sector, particularly in low and middle-income countries and at a time when they are trying to build efficient emergency medical systems and health care facilities. The annual socio-economic cost for low and middle income countries has been estimated at over US$ 518 billion and between 1% to 3% of countries' GDP.[10,11] Already a leading cause of serious health loss and overtaking diseases in health sector rankings such as malaria - a UK international development priority -the huge price paid for mobility in human loss and suffering is set to increase further. Death and injuries in road traffic crashes in developing countries are projected to be the 4th largest cause of healthy life years lost by the total population in 2030, compared with tuberculosis (26th) and malaria (15th). Road deaths and injuries are projected to be the 2nd cause of health loss for men by 2030 and the leading cause of healthy life years lost by children (5-14 years) from 2015.[12] Without new initiatives, Global Burden of Disease data suggests that more than 50 million deaths and 500 million serious injuries on the world's roads can be anticipated with some certainty over the first 50 years of the 21st century.[13] This can be compared with an estimated 1% probability that over the same period more than 40 million people could be killed in mega-wars or in a virulent influenza epidemic and around 4 million people by volcanoes or tsunamis.[14]

2.2 Impacts of road traffic injury on poverty

Research shows that road traffic crashes have a disproportionate impact on poor people. The loss of the major family wage earners in road traffic crashes can push people into poverty as well limiting the ability of victims to cope with the consequences. A study in Bangladesh found that road deaths were most common amongst the most economically active (males aged 16-45) and 75% of poor households reporting a road traffic death experienced a subsequent decrease in living standards.[15] In Bangalore 71% (urban) and 53% (rural) of poor households were not poor before a fatal road crash took place. Road traffic deaths were twice as high among the poorest socio-economic groups as among the richest in both urban and rural areas.[16] Studies conducted in the UK [17] [18] also indicate that the risk of child pedestrian crashes increases fourfold in deprived areas compared with other

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[7] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva

[8] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

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[14] Smil, V (2008). *Global Catastrophes and Trends: The Next Fifty Years*, MIT Press.

[15] Aeron-Thomas et al, 2004; *The Impact of Crashes on the Poor*. Study commissioned from TRL by GRSP with funding from the Swedish International Development Cooperation Agency (Sida) and TRL

[16] Aeron-Thomas et al, 2004; *The Impact of Crashes on the Poor*. Study commissioned from TRL by GRSP with funding from the Swedish International Development Cooperation Agency (Sida) and TRL

[17] Graham, D., Glaister, S., Anderson, R. (2005) *The effects of area deprivation on the incidence of child and adult pedestrian casualties in England*. Accident Analysis and Prevention, 37, 125-135

[18] Jones, S. R., Lyons, R. A., John, A., Palmer, S. R. (2005) *Traffic calming policy can reduce inequalities in child pedestrian injuries: database study*. Injury Prevention, 11, 152-156.

areas and, furthermore, that social disparities in child pedestrian risk can be reduced by means of measures such as traffic calming.

2.3 Alignment of road safety with Millennium Development Goals

Although there is no Millennium Development Goal (MDG) for addressing the prevention of deaths and serious injuries in road crashes, road safety priorities align well with the MDGs. Road traffic injury has implications for the MDG *poverty reduction* goal since the scale of loss of GDP from road crashes and impacts on poverty highlighted above will have some effect on its achievement, given the estimation that a 1% increase in economic growth is needed to reduce poverty levels by 0.7%.[19] Road safety is also highly relevant to the MDG goal for *ensuring environmental sustainability* and is being integrated in the increasingly adopted *safe, clean and affordable* mobility goals for transport policy at national and international levels in order to realise the associated co-benefits of integrated initiatives.[20] For example, the provision of safer infrastructure facilities to promote increased walking and cycling and measures to reduce vehicle speeds will also result in less greenhouse gas emissions and local air pollution, greater energy security, and improved physical well-being.[21] While the effects of road traffic injury on *education* are not much discussed, many thousands of children in developing countries will see their prospects for education diminished by injury and disability in road traffic crashes.[22]

2.4 UN resolutions, the Decade of Action for Road Safety, and the Global Plan

A Decade of Action for Road Safety was announced by the United Nations General Assembly in 2010. This followed forecasts of the growing global crisis and substantial reports by a range of international organisations, notably the *World Report on Road Traffic Injury Prevention* [24] which provided a widely accepted blueprint and recommendations for global action but has been slow in its implementation due to weak country road safety management capacity.[25] [26]

The Decade's goal is of *'stabilizing and then reducing the forecasted level of global road fatalities by 2020'.* This represents a halving of the forecast 2020 death toll with an estimated saving of 5 million lives and avoidance of 50 million serious injuries and a reduction in socio-economic cost of more than US$3 trillion.[27] Almost 60% of the prospective reduction in deaths and serious injuries fall within the World Bank's East Asia Pacific and South Asia regions alone, with another 18% in Sub-Saharan Africa.[28] In support of this goal, the UN General Assembly invited the World Health Organization and the United Nations Regional

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[19] Watkins K and Sridhar D, *Road traffic injuries: the hidden development crisis, A policy briefing for the First Global Ministerial Conference on Road Safety*, Moscow, 19-20 November 2009

[20] World Bank (2008). *Safe, Clean and Affordable Transport for Development: The World Bank Group's Transport Business Strategy for 2008 – 2012,* Transport Sector Board, Washington D

[21] Bliss T & Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

[22] Watkins K and Sridhar D (2009),*Road traffic injuries: the hidden development crisis, A policy briefing for the First Global Ministerial Conference on Road Safety*, Moscow.

[23] Bliss T & Breen J (2012). *Meeting the management challenges of the Decade of Action for Road Safety*, IATSS Research 35 48–55

[24] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva

[25] World Health Organization (2009), *Global status report on road safety – time for action,* WHO, Geneva.

[26] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

[27] Guria J (2009). *Required Expenditure: Road Safety Improvement in Low and Middle-Income Countries. Addendum: Revised Estimates of Fatalities and Serious Injuries and Related Costs*. Report to the World Bank Global Road Safety Facility, New Zealand Institute of Economic Research, Wellington.

[28] Bliss T (2011) *Global Directions in Road Safety,* Strategic Road Safety Forum, MUARC, Melbourne.

Commissions, in cooperation with the UN Road Safety Collaboration and other stakeholders to prepare a Global Plan.[29] The plan establishes five pillars: road safety management, safer roads and mobility, safer vehicles, safer road users and post-crash response in support of the Decade's goal and adopts the *Safe System* approach (the generic term for *Vision Zero*[30,31],*Sustainable Safety*[32,33] approaches used in Europe). National road safety performance is being monitored and periodic status reports, mid-term and final reviews will be presented at global Ministerial conferences in 2015 and 2020.

2.5 Millennium Development Bank's investment and country aid for road safety

An identified prerequisite for effective activity within the road safety management pillar of the highly ambitious *Global Plan* is to ensure that institutional strengthening priorities and related investments are properly sequenced and adjusted to the absorptive and learning capacity of low and middle-income countries.[29]

In addition to the efforts of the World Bank's Global Road Safety Facility, established in 2006 and a key actor in working with low- and middle-income countries to establish country road safety management needs and provide guidance, important support for this approach was provided in the joint statement of the Multilateral Development Banks (MDBs) in 2009.[34,35] This commits the MDBs to a shared approach to ensure systematic approaches to managing road safety outcomes and building capacity; to mobilize resource; and to "*ensure that safety is integrated in all phases of planning, design, construction, appraisal, operation and maintenance of road infrastructure particularly to improve safe access and protection for vulnerable road users who represent a significant proportion of the people served by the projects we finance*".

Development agencies and international organizations acknowledge that global funding of road safety is insufficient. Sustainable scaling up of investment in effectively targeted international development and country aid to low and middle-income countries is necessary and critical if these countries are to manage road safety outcomes. At the same time, key international agencies agree that countries will need to move straight to *effective practice* approaches given the unprecedented road safety challenge before them and to avoid repeating the costly evolutionary road safety path of developed countries in terms of lives lost and injuries sustained. International organisations and leading countries have worked to translate this knowledge into leading edge tools (e.g. iRAP), guidance on specific interventions (UNRSC 2006-2012) and data[36], professional networks (e.g. IRTAD and RoadPol) and a widely transferable good practice road safety management model and guidelines developed by the World Bank[37] and adopted by the OECD.[38]

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[29] United Nations Road Safety Collaboration (2011). *Global Plan for the Decade of Action for Road Safety 2011–2020,* WHO,Geneva

[30] Tingvall C (1995) *The Zero Vision*. In: van Holst, H., Nygren, A., Thord, R.,eds *Transportation, traffic safety and health: the new mobility.* Proceedings of the 1st International Conference, Gothenburg, Sweden Berlin, Springer-Verlag, 1995:35–57

[31] Swedish Transport Administration (2011), *Analysis of Road Safety Trends 2010, Management by Objectives for Road Safety Work, Towards the 2020 Interim targets, Borlänge*

[32] Wegman, F. Elsenaar, P. (1997) *Sustainable solutions to improve road safety in the Netherlands*. Leidschendam, Institute for Road Safety Research, 1997 (SWOV Report D–97–8)

[33] Eds. Wegman F, Aerts L,(2006)*Advancing Sustainable Safety, National Road Safety Outlook for 2005-2020,* SWOV, Leidschendam.

[34] Media Release (2009). *A Shared Approach to Road Safety Management. Joint Statement by the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, Islamic Development Bank and the World Bank,* World Bank, Washington DC.

[35] Media Release (2011). *Multilateral Development Bank Road Safety Initiative,* World Bank and Inter-American Development Bank, Washington DC

[36] WHO (2010). Data systems: a road safety manual for decision –makers and practitioners, Geneva.

[37] Bliss T & Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

3. Critical elements of successful evidence-based road safety practice

3.1 Introduction

A substantial body of knowledge has emerged over the last 60 years on how to achieve significant lessening of the costly, adverse impacts of motorisation which can now be applied systematically to any country irrespective of its safety performance or development status.[41] Great Britain for example, halved its death rate (per 100,000 head of population) between 1972 and 2000 despite a doubling in motorised vehicles and this is a typical finding for the best performing countries in road safety over that period. In 2010, Sweden's road toll was the lowest globally at 2.8 deaths per 100,000 people and with a program of targeted outcomes to 2020 is on track towards its long-term goal.

During the last 15 years there have been two major developments which have informed approaches to road safety and how to more effectively manage for better results. The first led by Sweden and the Netherlands in the second half of the 1990s has been the paradigm shift to the ambitious *Safe System* goal and strategy which better addresses human vulnerabilities and is, therefore, particularly relevant to the needs of low and middle-income countries. More recently, the World Bank and the OECD have underlined the importance of understanding road safety as a production process and the need for international benchmarking in the delivery of key *institutional management functions* which produce and make possible effective, system-wide *intervention* designed to produce *results*. There is an unprecedented alignment of views of all the key international organisations –WHO, UN, World Bank, ISO, OECD – on road safety management and about the relevance and importance of these developments for addressing the global road safety challenge. A brief summary of the critical elements of successful road safety practice based on the international literature is given below.

3.2 Governmental and top management leadership and accountability

Achieving sustainable road safety results is a complex multi-disciplinary and multi-sectoral activity and requires the input of a wide range of jurisdictions and public and private sector agencies and organisations. The *World Report* highlights the fundamental role of the lead agency in orchestrating this effort and in ensuring the effective and efficient functioning of the national road safety management system. Successful practice underlines the need for a lead agency to be a governmental body and publicly accountable for its performance.[39] Its leadership role must be accepted and fully supported across government to ensure funds and capacity. A central road safety office with adequate human, technical and financial resources is essential. However, there is no preferred structural model amongst the options of stand-alone agency, department within a Ministry, roads authority or office reporting to the Head of State.[40] Without this leadership, road safety management capacity reviews indicate that even the best strategies and plans remain on paper and are not implemented.[43]

Guidance based on documented successful national, jurisdictional lead agency arrangements and the delivery of the key country and lead agency management functions

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[38] OECD (2008) *Towards Zero: Achieving Ambitious Road Safety Targets through a Safe System Approach*.OECD, Paris
[39] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva
[40] Bliss T & Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

has been produced.[43] A new ISO standard in road safety management systems is just being finalised which provides organisations (public and private) who want to make a contribution to work related road safety with specific guidance on top management responsibilities (in Europe, 40-60% of all fatal work accidents are road crashes while working or commuting).[41]

3.3 Adopting ambitious long term goals and setting quantitative targets

Safe System goal and strategy: The current best practice phase of managing for results involves adoption of the *Safe System* goal towards the ultimate elimination of death and disability in road crashes (see Phase 4 below in Box 1).

Box 1: The four evolutionary phases of managing for results [43]

Progressive shifts in road safety management thinking and practices in high-income countries have been evident. Since the 1950s there have been four significant and progressively ambitious phases of development:

- Phase1: focused on driver intervention, with safety management characterized by dispersed, uncoordinated, and insufficiently resourced units performing isolated single functions.
- Phase 2: focused on system-wide interventions guided by the 'Haddon matrix'.
- Phase 3: focused on system-wide interventions, targeted results and institutional leadership. Good practice countries used action plans with numerical outcome targets to be achieved with evidence-based packages of system-wide measures based and new institutional leadership.
- Phase 4: is focusing on system-wide interventions; long-term elimination of death and serious injury; shared responsibility – *Safe System.* This comprises stepwise targets towards a long-term goal to eliminate death and serious injury which are seen as an unacceptable price for mobility; system-wide intervention (foreseen in Phase 2 and used successfully in Phase 3), but with renewed emphasis on better road and vehicle crash protection, post-crash care; new emphasis on speed management aimed at more effective injury prevention; and strengthened, accountable institutional leadership and meaningful shared responsibility to achieve results.

The *Safe System* intervention strategy is based on scientific safety principles and aims to ensure that in the event of a crash, the impact energies remain below the threshold likely to produce either death or long-term injury. This threshold will vary from one crash scenario to the next, depending upon the level of protection offered to or in use by the road users involved. For example, the chances of survival for an unprotected pedestrian hit by a vehicle diminish rapidly at speeds greater than 30km/h, whereas for a properly restrained motor vehicle occupant in the best designed car the critical impact speed is 50km/h (for side impact crashes) and 70 km/h (for head-on crashes).[42]

Box 2: *Safe System* intervention principles:

- Separation or safe integration of mixed road use
- Managing speeds to crash protection levels
- Providing crash protective roadsides and vehicles
- Deterring dangerous road user behaviour
- Managing risk through driver and vehicle standards and designs
- Fast and efficient emergency medical help diagnosis and care.

[41] ISO/PC241 DIS ISO 39001 *Road Traffic Safety Management Systems* (see national standardisation body for details)
[42] Tingvall C and N Haworth (1999) *Vision Zero - An ethical approach to safety and mobility*, Paper presented to the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne, 6-7 September 1999.

This *Safe System* approach, adopted in the *Global Plan,* is promoted in World Bank and OECD guidance as being especially relevant for low and middle-income countries[43,44] (see Box 3), and in the new ISO road safety management systems standard.[45]

Box 3: Relevance of *Safe System* approach to low and middle-income countries
The *Safe System* approach:

- Addresses all elements of the road traffic system in an integrated way;
- Emphasizes the reduction of death and long-term injury rather than the prevention of crashes which as the World Report highlighted is an unrealistic goal;
- Challenges the fatalistic view aptly termed 'the scandal of tolerance' (Allsop 2002) that road traffic injury is the price to be paid for achieving mobility and economic development by setting a societal goal with step-wise targets to eliminate road deaths and serious injuries in the long-term which can motivate and encourage all involved;
- Accentuates the shared and accountable responsibility of designers and users of the road network for achieving road safety results;
- Addresses limitations in human capacities in the setting of safety standards and rules and related compliance regimes for the planning, design and use of the road network; the conditions of entry and exit of vehicles and road users to the road network; and the recovery and rehabilitation of crash victims from the road network;
- Demands equity in addressing the safety needs of both motorised and non-motorised users;
- Aligns well with the goals of sustainable development and presents opportunities for achieving co-benefits with other societal objectives such as improved local air quality, greenhouse gas reduction, energy security, poverty reduction, social inclusiveness and occupational health and safety;
- Necessitates the strengthening of all elements of the road safety management system, especially institutional management functions, to achieve sustainable success.

Source: Bliss T and Breen J (2009).[46] ,OECD (2008) [47]

Step-wise interim quantitative targets: Target-setting in road safety is an international success story. Setting challenging but achievable staged, time-limited, quantitative final and intermediate outcome and output targets towards the ultimate *Safe System* goal to eliminate death and long-term injury has been identified as international best practice.[47] Quantitative targets can lead to better programmes, a more effective use of public resources and an improvement in road safety performance.[46,47] While an ambitious long-term or purely symbolic goal which is not supported by interim targets has no value, targets that are ambitious are associated with better performance than less ambitious targets. [48] Interim quantitative targets are usually expressed in terms of *final outcomes* e.g. numbers of deaths and serious injuries. Targets can also be expressed in terms of *intermediate outcome* e.g. reductions in average mean speed or increases in seat belt use. Some countries go further

[43] Bliss T & Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC
[44] OECD (2008) *Towards Zero: Achieving Ambitious Road Safety Targets through a Safe System Approach*.OECD, Paris
[45] ISO/PC241 DIS ISO 39001 *Road Traffic Safety Management Systems* (see national standardisation body for details)
[46] OECD (1994)*Targeted Road Safety Programmes*, Paris.
[47] Wong S. C., Sze, N.N., Yip, H.F., Loo, Becky P.Y.; Hung, W.T., Lo, H.K. (2006) *Association between setting quantified road safety targets and road fatality reduction*. Accident Analysis and Prevention, 2006, 38, 997-1005
[48] OECD (2008) *Towards Zero: Achieving Ambitious Road Safety Targets through a Safe System Approach.*OECD, Paris

and set *output targets* for their institutional service delivery e.g. number of breath tests required to be given annually by the police.

Until sufficient capacity and performance data is available in low and middle-income countries to set meaningful national targets, the World Bank recommends that countries adopt the long term *Safe System* goal and target reductions in specific corridors and areas using survey data of infrastructure safety quality (e.g. iRAP) and of safety behaviours (e.g. speed, crash helmet and seat belt use, drinking and driving).[49]

3.4 System-wide, evidence based intervention

A common misperception in countries starting out in road safety is to assume that since 90% of crashes may be due to human error that direct approaches relying heavily upon education and training can play a substantial part in saving lives and preventing serious injuries. Although these measures play a supportive role, there is little evidence to confirm this belief.[50] The findings of the *World Report* provided a substantial consensus-based blueprint for action by country, regional and global action and have subsequently been endorsed by successive United Nations General Assembly Resolutions, Reports by OECD provide review of the effectiveness of interventions and their benefits to cost. Together, they indicate that targeted, integrated packages of system-wide, evidence-based interventions can save many lives.[38,51] It is often difficult to identify the costs of national road safety programmes since much activity falls within general budgets, but one example from New Zealand identifies an annual cost of the national road safety program at approximately 1% of GDP, compared to the estimated annual cost of roads crashes at approximately 4.4% of GDP.[52]

The World Bank road safety management model (see Annex A) classifies intervention as follows:

- Planning, design, operation and use of the road network
- Entry and exit of vehicles and drivers to and from the road network
- Recovery and rehabilitation of victims from the road network.

3.4.1 Planning, design, operation and use of the road network

As indicated previously, the majority of death and serious injuries usually take place on a small proportion of sections of the main road network that are high volume and high risk due to the high operating speed permitted on them with mixed-use of motorised and non-motorised traffic. In the absence of high quality crash data these can be identified and targeted for ,multi-sectoral intervention by taking account of traffic volumes, mean speeds and traffic mixes, and by using safety rating tools such as those developed by the International Road Assessment Programme.[53] In urban and residential areas, studies in Sweden, the United Kingdom and the Netherlands report that when road engineering and speed management measures have been implemented together to reduce the probability of impact speeds exceeding 30 kph, there have been fatality savings for vulnerable road users of 25% to 35%.

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[49] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

[50] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva

[51] Koornstra M., D. Lynam, G. Nilsson, P. Noordzij, H-E. Pettersson, F. Wegman, Wouters P,(2002). *SUNFlower: A comparative study of the development of road safety in Sweden, the United Kingdom and the Netherlands*, SWOV, Leidschendam

[52] Ministry of Transport (2005). *Surface Transport Costs and Charges: Summary of Main Findings and Issue,* Ministry of Transport of New Zealand, http://www.transport.govt.nz/assets/PDFs/surface-transport-overview.pdf

[53] World Bank Global Road Safety Facility *Training Course Modules, Road Safety Training Workshop,, Washington DC, June 17-19, 2009*

Box 4: DFID's support for safety engineering research:

DFID has a long history of support for safety engineering research, primarily carried out by the Transport Research Laboratory during the 1990s. DFID sponsored the development and publication of Towards Safer Roads (TSR) which was the first major manual to address safety engineering and planning in developing countries. TSR also introduced the practice of safety audits (a standardised procedure for checking the safety concerns of road projects from the feasibility stage through to final construction and operation). The use of formal safety audits in new road projects followed in Nepal, Malaysia, Fiji and a number of other developing countries including Bangladesh.

Standards, rules and guidelines cover the planning, design, construction, use, operation and maintenance of all road networks. Compliance ensures that road builders, road operators and road users adhere to accepted safety rules, standards and protocols. However, most national road standards and rules do not provide for the degree of human vulnerability inherent in the use of the road network. For example, many current standards for junction design and management of the transition from high to low speed environments expect vulnerable road users to compete successfully against higher speed, higher mass vehicles, with tragic consequences.

Proactive safety planning and design

Integrating *Safe System* principles through proactive safety planning and design can address intrinsic dangers in the road transport system and improve protection for non-motorised as well as motorised road users. [54] A further advantage is the prevention of long-term costs associated with remedial treatments of poor design in newly created networks.

Modern approaches to safety engineering involve establishing clear urban and rural road hierarchies which better match function to speed limit and layout and design; separating oncoming traffic on high-volume, high-speed roads to prevent head-on collisions and providing crash protective roadsides to address run-off road collisions; ensuring safe speeds at intersections to reduce fatal and serious side collisions and ensuring safe speeds on roads and streets with dangerous mixed used where separation of motor vehicles and vulnerable road users may be difficult. [59,55,56]

Studies show that for both urban and rural environments, small differences in speed can have a substantial effect on the occurrence and severity of road crashes and injuries. Research indicates that 1% decrease in average speed corresponds with a 2% decrease in injury crashes, a 3% decrease in serious injury crashes and a 4% decrease in fatal crashes and vice versa. A 5% increase in mean speed will lead to a 20% increase in fatal crashes and vice-versa.[57,58] The chances of survival for an unprotected pedestrian hit by a vehicle diminish rapidly at speeds greater than 30km/h, whereas for a properly restrained motor vehicle occupant the critical impact speed is 50km/h (for side impact crashes) and 70 km/h (for head-on crashes).[59]

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[54] OECD (2008) *Towards Zero: Ambitious road safety targets and the Safe System approach*, OECD, Paris, 2008
[55] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva
[56] UNRSC (2012), *Safe roads for development: a policy framework for safe infrastructure on major road transport networks*
[57] Nilsson G (2004) *Traffic safety dimensions and the power model to describe the effect of speed on safety*. Bulletin 221, Lund Institute of Technology, Lund University, Lund 2004
[58] Elvik R (2009) *The Power Model and the relationship between speed and road safety, Update and new analyses,* TOI, Oslo.
[59] Tingvall C and N Haworth (1999) Vision Zero - An ethical approach to safety and mobility, Paper presented to the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne, 6-7 September 1999.

New network assessment tools such as the International Road Assessment Programme (iRAP) can be used to encourage the adjustment of the design and layout of the road and road networks such that they are self-explanatory, thus minimising error, and provide crash protection if an error is made. In low and middle-income countries where crash injury data may not yet be available or sufficiently reliable, the iRAP tool is used widely to rate the safety of roads systematically and to identify related mass action infrastructure investment programs. The tool is used to identify likely safety benefits for different types of road user in term of lives saved, injuries avoided as well as economic returns for different options.[60] iRAP assessment are now being carried out widely on the existing network as are safety audits on new road projects.

Box 5: Targeting main crash types with evidence-based engineering intervention. Source [61] [49]

Vulnerable road user fatal and serious injury crashes	**Fatal and serious injury crashes at intersections**
Based on *Safe System* principles, to minimise the likelihood of fatal outcomes from any vehicle-pedestrian crash, impact speed should not exceed 30km/h. Intervention options which could assist in achieving fatality reductions include: • Separating vulnerable users and vehicles physically by fencing or other barriers. • Lowering the travel speeds of vehicles by reducing and enforcing speed limits at or below 30km/h. • Providing adequate traffic light controlled road crossings in areas of high pedestrian activity in order to encourage pedestrian use of these crossings and their compliance with the signals.	Based on *Safe System* principles, the impact speed in a side impact crash should not exceed 50 km/h. Opportunities to reduce impact speeds include: • Lowering speed limits, especially in the vicinity of intersections on 60, 70 km/h and 80 km/h arterials. • Improving intersection controls with roundabouts, traffic signals, platforms or other treatments. • Applying skid resistance pavement treatments to improve braking performance. • Modifying traffic signals to allow fully controlled turning movements, albeit at the cost of reduced intersection throughput.
Fatal and serious injury run-off-road crashes.	**Fatal and serious injury head-on crashes**
These can be reduced by ensuring that roads include some of the following features: • Wide paved shoulders. • Tactile edge lining. • Clear roadsides for 10 to 15 metres or roadsides with objects shielded by flexible barriers. • Lower speed limits to provide more recovery time.	These can be addressed by: • Lowering speed limits on two lane two way roads to 70km/h or less. • Constructing a divided carriageway. • Installing a centre median between the two opposing lanes of traffic. • Safe speeds in general.

[60] International Road Assessment Programme, Star Rating Roads For Safety: The iRAP Methodology , www.irap.org
[61] OECD (2008) *Towards Zero: Ambitious road safety targets and the Safe System approach*, OECD, Paris.

Box 6: Examples of effective implementation of *Safe System* engineering approaches and measures [5]

Sweden's rollout of median barriers, roadside barriers and roundabouts: With over 70% of deaths occurring in single vehicle and head-on collisions Sweden commenced a *Vision Zero* investment program in safety engineering targeting an increased proportion of total traffic volume to be travelled on roads with new median and roadside crash protection. Since 2003, the percentage of total traffic volume travelling on roads with speed limits of more than 80 km/h and fitted with median barriers has risen from 50% to 67% in 2010, against a 2020 target of 75%. the 2+1 median barrier treatments reduced deaths by 80% and deaths and serious injuries by 50-60%. Improved junction safety has also been targeted with 80-90% fewer deaths occurring at sites where roundabouts have been implemented. [1]

Sustainable safety engineering measures in The Netherlands: The aim of the Dutch *Sustainable Safety* policy is to re-engineer and manage the road network to provide compatibility between road functions, speed limits and road layouts in order towards safe use and a substantially reduction in crash deaths and injuries. The Start-up Program of *Sustainable Safety* in 1998 was primarily targeted at safer infrastructure. Between 1998-2007 nearly all road authorities drew up a plan to re-classify their roads into *Sustainable Safety* categories. Large reductions in crash deaths were achieved on newly classified 30km/h and 60km/h roads in the period 1998-2008.[2] The introduction of 30km/h zones led to a 10% reduction in deaths per km road length and 60% fewer in-patients per km of road.[3] Between 1998-2008, more than 2,300 roundabouts were constructed and those provided between 1999 and 2005 resulted in a 76% reduction in deaths and a 46% reduction in serious injuries.[2] A Norwegian meta-analysis of studies on roundabouts at cross roads indicates a benefit to cost of 2.50 and of 2.00 at T junctions.[4]

Targeting the road network in New Zealand: In New Zealand nearly 90% of the social costs of road crashes are incurred on just 20% of the total network. *Safe Roads* are a key target of New Zealand's *Safe System* strategy and targeting key urban arterial roads and key rural State corridors with effective engineering and enforcement treatments to 2020 has been identified as addressing up to 13% of the network and 60% of the social cost of crashes.[5]

- [1] *Lie A: 2+1 - Roads with Cable Barrier -a Swedish Success Story, 2010;* [2] *SWOV, Sustainable Safety effects, 2009, Leidschendam;* [3] *Wegman, F.C.M., Dijkstra, A., Schermers, G. & Van Vliet, P. (2005). Sustainable safety in the Netherlands; Evaluation of a national Road Safety Programme. 85th Annual Meeting TRB, Washington DC;* [4] Elvik, R., Vaa, T., Høye, A., Erke, A. & Sorensen, M,2009. *The handbook of road safety measures,2nd revised edition*. Amsterdam: Elsevier;[5] *Bliss and Breen 2012, Unpublished World Bank safety resource paper*

Securing compliance with key safety rules

This is achieved by combination of high-visibility, data-led police enforcement combined with social marketing and associated publicity giving quick results for the short-term and high expectations of in-vehicle technologies for the longer term (e.g. seat belt reminders (already widely fitted), alcolocks and intelligent speed adaptation). The benefits to cost of this activity have been widely researched and are substantial. For example, in New Zealand, high-visibility safety policing to reduce drinking and driving, speeding and increase seat belt use led to a substantial reduction of road trauma with benefits to cost estimated within the range of 8:1 – 13:1.[62] In Great Britain in 2004, speed camera operations at more than 4,000 sites prevented some 3,600 personal injury collisions, saving around 1,000 people from being killed or seriously injured with a benefit to cost

[62] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

ratio of 2.3.[63] Good practice guidelines to assist the preparation of these interventions for projects and programmes in developing countries have been produced in a partnership of the leading international agencies.[64,65,66,67]

Box 7: Capacity building with the Jamaica Police – Establishment of the Traffic Accident Analysis Unit

The Traffic Accident Analysis Unit was established by the Jamaica Constabulary Force in 2003 with capacity-building support from DIFD. This marked the beginning of data-led road policing in Jamaica which over the next 8 years saw more than a three-fold increases in enforcement activity of key traffic rules (from around 200,000 ticketed offences to 540,000) with combined publicity. Between 2003-2011 a national 20% reduction in road traffic deaths was achieved.

3.4.2 Entry and exit of vehicles and drivers to and from the road network

These comprise the fundamental needs of licensing, type approval, testing standards for vehicles and compliance regimes as well as the removal of unfit vehicles from the network. Research and experience shows that improving the safety quality of the vehicle fleet is an effective and efficient means of securing large reductions in deaths and serious injuries.[68]

Box 8: Improving vehicle safety

Research shows that improvements to the vehicle can make a large and efficient contribution to reducing death and serious injury in road crashes., For example, a study of road safety in Sweden, United Kingdom and The Netherlands attributed a 20% reduction of fatalities in road crashes in these countries between 1980-2000 to vehicle safety improvements[1]. In the United Kingdom for an estimated overall 25% reduction in fatalities and serious injuries for the years 2000 – 2010 the largest gains were produced from vehicle safety (around 40%), road safety engineering (around 36%) and additional measures for speed reduction (around 24%).[1]

Since the late 1990s more significant casualty reduction benefits have been achieved through improvements in car occupant safety due to a combination of legislation, individual car manufacturing initiatives and New Car Assessment Programs (NCAPs) which are playing a key role in encouraging improvements in in-car safety around the world.. e.g. Euro NCAP, Australasian NCAP, US NCAP, Japan NCAP, Korean NCAP (South Korea), China NCAP and Latin NCAP. A new Global NCAP organisation was announced in June 2011 Research indicates that 5-star rated Euro NCAP cars have a 68% lower risk of fatal injury and a 23% lower risk of serious injury compared to 2-star rated cars.[1] Increasing economic growth resulting in very rapid increases in new-car registrations in populous, emerging economies such as China and India creates.

Similarly licensing and testing standards for driving and riding and penalty systems can influence road safety outcomes. Driver standards are a major concern of agencies in low

[63] Allsop RE, *The effectiveness of speed cameras: A review of the evidence*, RAC Foundation November 2010
[64] World Health Organization (2006). *Helmets: a road safety manual for decision-makers and practitioners*, Geneva
[65] Global Road Safety Partnership (2007). *Drinking and driving: a road safety manual for decision-makers and practitioners,*Geneva.
[66]Global Road Safety Partnership (2008). *Speed Management: a road safety manual for decision-makers and practitioners*,Geneva.
[67] FIA Foundation for the Automobile and Society (2008).*Seat-belts and child restraints: a road safety manual for decision-makers and practitioners*, London.
[68] Broughton J, Allsop RE, Lynam DA and McMahon CM (2000), *The numerical context for setting national casualty reduction targets* TRL 382, Crowthorne.

and middle income countries where unsafe road user behaviour is evident as a result of the low quality of licensing standards, weak enforcement of key safety rules and the absence of self-explaining road environments. Whereas, the evidence is thin for the casualty reduction value of driver training, graduated driver licensing schemes (which aim to manage exposure to especially high risk during the first years of driving or riding through specific measures) have been to shown to reduce road crashes in a range of studies by up to 30%.[69] [70]

Box 9: Graduated driver licensing

A graduated driver licensing scheme was introduced in Victoria, Australia.

Main provisions:

- A minimum 12 month learner period and 120 hours of on-road supervised driving experience for the under 21s
- A new and more challenging on-road driving test to get a probationary licence
- an increase of the probationary period from three to four years for those aged under 21 years
- A ban on mobile phone use by learner and P1 drivers P1 drivers limited to one peer passenger (16 to 21 years)
- An extension of the zero blood alcohol limit from three to four years.
- new probationary prohibited vehicle restrictions
- Re-licensed drink drivers aged up to 26 years or on P plates must drive a vehicle fitted with an alcohol ignition interlock to prevent re-offending, and a range of educational support measures.

Main results:

- 23% fewer first-year drivers (18-20 years) involved in casualty crashes
- 31% fewer first-year drivers (18-20 years) involved in fatal and serious injury crashes
- 57% reduction in first year drivers involved in casualty crashes while carrying two or more peer passengers, with a corresponding 58% reduction for involvements in fatal and serious injury crashes,
- The estimated impact of the enhanced GLS for first and second year drivers translates to 7 fewer deaths, 100 fewer serious injuries, and 268 fewer minor injuries per annum.
- The overall estimated savings derived from the interim evaluation are $39 million per annum.

3.4.3 Recovery and rehabilitation of victims from the road network

The appropriate management of road casualties following a crash is a crucial determinant of the chance and quality of survival. Effective post-crash care reduces the consequences of injury by efficient emergency notification, fast transport of qualified medical personnel, correct diagnosis at the scene, stabilization of the patient, prompt transport to point of treatment, quality emergency room and trauma care, and rehabilitation services.[71,72] The quicker the patient has access to the emergency medical system, the greater are the chances of surviving and making a full recovery. Research indicates that reducing the time

[69] Mayhew D (2000) *The effectiveness of graduated driver licensing. In* Road Safety Research, Policing & Education Conference, 26-28 November 2000, Brisbane, Queensland.
[70] David Healy D and Catchpole J,(2012) *Victoria's Graduated Licensing System Evaluation Interim Report* Warren Harrison, Eastern Professional Services, February 2012
[71] Sasser S, Varghese, M., Kellermann, A., Lormand, J.D. (2005),*Pre-hospital trauma care systems,* WHO, Geneva.
[72] Mock C, Lormand, J.D., Goosen, J., Hoshipura, M., Peden, M. , (2004) *Essential trauma care guidelines*, WHO, Geneva.

between crash occurrence and the arrival of emergency medical services from 25 to 15

Box 10: First responder training in Ghana [1 1]

In Ghana the majority if injured persons are transported to hospital by some type of commercial vehicle such as taxi or bus. A study was carried out of 335 commercial drivers trained in a six-hour basic first aid course costing US 3$ per participant. In follow up interviews with 71 drivers 11 months after the course, 61% indicated that they had provided first aid since taking the course with considerable improvement in the provision of key first aid components compared to what reported before the course. The study concluded that even in the absence of a formal emergency medical system, improvements in the process of pre-hospital care are possible by building on existing, although informal pre-hospital transportation.

First aid component	*Before*	*After*
Crash scene management	7	35
Airway management	2	35
Bleeding control	4	42
Splint application	1	16
Crash scene management	7	21

minutes could reduce deaths by one third.[73]

3.5 Well-orchestrated coordination

The sheer scope of the road safety task illustrated above requires meaningful institutional leadership, collaboration and capacity within Government amongst the key partners – transport, roads, police, health, planning and education agencies – as well as engagement with key partners in the business sector and civil society to achieve country goals. The non governmental organisation (NGO) sector can play a key role is advocacy and promotion of evidence based and equitable intervention and networks have been established in support of this. Good practice activity is well-documented [For examples see 74,] At the same time, in some low and middle-income countries, national road safety councils have been established as coordinating bodies (and often with NGO status) with a leadership function, but without a lead governmental road safety agency to support them. Without adequate funding, technical resources and an authoritative governmental lead agency in support, country capacity reviews confirm that this coordinating model has little chance of success.[75]

3.6 Securing sustainable funding

Long-term funding commitments sustained over decades and use of rational resource allocation tools are essential features of road safety management systems in successful practice. Various mechanisms for securing and allocating public sector road safety investment funds can be identified, but there are no preferred models for this (see Box 12 for some examples of country funding). Significant private sector support for proven road safety engineering treatments can also be forthcoming from sectors such as the insurance industry, where business cases are strong. The role of international development funding is mentioned in Sections 2.5 and 5.

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[73] Sánchez-Mangas R,García-Ferrer A, de Juan A, Arroyo A M (2010). *The probability of death in road traffic accidents. How important is a quick medical response?* Accident Analysis and Prevention 42 (2010) 1048

[74] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E, Mathers C (2004). *World Report on Road Traffic Injury Prevention*, World Health Organization and World Bank (Washington), Geneva

[75] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

3.7 Delivery of other key management functions

Other key management functions include providing capacity for developing legislation which meets the road safety task, periodic review; robust monitoring and evaluation of safety outcomes (See Box 13) and outputs and independent peer review and well-supported research and development and knowledge transfer. Recent reviews of good international practice in the delivery of these functions can be found in World Bank and OECD country guidance.[76, 77]

Box 11: Safety funding and resource allocation

Box reproduced from unpublished World Bank Resource Paper.BlissT and J Breen, December 2011
Source: Bliss and Breen 2009

In good practice countries the lead agency takes responsibility for securing access to sustainable, annual funding for the road safety program sourced in the main from public sector taxes, levies and charges, and distributed to strategic partners in government budgets. Taxes and levies can also be earmarked for road safety purposes, with specific funds being created to receive and allocate the revenues collected, and road funds can include safety investments in their investment programs.

Earmarked funding for Safe System road safety engineering: Road safety in Sweden is mostly funded by government and through general revenue distributed to the lead agency – now the Swedish Transport Administration (STA) – and other sectors. In 1999 funding to the lead agency was doubled with a total of SEK 8.5 billion ($US 1.25 billion) to be made available for road safety over 10 years. An increased and earmarked allocation was made to allow resources for physical road safety measures such as roads with median guardrails, safer intersections and safer road shoulders.

Earmarked taxes and insurance levies: Some taxes can be earmarked (or hypothecated) for a specific purpose. For example, fines income from speed cameras have been earmarked for road safety interventions at hazardous locations in the UK resulting in a large, successful rollout of cameras and significant casualty reductions. Australia and New Zealand impose a levy on motorcycles to fund engineering treatments at high-risk sites and other countries such as Finland levy a fee on vehicle insurance premiums to help fund road safety programs.

Road funds and road safety funds: There are some good practice examples of road funds being used to finance road safety investments. In New Zealand the road fund finances the national road safety enforcement programmed, national road safety education, national publicity and awareness campaigns, national strategy management and coordination processes, national and local low-cost safety engineering measures, and general road network investments that contribute to improved road safety outcomes. It also matches local government funding for road safety initiatives. Sources of revenue for the fund include a fuel excise duty; axle weight-distance charges paid by diesel vehicles; motor vehicle registration fees; interest earned on the road fund account; and revenues earned from sale of surplus state highway property. By subjecting all road safety interventions to benefit/cost analysis, the system also encourages an objective approach to the various factors that contribute to the delivery of a safe, efficient network. As in other Australian jurisdictions, road safety funding in Western Australia is predominantly secured at State rather than Federal levels. In addition to agency funding streams, the Office of Road Safety manages the funding of road safety programmes through its administration of the Road Trauma Trust Fund (RTTF) which receives 100% of revenue from penalties imposed on motorists for offences detected by the state's speed and red light cameras…

[76] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC
[77] OECD (2008) *Towards Zero: Ambitious road safety targets and the Safe System approach*, OECD, Paris

Box 11: Continued

… The program is overseen by the State road safety coordination body and provides a transparent mechanism for funding multi-sectoral road safety activities.

Resource allocation frameworks: A rational framework for resource allocation based on cost-effectiveness and cost-benefit analysis using willingness to pay measures for establishing the value of a statistical life (VOSL) to ensure lives saved and injuries avoided are properly accounted for is also evident in good practice countries, to allow strong and objective business cases to be put forward for road safety funding.

Box 12: Monitoring and evaluation – overview of good practice [86]

Function: *Monitoring and evaluation* concerns the systematic and ongoing measurement of road safety outputs and outcomes (intermediate and final) and the evaluation of interventions to achieve the desired focus on results.

Dimensions:

- • Establishing and supporting data systems to set and monitor final and intermediate outcomes and output targets.
- • Ensuring transparent review of the national road safety strategy in terms of results, interventions and institutional management functions.
- • Making any necessary adjustments to interventions and institutional outputs needed to achieve the desired result
-

The effective monitoring and updating of project and programme targets requires appropriate management structures, systems and procedures for the collection, processing and publication of reliable data. The establishment and sustainable funding of transport registries for drivers and vehicles, crash injury databases and periodic survey work to establish performance and exposure data engages the transport, police, and health sectors (and in some countries the governmental insurer) as well as independent scientific expertise to ensure a transparent measurement process.

4 Building management capacity

Country road safety management capacity weaknesses identified in a wide range if reviews carried out by international development agencies present a formidable barrier to progress and institutional management functions require strengthening. A clearly defined focus on results is often absent. This reflects the lack of leadership of a targeted strategy that is owned by the government and relevant agencies, with responsibilities and accountabilities for its achievement being clearly specified and accepted. As a consequence coordination arrangements can be ineffective, supporting legislation fragmented, funding insufficient and poorly targeted, promotional efforts narrowly directed, monitoring and evaluation systems ill-developed, and knowledge transfer limited. Country road safety management capacity weaknesses must be systematically addressed as an urgent priority if sustainable success is to be evident over the coming decade. Otherwise road safety results in low and middle-income countries will continue to deteriorate in the face of rapid motorization and scaled-up road infrastructure provision.[69]

There has been a tendency for past technical assistance support provided to low and middle-income countries to prepare national action plans which simply detail the interventions that should be made to reduce road deaths and injuries with little consideration given to the institutional capacity and funding needed to deliver them. Such a response is neither appropriate nor effective.

Based on reviews of successful as well as unsuccessful practice, the World Bank's Global Road Safety Facility has produced a country investment model in road safety management guidelines designed to assist low and middle income countries and development aid agencies in addressing these issues.[78] These guidelines acknowledge that low income countries cannot expect to develop all the road safety management arrangements evident in the best performing countries overnight. The critical issue for road safety development is how countries go from weak to stronger capacity to allow implementation of measures which will achieve sustainable results. The guidelines provide a pragmatic approach and a tool designed to overcome widely identified country capacity barriers outlined above and to take account of the learning and absorptive capacity of the country concerned. They specify a phased management and investment framework (see Boxes 14-15) towards sustainable scale-up of country investment preceded by the conduct of a road safety management capacity review which addresses all elements of the management systems and their linkages. For each element of the road safety management system (See Annex A) a pathway from weak to strong capacity can be shaped in accordance with the establishment, growth and consolidation phases of the investment strategy (See Box 8).

Box 13: Sequencing of investments in establishment, growth and consolidation phases of a long-term investment strategy

System element	Capacity strengthening phase and examples of priority initiatives		
	Establishment	Growth	Consolidation
Results	▪ Set quantitative performance targets for demonstration corridors and areas	▪ Set quantitative national targets	▪ Devolve national targets to regions, provinces and districts
Interventions	▪ Implement comprehensive multi-sectoral measures in targeted high crash-density demonstration corridors and urban areas ▪ Review and internationally benchmark selected safety policies and interventions, and commence implementation of reforms	▪ Roll-out multi-sectoral measures across high crash-density corridors and urban areas of total road network ▪ Implement ongoing reforms of safety policies and interventions, and introduce new measures in accordance with international good practice	▪ Sustain comprehensive multi-sectoral measures across total road network and extend targeting to less risky roads. ▪ Review and internationally benchmark safety policies and interventions, and implement reforms.

[78] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC

Box 13: Continued

Institutional management functions	▪ Establish lead agency role and functions and related coordination arrangements ▪ Manage, monitor and evaluate road safety results in high crash-density demonstration corridors and areas ▪ Review and internationally benchmark institutional management functions, and commence implementation of reforms ▪ Commission building or upgrading of national crash analysis system	▪ Strengthen and refocus lead agency role and functions and related coordination arrangements ▪ Manage, monitor and evaluate road safety results across high crash-density corridors and urban areas of total road network ▪ Implement ongoing reforms of institutional management functions ▪ Disseminate safety performance data from national crash analysis system and ensure open access to system by all partners and stakeholders.	▪ Review and reform lead agency role and functions and related coordination arrangements ▪ Extend performance monitoring and evaluation of safety results to less risky roads in network. ▪ Review and reform institutional management functions ▪ Upgrade national crash analysis system and extend performance monitoring capabilities.

Box 14 Establishment Phase steps: World Bank Road Safety Management Guidelines (2009)

Step 1: Conduct country road safety management capacity review to seek consensus of key partners on strengths and weaknesses of the management system including assessment of leadership arrangements; specify a long-term investment strategy and identify *Safe System* projects to launch the strategy.

Step 2: Prepare and implement multi-sectoral *Safe System* demonstration programs/ projects which adopt a 'learning by doing approach'. The aim is to achieve rapid knowledge transfer about leadership and partnership working to implement effective effective interventions and measuring, targeting and monitoring outcomes and outputs and rapid results.

The World Bank's recent shift to *Safe System* road safety projects represents a significant change from previous approaches.[79,80] Current road safety investment aims to anchor country capacity building efforts in systematic, measurable and accountable investment programs that simultaneously accelerate the transfer of road safety knowledge, strengthen the capacity of participating Governmental partners and stakeholders and rapidly produce results in targeted high-risk corridors and areas to provide benchmarks and dimensions for the next stage of investment. [81]

[79] Bliss T (2004). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention,* Transport Note No. TN-1, World Bank, Washington DC.
[80] World Bank Global Road Safety Facility (2009). *Strategic Plan 2006–2015*. The World Bank, Washington DC
[81] Bliss T and Breen J (2012).*Meeting the management challenges of the Decade of Action for Road Safety*, IATSS Research 35, 48–55

Box 15: Argentinian World Bank Road Safety Project

The project was prepared in collaboration with the transport and health sectors and aims to reinforce the central role of a newly created lead agency in Argentina, to enable it to effectively and efficiently deliver its institutional management functions and build and strengthen its leadership and partnership capacity in the process. A two-stage output-based investment process finances institutional capacity strengthening priorities such as improved data management and monitoring and evaluation systems, targeted multi-sectoral interventions in high-risk corridors, and policy reforms where weaknesses have been identified. The project includes an incentive fund designed to attract participation by community-based organizations and municipalities. It also benefits from international peer-to-peer partnerships facilitated by the World Bank Global Road Safety Facility which have engaged the International Road Assessment Programme (iRAP) for project corridor safety surveys and the specification of infrastructure safety improvements, the International Road Traffic Accident Database (IRTAD) Group and the transport and health Ministries from Spain for support with road safety database establishment and management, and the International Road Policing Organization (RoadPOL) for support with the management and delivery of effective general deterrence road policing in the project corridors.

Source: World Bank, 2011

Strengthened institutions and the accelerated knowledge creation and transfer central to this, plus scaled-up investment and increased international cooperation and development aid will be critical in addressing the Decade of Action's goal and related plan. Without this, ill-prepared low and middle-income countries are unlikely to manage the unprecedented scale and scope of the crisis they face.[82]

5. Priority actions for DFID

At global level better harmonisation of activities and more partnership opportunities between international and national development organisations are now needed that can combine and leverage the effective weight of resources being mobilized and enhance their likelihood of achieving measurable results.[69] The leading edge investment approach and related tools now being used by the World Bank and the new partnerships being formed by the MDBs provide a timely global focus towards this end The4 Joint Statement of the Multilateral Development Banks (MDBs) in 2009.[83,84] commits the MDBs to a shared approach to ensure systematic approaches to managing road safety outcomes and building capacity; to mobilize resource; and to "*ensure that safety is integrated in all phases of planning, design, construction, appraisal, operation and maintenance of road infrastructure particularly to*

[82] Bliss T and Breen J (2012).*Meeting the management challenges of the Decade of Action for Road Safety*, IATSS Research 35, 48–55

[83] Media Release (2009). *A Shared Approach to Road Safety Management. Joint Statement by the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, Islamic Development Bank and the World Bank,* World Bank, Washington DC.

[84] Media Release (2011). *Multilateral Development Bank Road Safety Initiative,* World Bank and Inter-American Development Bank, Washington DC

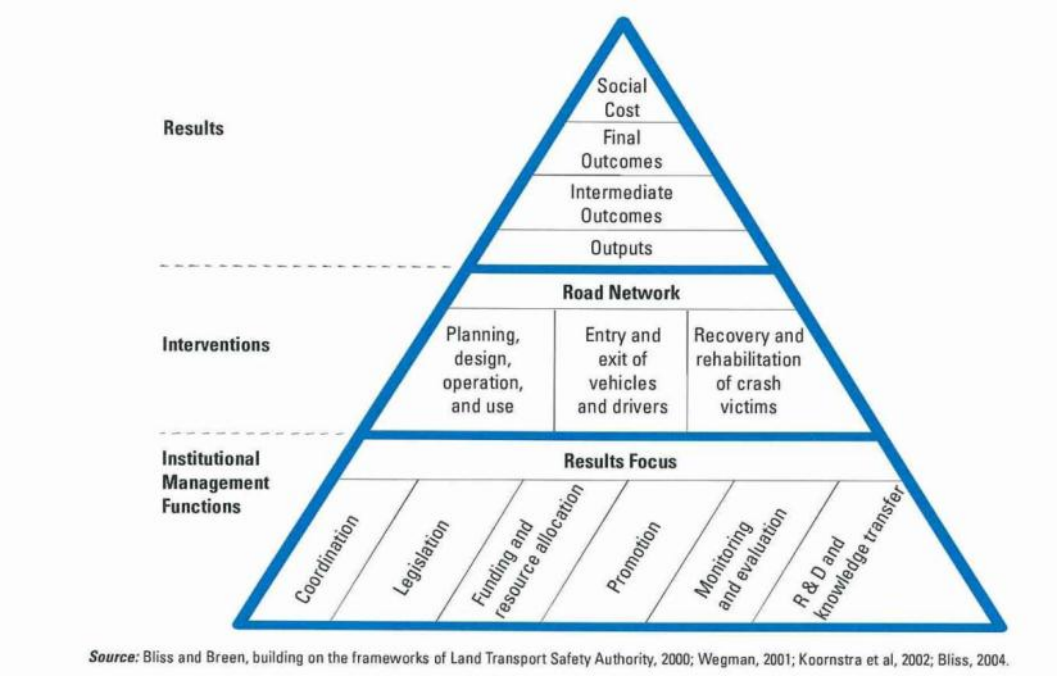
improve safe access and protection for vulnerable road users who represent a significant proportion of the people served by the projects we finance".

The scale of the road safety crisis has led the UN, international agencies and leading nations to view road safety as an international development priority. DiFD has been an important global partner in road safety with active assistance in many countries and in knowledge transfer. The UK, as a signatory to the UN Resolution on the Decade of Action and a global leader in road safety, is being encouraged by Parliament and non-governmental organisations to increase its investment, particularly in road safety capacity building.[85] DiFD can make an important contribution through specific support and encouragement of MDB road safety initiatives (65% of DFID funding to the road sector is delivered through the MDBs).as well as for new, directly-funded capacity building initiatives utilising the new approaches to road safety investment highlighted earlier, as well as twinning arrangements.

[85] International Development Committee (2011) Ninth Report, *DFID's Role in Building Infrastructure in Developing Countries* - House of Commons.

Annex 1: The road safety management system

Road safety management can be viewed as a production process with three inter-related elements: *institutional management functions* that produce *interventions* that in turn produce *results*. Close attention must be paid to all these elements and their linkages as the limits to improving country road safety performance are shaped by their inherent weaknesses and vice versa.[86]



Source: Bliss and Breen, building on the frameworks of Land Transport Safety Authority, 2000; Wegman, 2001; Koornstra et al, 2002; Bliss, 2004.

This systemic management framework derives from New Zealand's 2010 target setting model that linked desired results with interventions and related institutional implementation arrangements.[87] Elements of this model were adopted by the European Transport Safety Council which highlighted the specification of results measures[88]; which were further elaborated by the SUNflower Project that defined implementation arrangements in terms of 'structure and culture'[89]; and then further extended by the World Bank prototype guidelines which identified key management functions including lead agency and related coordination arrangements on the basis of international best practice as well as the conduct or road safety management capacity reviews.[90]

[86] Bliss T and Breen J (2009). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects,* World Bank Global Road Safety Facility, Washington DC.

[87] Land Transport Safety Authority (2000), *Road Safety Strategy 2010: A Consultation Document*. National Road Safety Committee, Land Transport Safety Authority, Wellington.

[88] Wegman Fred, (2001). *Transport safety performance indicators*. Brussels, European Transport Safety Council.

[89] Koornstra M., D. Lynam, G. Nilsson, P. Noordzij, H-E. Pettersson, F. Wegman and P. Wouters (2002). *SUNFlower: A comparative study of the development of road safety in Sweden, the United* Kingdom *and the Netherlands*, SWOV, Dutch Institute for Road Safety Research, Leidschendam. Available on the Internet: http://www.swov.nl/rapport/Sunflower.pdf

[90] Bliss T (2004). *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention*, Transport Note No. TN-1, World Bank, Washington DC.

Review 08

Corruption and transparency

By Jill Wells and Nina Neeteson

1. Introduction

This paper aims to provide a useful outline of what evidence is available about corruption and transparency in the provision of infrastructure in developing countries and to provide guidance for policy-makers trying to tackle the issue. It falls short of the rigour of a systematic review due to time and resource constraints and the huge scope of the subject. The research has been structured to cover two key concerns: 1) What are the risks and impacts of corruption in infrastructure provision and 2) what policy responses, such as transparency, are available to address the problem.

We understand *infrastructure* to be the basic physical structures and facilities (e.g. buildings, roads, power supplies) needed for economic and social activities and the provision of *services. Utilities* are the set of services provided by public or private organizations for general consumption - such as electricity, gas, telecommunications, water and sewage. The distinction between the construction of infrastructure and service delivery is important as (despite some areas of overlap) it points to two separate arenas of action, each with its own set of organisational frameworks and actors and opportunities for corruption. This report focuses on infrastructure construction – the provision of the hardware – as opposed to

service delivery. We will use the concept of the infrastructure project life-cycle to draw out the risks and opportunities apparent at each stage. We also include reference to some macro-level studies that establish a link between corruption and service delivery and we briefly examine the relationship between corruption and the privatisation of utilities.
We understand *corruption* as the deliberate misuse of power for private, institutional or political gain. Acts of corruption include bribery, extortion, fraud, embezzlement, influence peddling, deception and nepotism. The definition has been kept deliberately broad, focusing on the intent of behaviour more than its specific content. The issue of motive is important as it distinguishes deliberate deception from mere mismanagement. However in practice it is very difficult to disentangle the two. This difficulty is highlighted in several reports on the pilot phase of the DFID/World Bank Construction Sector Transparency initiative (CoST).[1] While the initiative uncovered many instances of concern in project delivery (including high prices, inappropriate design, poor quality and significant time delays) it concluded that a detailed investigation by experts would be needed to attribute the cause to corruption, as opposed to poor management or negligence (CoST 2011c).

The paper is divided into three major sections. In section II we review the nature of the evidence on corruption in infrastructure. Section III provides evidence on the major corruption risks in the sector, separating them into macro and micro studies. Section IV surveys the available evidence on policy responses.

2. Nature of the evidence

This section outlines the different types of evidence that are available for study, and briefly discusses the particular strengths and weaknesses that must be considered in their application.

Firstly, indicators that measure the perception of corruption are widely used as international benchmarks, but severely limited in their accuracy. Examples are TI's Corruption Perceptions Index (CPI), WBI's Control of Corruption Index (CCI), and Global Integrity's Public Integrity Index (PII). These indices are generally based on assessments by experts and are unreliable as a guide to the actual level of corrupt behaviour taking place in a country. They also tell us nothing about the causes or impacts of corruption and are therefore not useful for policy making. They mostly focus on corruption at country (rather than sector) level and on the formal and multinational business sector rather than households or informal businesses (see Kenny (2006) for summary of major problems and Olken (2009) for more in-depth analysis from Indonesia).

Surveys are somewhat better. They can provide direct evidence of the experience of corruption by households, individuals and enterprises. Examples are the World Bank's Business Enterprises Surveys (WBES), the Business Environment and Enterprise Performance Surveys (BEEPS) which cover transition countries, and the WBI's household Global Corruption Diagnostic Surveys (GCDS).

But survey evidence also has limitations. The unit of analysis is generally the country and the evidence does not tell us very much about the sector-specificity of corruption and the various forms of corruption that exist in the industry. Kenny (2006, 2009) found no significant correlation between estimates of corruption across all sectors and in construction. Ladbury

[1] CoST seeks to raise the level of transparency in the delivery of publicly funded construction projects through the disclosure of project information to the public. It was piloted over a three year period in seven countries – Ethiopia, Malawi, the Philippines, Tanzania, UK, Vietnam and Zambia - and later in Guatemala as an associate country. All documents can be downloaded from the CoST website: www.constructiontransparency.org

(2003) argues that the standards by which activity is deemed as 'corrupt' seem to be more specific to the construction industry than to the country.

Both perceptions indices and surveys generally only reveal bribe payments – and this not always accurately. Most often captured are payments on the part of households or businesses for connections to various services – known as 'petty corruption'. Surveys rarely capture large scale illegal payments by companies to win bids (OPM 2007). Kenny (2009) points out that bribery alone is insufficient to explain the low rates of return on investments in SSA. Other types of corruption elsewhere in the project cycle must evidently be more

harmful to economic outcomes. We attempted to gather some of the evidence that exists on the forms and consequences of corruption at various stages of the project cycle and present this in section 111B, but found the evidence is minimal.

About corruption in private infrastructure we know even less. Utility providers are generally not included in surveys because they are too few in number to be sampled. Public expenditure tracking surveys (PETS) can provide information on the diversion of funds in relation to specific services but they are dependent on the quality of administrative records which are often extremely poor. Such surveys have been undertaken in Ethiopia, Kenya and South Africa (among other countries). Jaćimović and Fonseca (2012) provide a very helpful summary of these and similar initiatives.

There are, however, a large and increasing number of studies that use econometric analysis to estimate the total economic cost of corruption or to establish a link between some measure of corruption/governance and service delivery outcomes (price, access, reliability etc.). A selection of these is reviewed in Section 111 A. These studies are generally cross country comparisons at one point in time, as opposed to measuring changes in corruption and performance over time. While they may suggest that a reduction in corruption would improve economic performance, they do not establish the causal link to conclude that a reduction in corruption would be followed by an improvement in economic performance (OPM 2007).

The best evidence we have found to suggest what kind of intervention would reduce corruption is a systematic review of evidence on the effectiveness of anti-corruption policy - what has worked, what hasn't and what we don't know (Hanna et.al. 2011). Although not focused on infrastructure the review did include an observational/econometric study of utilities in India (Asthana 2008), a quasi-experimental study in the water sector in Indonesia (Chavis 2010) and one randomised control trial in the roads sector in Indonesia, which also tested the efficacy of two different solutions to the problem of corruption (Olken 2007). These are reviewed in Section 1V.

A second and only recently available systematic review has been read with interest but appears to be less useful for our current purpose because of the proxies used for transparency which include privatisation, regulation, decentralisation (Thillairajan et.al.2012). However, as these proxies for transparency are some of the suggested interventions to address corruption, the study does provide very useful evidence of the efficacy of such interventions. It will doubtless be reviewed by others in the infrastructure sector studies that are a part of this evidence review. It is briefly reviewed under the 'transparency' heading in section IV.

We have attempted to grade the different bodies of evidence reviewed in the paper as 'strong', 'suggestive, and 'weak' as per the criteria used in the WASH study:

- Strong evidence: several good quality studies that consistently show an effect. For example, randomised trials with a low risk of bias or observational studies showing a large effect size with a low potential for confounding causality.

- Suggestive evidence: studies which show an effect but statistical support is weak due to insufficient study size or lack of experimental evidence. Or, studies which show significant effects but there is a risk of bias and confounding.

- Weak evidence: no studies have been done or, where they been done, they have shown inconclusive results.

The macro level evidence on corruption risks (Section 111A) is generally strong with many large scale studies (only a few of which have been included) demonstrating a link between corruption, infrastructure performance and economic growth. However, the nature of the evidence available on the causes, forms and impacts of corruption at various stages of the infrastructure project cycle (Section 111B) is very limited in scope and reliability. Most are empirical analyses based on country specific or even community level case studies which we would put into the 'suggestive' category.

The evidence on policy responses (Section IV) is also mostly suggestive with mixed results. Transparency was indicative of this, thus there is less emphasis on it as a policy response than had been anticipated. The only strong evidence would seem to be on 'monitoring and incentives' which is the major finding emerging from a DFID systematic review.

3. Risks and impacts of Corruption in Infrastructure

The construction sector (which provides the hardware for infrastructure services) is widely reported as one of the most corrupt. It repeatedly tops the charts of Transparency International's Bribe Payer's Index, perceived as the sector most likely to engage in bribery (Hardoon and Heinrich, 2011). A survey of business leaders in six developed countries carried out by Control Risks Group in 2002 found the construction sector to be the most corrupt (Control Risks 2002, cited by Stansbury 2005).

The nature of the industry and the manner in which infrastructure services are operated exposes construction to structural vulnerabilities which encourage corruption. (Rodriguez et. al., 2005) Stansbury (2005) outlines thirteen features of construction projects that make them particularly prone to corruption. These include: size, uniqueness, complexity, the length and phasing of projects and the number of contractual links. The unique design of individual projects and contracts renders oversight of cost and quality extremely problematic, and precludes the use of standard benchmarks for comparison. This is further obscured by the way projects are structured, through various phases and contractual links that disperse accountability among numerous contractors and subcontractors of different trades. The actors have to comply with various control mechanisms the purpose of which is to ensure accountability. Where the control mechanisms are weak, or have broken down, an environment is created where poor management practices and corruption can thrive (CoST 2011c). [2]

In addition, the importance of the sector as a provider of public goods exposes it to the misuse of immense investment and power emanating from government involvement. Government spending accounted for 78 percent of infrastructure investment worldwide from

[2] The role of control mechanisms as tools against corruption is included in section IV.1

1984 to 2003, leaving ample opportunity for rent-seeking and the interference of vested interest (Kenny, 2007).

A. Macro-level Analysis

The negative impact of corruption on economic growth, infrastructure service delivery and other outcome measures is revealed by several large scale econometric studies, a small number of which are reviewed below. These studies were selected because they specifically included a measure of corruption as a variable. However, the unreliable proxies used to measure corruption are a weakness.

One seminal study that examined the damaging effect of corruption on economic growth in the realm of service delivery is Estache and Kouassi (2002). The authors examined the link between performance and corruption levels among 21 water utility companies in Africa,

using the most efficient company as a benchmark standard. They concluded that the average increase in efficiency gained from operating in a non-corrupt environment would be 64 percent. This suggests that corruption plays an important role in price inflation, and therefore presents a significant obstacle to increased access by the poor to clean water.

Dal Bo and Rossi (2004) carried out an extensive analysis of utility companies in 12 Latin American countries to explore the relationship between corruption and performance in service delivery. The study confirmed that higher levels of corruption are associated with reduced labour productivity and inflated operation and maintenance costs, thereby impeding performance. The evidence is good and statistically sound, although the usual caveat about trusting measures of corruption based on perception indices applies.

In a study of investment in telephone networks and electricity generation in more than 100 countries over the course of a century, Henisz (2002) finds that corruption has a substantial and significant impact. Specifically, he concludes that infrastructure in Africa and Asia would have developed at a much quicker pace and to higher standards had corruption not been an inhibiting factor. The proxy used to measure corruption is based on the assessed capacity of governments to constrain corruption rather than the actual occurrence of corrupt behaviour.

A further study of the relation between infrastructure performance and corruption levels was carried out by Kaufmann et. al. (2004), this time using data at city rather than country level. Measures of corruption used included volume of bribery payments, extent of state capture in the regulatory process, and degree of corruption control. The study found that each measure has a substantial and significant impact in reducing access to services and diminishing the quality of service delivery. The evidence is good and corresponds with the findings of country-level analysis, although it should be noted that the measures of corruption are subjective and do not lend themselves to cross-referencing with other studies.

Del Monte and Papagni (2001) compared infrastructure investment, economic growth and measures of corruption in their analysis of 20 regions in Italy. As expected, infrastructure investment was found to have a positive impact on growth rates, while high levels of corruption corresponded with low growth rates. The study confirms the hypothesis that corruption negates the positive contribution of infrastructure investment to economic growth rates. Although the study is somewhat outdated now, it provides good evidence from a robust data set.

However, while macro-level data is useful to illustrate that corruption is a major issue which merits attention, it does little to explain how and why corruption actually occurs, or who the major actors and victims are. For this insight, we need to rely on qualitative micro-level evidence, as outlined below.

B. Micro-level Analysis

A sound basis for understanding corruption at the micro level comes from a series of papers written by Charles Kenny while at the World Bank. Kenny (2006, 2009a) argues that low rates of return on investments in SSA cannot be explained solely by bribe payments – which are the main forms of corruption captured by perceptions indices and surveys. More important than the size of the bribe is what the payments are made for. Payments for favours at different stages of the infrastructure project cycle (from project selection through design and construction to operation/service delivery and maintenance) will have different impacts. Using data from a large number of studies he demonstrates that the most harmful forms of corruption are (1) corruption which influences the budgeting process to divert investment towards poor projects and towards new construction at the expense of maintenance and (2) corruption involving substandard construction which shortens the life of projects and hence drastically reduces the Economic Rate of Return (ERR).

Information on these particularly harmful forms of corruption (many of which are non-financial and include lobbying) is minimal. What there is comes from detailed surveys of industry participants (including close observation and face to face interviews), which are generally small in scale. Further insights can be gained from the results of the CoST pilot project, but it is important to bear in mind that CoST is a transparency (as opposed to an anti-corruption) initiative. It is not an audit, regulatory or judicial body and the project did not set out to investigate potential instances of corruption.
We have gathered some of the evidence that exists on the forms and impacts of corruption at major stages of the project life-cycle and present this below.

3.1 Project selection

The risks involved in selecting and prioritising projects include political influence or lobbying by private firms to bias selection to suit political or private interests. This can result in the approval of projects that are unnecessary (white elephants) in which case it can be argued that 100% of the investment is wasted. In certain cases, projects are conceived solely as vehicles for corruption and would not have passed the planning stage without this motivation (Stansbury 2005).

In addition, deliberate falsification of costs and over-estimation of benefits can result in the approval of projects without economic justification. In a review of 258 mega transport projects worldwide Flyvjberg (2007) found costs seriously underestimated at the time of the decision to build. Underestimation of costs averaged 45% in rail, 35% in bridges and tunnels and 20% in roads. The average for 10 developing country projects included in the sample was 64.6%. The paper shows that forecasts of passenger demand are also often overestimated. The combination of underestimated costs and overestimated demand means that selected projects often have low or even negative rates of returns. Under-estimation of costs on major construction projects is common and not necessarily associated with corruption. But the author of the above study argues that the nature and extent of the estimation errors he recorded could not be attributed solely to technical issues or poor judgement. He concluded that in many cases deception is deliberate, due to economic incentives and/or political motivation.

Infrastructure projects can also be used as vote winners rather than being selected on the basis of priority and availability of financial resources. This is particular evident prior to elections when politicians interfere to push projects which benefit their constituents, as evidenced by ‘bridges to nowhere’, or use construction projects as a major source of election funding. These two motivations (pleasing constituents by promising projects and raising funds) both appear to be evident in recent developments in Tanzania. The national roads agency (TANROADS) signed 22 major road contracts in the year prior to the general election in October 2010, without apparent funding. The projects were to be completed within 1 to 3 years, but only 6.5% of the total contract cost was included in the 10/11 budget

and only 7.8% had been paid as mobilisation advances by June 2011 (TANROADS, Annual Report 2011). Construction has also been noted as a major source of election funding in Ghana and Nigeria (Ladbury 2003).

3.2 Planning and design

During the planning and design stage, corruption can result in projects that are overdesigned or overpriced. Costly designs increase consultants' fees and contractors' profits. The practice of paying consultants on the basis of a percentage of the total cost of the asset (which is still common in many countries) creates a perverse incentive to designers to raise the specification and inflate the price and hence their fees.

Even where such financial incentives are not present, the consultant responsible for design is in a powerful position as s/he may be influenced to design a project to favour a specific

contractor's technology and contractors or clients may bribe the consultant to bring this about (Stansbury 2005). Consultants are also responsible for estimating project costs prior to tender and can provide high estimates to provide a cushion for diversion of funds. The consultant's influence is enhanced further if s/he is responsible also for managing the construction stage, where bribes paid can be recovered by variation orders, inflated claims and/or acceptance of substandard work.

Few academic studies could be found which provide evidence of corruption at the design stage. But the CoST pilot found serious concerns related to project feasibility, design and funding (26% of the total number of concerns) in all of the pilot countries except for the UK. [3] The comments of the Assurance Teams [4] in this respect related to failure to complete the design before going to tender for the works contract and/or to the poor quality of the designs (items missing, failure to survey sites etc.). More serious issues related to design (including overdesign, inflated price estimates and expensive design changes) were also noted in Ethiopia (CoST 2011a: CoST 2011d).

3.3 Tender and selection of consultants and contractors

Risks around tendering are where attention to date has largely focused and where we have most evidence. The risks include straightforward bribery, as well as other forms of coercion/collaboration between procurement officers and potential bidders to win tenders. These are the most widely known forms of corruption, but may not be the most serious.

BEEPs survey evidence suggests average payment to obtain government contracts in construction in Eastern Europe and Central Asia is 7% of contract value (Kenny 2006) Discussion with contractors in Tanzania found an average of 10-15% is paid in bribes to win the contract (TACECA 2007). Contractors in Ghana and Nigeria report they pay between 10 and 20% in bribe to win a tender, in addition to bribes to first get onto the list of approved contractors (Ladbury 2003). The most serious consequences of bribery on project costs is when the bribes paid to win a contract are recovered during contract execution through changes to the scope or specification of the project and/or the use of insufficient or substandard materials which will impact on the quality of the asset and subsequent maintenance costs. This is explained further in the following section.

[3] Ethiopian, Malawi, Philippines, Tanzania, Vietnam and Zambia. Guatemala was not included.
[4] Assurance Teams were appointed under the CoST project to verify and analyse the disclosed information, highlight 'causes for concern' and make informed judgements on cost and quality. CoST (2011a) explains the process and inherent difficulties faced.

There is also evidence of collusion whereby it is agreed to let one contractor win in return for a percentage payment or similar support on another contract. Collusion among bidders to allocate contracts is not always regarded as corruption but is often linked to corrupt officials in the procurement agency (Lambert-Mogiliansky 2011). Hard evidence from investigations into cartels comes mostly from developed countries but Davis (2004) found in interviews with 1400 staff and customers in agencies delivering WSS in south Asian localities that cartels were operating in every case. The few contractors willing to provide the information estimated that the winning bids would be 15% higher than they would have been in a competitive environment.

However, collusion to allocate tenders may not result in higher prices and may occur just because contractors wish to share out the allocation of contracts so that they can rationalise their workload. Whether or not this is the case, this form of collusion may not be as damaging as bribery or submitting an unrealistically low price – known as low-balling – to win the tender. Kenny (2009a) calculates that a 20% increase in tender price through collusive bidding will reduce ERR by only 4%, whereas a 20% decrease in spending on materials due

to the need to recover bribes paid to win the bid (or low tender price) halves the useful life of road and reduces ERR by 15%.

Often overlooked (possible because the contract sums involved are smaller) is corruption in the award of contracts with professional consultants. But the value of the consultant's contract is not significant here as consultants may collude with the contractor (with or without the cooperation of the client) to facilitate the extraction of rents from the construction contract and share in the proceeds (Mawenya 2007). This is particularly well illustrated by anecdotal evidence that came to light in one CoST pilot country, where we learned that an engineer was willing to undertake design assignments for a very low fee and to recoup substantial rewards from the contractor(s) that his designs favoured.

3.4 Construction

The biggest risk during construction is from the supervisor approving sub-standard work and/ or issuing variations to reduce the scope or increase the contract sum. This may be brought about by collusion between supervisor and contractor or by the contractor bribing or blackmailing the supervisor. Checks and balances inherent in a contract rely on each party having a distinct role: once compromised there is no one to supervise the supervisors (Ladbury2003). Industry sources indicate that collusion between consultants and contractor is common (Mawenya 2007).

Forty per cent (40%) of the 'causes for concern' reported by Assurance Teams in the CoST pilot related to the construction phase of projects (CoST 2011a). One third (31%) of concerns were about time and cost overruns. [5] But in only a few cases were the Assurance Teams prepared to say that the overruns were unjustified and this was mostly on the basis of inadequate documentation. Attributing overruns to corruption is problematic - especially so in view of the fact that the procuring entities involved seemed to pay little attention to the management of time and cost. This could be because there is often blame on both sides. For example, in Zambia poor payment practices on the part of the client were noted on 11

[5] Significant time and cost overruns were also found in the CoST baseline studies. Of the 145 projects sampled in 8 countries the average time overrun varied between 9% in the UK and 130% in Ethiopia. Cost overruns were everywhere less that the time overruns (CoST 2011b)

out of 17 projects. When public clients are not paying there is little leverage to push the contractors to complete on time (CoST 2011c). [6]

However, evidence from Tanzania suggests there may be a direct link between bribery to win a contract and lax supervision of contracts. 83% of contractors interviewed by TACECA (2007) paid bribes of 10-15% to win contracts in return for a 'conducive environment' for recovering the shortfall through delivery of substandard works. In Ghana and Nigeria supervising engineers and contractors agree to use fewer materials and split the savings (Ladbury 2003).

Davis (2004) found contractors paying additional bribes (kickbacks) during construction of between 5-11% of contract value in part to cover low quality work, with materials worth 3-5% of contract value not supplied. Kenny calculates that this means an economic cost equal to 9-20% of contract price (using Olken's estimate that a marginal dollar of materials stolen reduces discounted benefits of the road by 3.41% due to shorter life).

Bigger losses of materials and labour during local road building projects in Indonesia are reported by Olken (2007). The evidence is based on detailed analysis of inputs and outputs as part of a randomised control trial in over 600 Indonesian villages. Each village received an annual lump sum of Rp.80million ($8,800) for funding infrastructure. The study found that on average 24% of expenditure on infrastructure went missing.

3.5 Maintenance

Corruption impacts on maintenance in two ways: first, corruption during bidding and construction which affects the quality of the delivered asset (as outlined above): second, inadequate funds allocated for maintenance as new construction takes precedence.

Tanzi and Davoodi (1997) is the only study found which correlates the general level of corruption (perception) with low quality infrastructure and low expenditure on maintenance. The evidence presented shows that higher corruption is associated with (i) higher levels of public investment (ii) lower government revenues (iii) lower expenditure on operation and maintenance and (iv) lower quality of public infrastructure. The authors explain the finding that corruption is linked to lower expenditure on maintenance to the fact that maintenance contracts are generally of low value and hence offer less opportunity for public officials to benefit from 'commissions' paid by firms to win a contract. Commissions are often tied to project costs, creating an incentive for larger projects. This could feed through to a preference for larger projects in budget allocations – to the detriment of maintenance.

On the basis of World Bank estimates of maintenance costs for various types of infrastructure, Kenny(2007) argues that O&M budgets in many developing countries are too low to sustain existing stocks. A recent estimate for Latin America suggested maintenance expenditures were approximately half of the level they should be at (Rioja 2003). There are many reasons for this, including unwillingness until recently of donors to fund routine maintenance and inadequacy of domestic sources of funds, It could also be due to bad decision-making, but then it has to be asked why bad decisions continue to be made? Although there is little hard evidence, corruption is likely to be a factor in the incentives to launch new construction projects. Kenny (2006) in fact concludes that the incentive to build

[6] A further 9% of concerns related to quality, but it proved very difficult to assess quality on the basis of contract documentation alone, plus a single visit to the site. A proper assessment of quality would require a full technical audit.

new rather than maintain existing infrastructure is a major negative development impact of corruption.

4. Policy responses

Surveying the evidence available, it becomes clear that corruption in the construction sector presents a major challenge. Several estimates of total global losses due to corruption have been made. For example the American Society of Civil Engineers claims that corruption in construction costs US$ 340 billion a year worldwide (ASCE 2005). This is only 5% of total global construction output, estimated in 2011 at US$7.2 trillion (Global Construction Perspectives 2012). Kenny (2009a) has calculated that if 5% of investment in infrastructure is lost to corruption, the financial burden alone would add up to US$ 18 billion a year in developing countries. If (as many suggest) 10% is lost to corruption the figure doubles to US$36 billion. It is likely that the actual financial cost is considerably higher, as the percentage estimates rely largely on quantifiable evidence of bribery payments and ignore more hidden forms of deception, theft and collusion.

Considering the scale and cost of the issue, it is not surprising that corruption has risen steadily as a major issue on the agenda of policy-makers around the world. Several initiatives attempt to tackle the problem, some through targeted interventions and others through more generalised sector regulation. The most important findings are reviewed below.

4.1) Monitoring and incentives/sanctions

In a systematic review of evidence of the effectiveness of anti-corruption policy, Hanna et.al.(2011) found convincing evidence that monitoring and incentive-based interventions (both financial and non-financial) have the potential to reduce corruption at least in the short term.7 Monitoring on its own, however, is not useful unless there are also incentives and/or sanctions. The biggest incentive to non-corrupt behaviour is, of course, the threat of exposure and subsequent sanctions. When bureaucrats or elected officials are held responsible for corruption, it is possible to use the threat of unseating those found corrupt or publicising their corrupt behaviour (naming and shaming) as an incentive. Sanctions that can also be applied to companies (as well as public officials) are fines and imprisonment. But guilt has first to be proven and this requires the capacity to conduct a proper investigation in order to prosecute those concerned, as well as a competent, honest and independent judiciary. Such investigations are expensive and seldom brought to a successful conclusion, even in highly developed countries. One high profile case is the Lesotho Highlands Water Project which resulted in jail sentence for the public official involved and substantial fines on international contractors and consultants (Darroch 2005).

The complexity of the delivery of public construction projects, and the large sums of public money involved, means that laws, regulations, systems and procedures have to be in place to guide and control the process. The required measures have been described by the Global Infrastructure Anti-Corruption Centre (GIACC) [8] as simply good management practices: i.e. due diligence on project participants; good tendering controls (competitive tenders, evaluation committees etc.); good project management controls (separation of functions, commercial controls over measurement and quality, financial controls over invoicing etc.); training of project staff; whistle-blowing procedures; audit etc. Well run projects will have all

[7] The review was not confined to infrastructure but included three studies of infrastructure sectors: Olken (2007), Chavis (2010) and Asthana (2008), all of which are mentioned below.
[8] www.giaccentre.org

these elements in place as a matter of course. In combination they help to reduce corruption as they constitute a series of independent checks and balances which make corruption difficult to perpetrate. If such rules and systems are in place and compliance is monitored the room for corrupt activity should be reduced. [9]

There is enormous discrepancy in the extent to which such controls are in place in countries around the world. But in the past 10 years many developing countries have embarked on a programme of procurement reform, under the guidance of the World Bank and OECD. OECD/DAC has established a methodology for assessing country procurement systems which has been used to diagnose capacity building needs. Procurement reforms involve the establishment of a high level authority to provide oversight of the process. Some of the best of such authorities are now fulfilling their oversight role. For example the Public Procurement Regulatory Authority (PPRA) in Tanzania is conducting regular audits of 300 or so public procuring entities in the country and imposing sanctions (which include 'naming and shaming') on those found to be failing to abide by the rules. [10] An additional level of monitoring/oversight by an independent body is proposed by the Global Infrastructure Anti-Corruption Centre (GIACC) under their Project Anti-Corruption System (PACS).

However, one weakness of the procurement reforms is that the focus to date has largely been on the tender stage of the project cycle and less attention has been paid to key decisions that are taken before tender (project selection, planning and design) or during contract implementation, yet these are the stages at which the effects of corruption are most severe. Kenny (2006, 2009a) argues that anti-corruption policy needs to shift away from the

single project and from the current focus on procurement. Any anti-corruption strategy should start at the level of the sector and focus on reducing the most damaging consequences of corruption.

It is also important to note that monitoring will be ineffective unless it is implemented and monitored by a party desiring to lower corruption. Monitors/auditors must be non-corruptible (Hanna et.al. 2011). When monitoring is ineffective, because the monitors themselves are corrupted or because new methods are created for obviating the rules (Bannerjee et.al. 2007), interventions might be needed that change the underlying rules of the system (Hanna et.al.2011). Strategies that change the rules are also thought to be more sustainable in the long term, but more research is needed. Two interventions were examined by Hanna et.al. (2011) that change the underlying rules of the system: decentralisation with community participation and public auctions (open tenders). Other such initiatives are privatisation, which raises other issues (see point 9 below) and e-procurement, which is presumed to lower corruption by increasing transparency in the advertising and ward of contracts.

The measures proposed by Hanna et.al.(2011) are discussed first, followed by others that are suggested in the literature, including transparency .

4.2 Decentralisation and community monitoring

On decentralisation the evidence is mixed. The authors found some evidence that decentralisation has potential to reduce corruption but it is context specific. It depends on high levels of community participation and can be successful but only when (i) officials elected directly by the population they serve and therefore accountable to them and (ii) the community can punish corruption (e.g. through withdrawing support for elected officials).

[9] These points were made in private correspondence with Catherine Stansbury, co-founder of GIACC
[10] See PPRA annual reports which can be downloaded from their website www.PPRA.go.tz

Giving communities the opportunity to report on corruption has no effect if the corrupt officials do not face punishment (Hanna et.al. 2011).

Chavis (2010) studied the effect of community involvement in decentralised road projects in Indonesia. He found that building the capacity of the community to participate in and/or oversee the prioritising, planning and construction of projects is necessary and can be costly. An increasing number of villages competing for a project led to a decline in road construction costs – indicating that increased competition and participation from local communities can have an effect on the efficiency with which road construction funds were used.
However, in a controlled experiment investigating the relative effectiveness of community monitoring versus the threat of audits in local level road construction in Indonesia, Olken (2007) found that community monitoring was less effective. While the threat of an audit reduced unaccountable material and labour expenditures by 8%, community participation had smaller and statistically insignificant average reductions in expenditures. Whilst community monitoring led to improved wages (14 to 22%) it had little impact on material purchases. The author suggests that the villages had more incentives to monitor the former (from which they benefitted directly) than the latter where the benefit would be to the community at large. He also found that community participation was more effective when by-passing village elites and governments with invitations to participate channelled through village schools.

Contrary evidence is also provided by Asthana (2008) in a study of the relationship between decentralisation of provision of water supply and corruption in the provision of services. Drawing on a large database from two large Indian states of Madhya Pradesh and Chattisgarh, the author found that the level of corruption in water supply agencies run by local governments is higher than that in the agencies run by the regional government. The conventional wisdom that decentralisation brings management closer to the service recipients and is therefore likely to reduce corruption is inconclusive.

4.3 Public auctions (open tendering)

Public auctions (an element of procurement reform) are designed in part to address the issue of bribery and other forms of corruption during tender and selection. They aim to do this by eliminating discretion through (i) opening tenders to all through public auctions and (ii) evaluating bids on price alone to avoid any element of subjectivity.

There are a large number of econometric studies that purport to show that public auctions increase competition which in turn leads to lower prices. But the majority of these studies relate the number of bidders to the tender price and ignore that fact that tender price is not the same as the final price paid by the buyer – i.e. that the contracts are incomplete (Bajari et.al.2006). We have found no evidence to show that using open tender and evaluating on the basis of price alone will lead to lower final prices and hence, by implication, fewer losses due to corruption.

In a comprehensive study of US government procurement of computer hardware and systems, Kelman (1990) argues that the current system does little to reduce corruption while exacting an enormous toll on the quality of performance. This is because open competition and awarding contracts on the basis of price alone, without consideration of the suppliers' past performance, can prevent the government from obtaining better value from its vendors. Moving away from lowest price would have many advantages. It would allow the buyer to tap into the vendor's knowledge and experience through 'early supplier involvement' in planning and design and in developing the specifications.

The construction literature has long argued that opening tenders to all and evaluating on the basis of price alone can have negative implications for outcomes. [11] The UK re-thinking construction agenda has moved away from a price based approach towards innovative forms of procurement such as partnering, and the use of integrated supply chains with a focus on the outcomes (Latham 1995, Egan 1998, National Audit Office 2001). In 2005, the National Audit Office reported that this agenda had led to 55% of UK public sector projects coming in on budget compared to 25% in 1999. Similar initiatives have also taken place in Australia New Zealand, the USA, Germany and Denmark (Nijhof et al. 2009).

Some evidence is now emerging to show that these arguments are beginning to be taken on board by economists. For example, Bajari et.al. (2008) use data from private building contracts in California to demonstrate the limitations of auctions. They conclude that auctions may perform poorly when projects are complex or design is incomplete (as was found in many projects examined in the CoST pilot). Auctions also stifle communication and prevent the use of the contractor's expertise in the design of the project.

Using econometric analysis, Tran (2008) employed a comprehensive set of internal bribery records from an Asian trading firm to evaluate different auction regimes. To fight corruption the country mandated *best value auctions* in 2001 and strengthened them to more transparent *best price* auctions in 2004. *Best price* auctions had the greatest impact on reducing corruption. However contracts went to less efficient firms. The results indicate that open and non-discretionary auctions can significantly reduce corruption, but at some cost to efficiency.

A further danger of basing contract award on price alone is that it can lead to massive under-pricing to win contracts. Insufficient money in the contract is likely to lead to long delays, substandard work and budget overruns

4.4 Transparency Initiatives

Transparency is increasingly discussed as a tool against corruption. This is based on the assumption that corruption depends on secrecy, and that publicly available project data will lead to stakeholders being better informed and able to hold authorities to account over project costs and outcomes. However, there is very little actual evidence to support this link between transparency and accountability, and where studies have been done they show that a successful synthesis between these two mechanisms depends on a number of contextual conditions (McGee 2010).

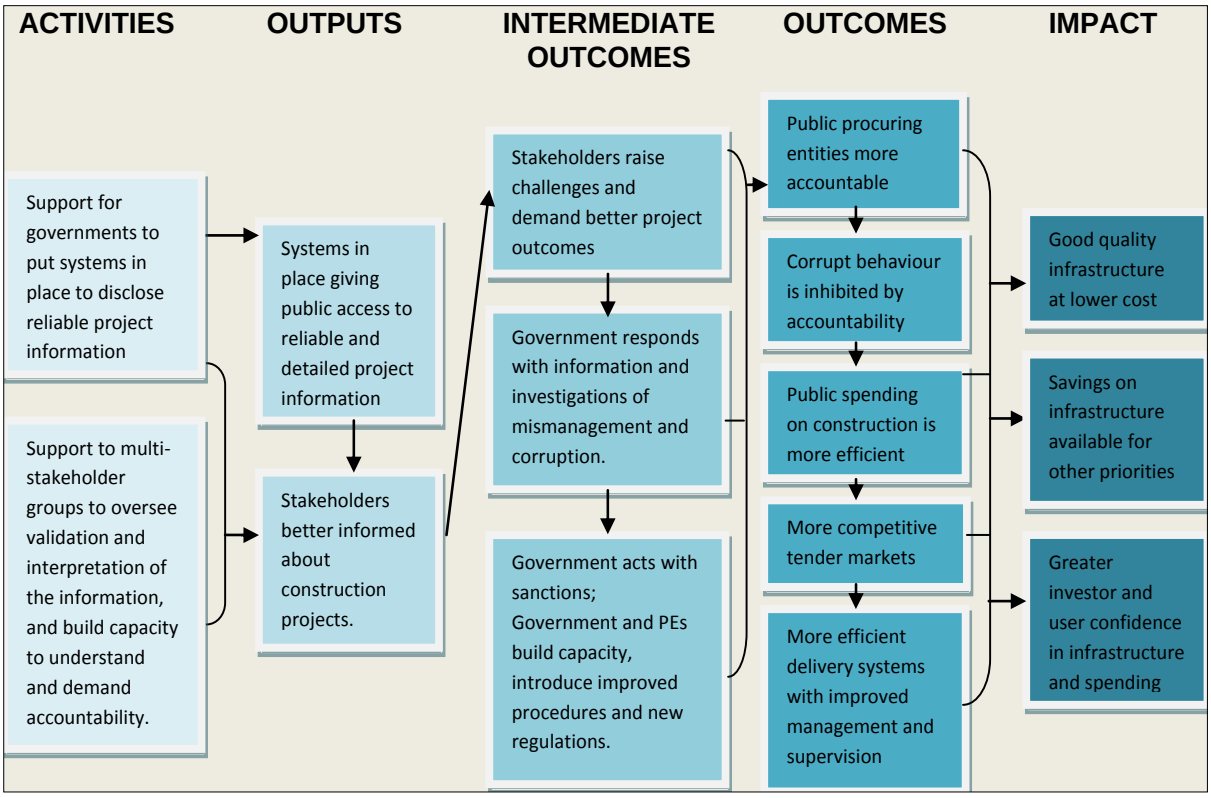
From the evidence available, features that are likely to affect the success of a transparency and accountability initiative include the following:

- Political will in the country concerned, in particular the willingness to (i) disclose information (ii) investigate challenges and (iii) accept the findings of investigations and take action: Without the threat of effective sanctions, citizen mobilisation is difficult to sustain in the long run (Joshi 2010)
- The quality and relevance of the information disclosed and the capacity of stakeholders to analyse and interpret it
- The motivation of stakeholders to raise challenges which in turn depends on whether (i) they stand to gain direct benefits and (ii) they have direct control over the outcomes or trust in government to take action (Olken 2007) [12]

[11] For a 'tongue in cheek' summary of the arguments see Constructing Excellence 2011
[12] Results of an internal investigation of the links between transparency and accountability for the CoST international secretariat

In a broader sense the success of such initiatives also depends on the presence of an effective and free media, an enabling legal environment and the rule of law. A 'results chain' developed for the design of the proposed CoST global programme illustrates these points.

Figure 1: Results chain developed for the CoST Global Design



In 2010 DFID commissioned a systematic review of the evidence that increased transparency in infrastructure procurement and delivery can have on access, costs, efficiency, price and quality (Thillairajan et.al. 2012).[13] However, the outcome is

disappointing as the interventions chosen as proxies for transparency (e.g. privatisation, decentralisation, regulation) influence outcomes through a range of means and not just through greater transparency and the evidence reviewed does not assess how much of the outcome is due to changes in transparency. Still, the study does provide useful evidence of the efficacy of such interventions. It will doubtless be reviewed by others in the infrastructure sector studies that are a part of this evidence review.

The independent Global Infrastructure Anti-Corruption Centre (GIACC) supports the full disclosure of project information onto a website, which is the approach of the Construction Sector Transparency initiative (CoST). As explained earlier, the CoST Pilot demonstrated that disclosure of project information can highlight mismanagement and inefficiency but it was almost impossible to determine if corruption had taken place. Nevertheless, greater transparency is an important first step, opening the door to monitoring by oversight agencies, local communities, or the public at large. Knowledge that details of construction contracts will be made available to the public could also serve as a deterrent to corrupt actions on the part of public officials and private companies. Baseline studies in the eight CoST pilot countries

[13]The review was confined to econometric and quantitative studies in developing countries undertaken between 1995 and 2010. Ninety (90) studies meeting the search criteria were examined in depth.

revealed that little information is currently required by law to be disclosed (including the UK) and actual disclosure falls far short of what is legally required.

Transparency is not just about disclosing information to the public. Following the exposure of the estimated fraud of €1.5bn in the Netherlands construction sector, a transparent commercial relationship between clients and suppliers is seen as essential to rebuilding trust and improving the efficiency of the market (Doree 2004, Nijahof et al 2007, Nijahof et al 2009). According to Nijahof (2009), trust can be built within the tender requirements with more transparency about the performance that is to be delivered and more transparency about past performance.

Trust can also be built through innovative forms of contract where the relationship is based on a common financial interest as the parties share in any cost savings or losses. Endorsed by the UK and South African Governments, NEC3 Contracts achieves transparency by ensuring that the client and suppliers receive the information at the same time, and that there are no hidden transactions (Hawkins et al 2006). It also uses an open book approach to managing costs which CoST recognised as providing a transparent and accountable approach to cost management (CoST 2011c).

4.5 Integrity pacts

Another type of direct intervention is the application of Integrity Pacts. The concept was designed by Transparency International to tackle information asymmetry and introduce transparency into the process of public contracting. The pacts involve an agreement between government and bidders outlining the rights and obligations of all parties and cementing their commitment to refrain from engaging in bribery. The underlying logic is to create a common framework so that bidders can act with integrity knowing their competitors are bound by the same restraints and therefore cannot gain an unfair advantage from illicit behaviour. While there may appear to be little difference between an integrity pact and all parties agreeing to abide by the rules of the tender, the pact also includes monitoring tools and various sanctions as reinforcement mechanisms.

Boehm and Olaya (2006) studied two case studies in Argentina and Colombia where Integrity Pacts were used in the procurement of two major public infrastructure projects. Their findings seem to confirm the rationale. Shared and assured transparency through the creation of a pact shattered the information asymmetry that usually persists in the bidding process and encouraged increased participation as actors were assured that the process was fair. In Colombia, bidders admitted directly that “transparency introduced by the IP played a key role in encouraging participation” (*ibid,* p. 447).

4.6 Legislation and standards

The Foreign Corrupt Practices Act was established by the US Government in 1977 and was aimed inter alia at criminalising the payment of bribes to foreign officials. In his review of the efficacy of the Act, Krever (2007) claimed that it has had only limited success in curbing foreign bribery.

Many other countries are now implementing anti-bribery legislation to combat corruption following pressure from the OECD. The OECD Convention on *Combating Bribery of Foreign Public Officials in International Business Transactions* which came into force in 1999 is open to accession by any country which is a member of OECD or has become a full participant in the OECD Working Group on Bribery in International Business Transactions. As of March 2012 39 countries had acceded to the Convention.

The convention requires countries to pass laws against overseas bribery. The UK Bribery Act 2010 is viewed as the most punitive legislation as it applies to bribery in the private sector as well as to the bribery of public officials inside and outside the UK. It also requires UK based organisations to apply 'adequate procedures' to prevent bribery and corruption being committed by persons associated with the organisation.

Although business has been concerned that it puts UK contractors and consultants at a competitive disadvantage, it is unlikely to impact on the market share of UK contractors. Most have withdrawn from the most competitive markets (e.g. in Africa) prior to the legislation coming into force due to the fact that they are unable to compete with the Chinese firms who now dominate the African market because they have less regard to ethical and other standards issues (labour, environmental etc.). [14]

Many companies are likely to adopt the new anti-bribery standard published by BSI (BS 10500:an international anti-bribery framework) as its likely to be viewed as meeting 'adequate procedures' under the Bribery Act. However, it will require clients to include compliance with the standard in their tender requirements for it to become effective.

4.7 Anti-corruption agencies

A number of anti-corruption agencies (ACAs) have been set up in recent years following the very successful models in Singapore and Hong Kong. Heilbrunn (2004) finds that such agencies have failed to reduce corruption in all but a few special circumstances. Too often setting up an agency is little more than a token effort and avoids making difficult reforms in procurement practices, financial management, internal and external audits and conflict of interest laws, which are all needed to improve public sector management and reduce corruption. Assigning functions to ACAs that should be performed by general auditors, police bureaus, procurement boards, may dilute effectiveness. Where ACAs have succeeded it is due to national consensus and domestic coalition support for genuine reform.

De Maria (2008) argues that ACAs were the result of a search for the magic bullet but they are doomed to fail in Africa because they are based on a western construct of good governance which assumes mature states where institutions are in place and working, as well as the assumption of an absence of political interference.

A detailed study of ACAs in five African countries (Ghana, Malawi, Tanzania, Uganda and Zambia) found major problems stemming from a lack of compatibility between the motivations and expectations of the parties involved - governments, donors and ACAs themselves. The widespread lack of success is also attributed to inadequate capacity and

funding, the absence of independence and a clear reporting hierarchy and the absence of a commitment by government to enact reforms that may be politically difficult (Doig et.al. 2005: Heilbrunn 2004)).

4.8) Privatisation

Privatisation is sometimes advocated as a way of addressing corruption in public sector bodies responsible for the provision of infrastructure and delivery of services. If privatisation is poorly prepared it can of course create many more opportunities for corruption. The process itself should be transparent and competition encouraged between potential buyers.

[14] This is demonstrated very clearly in a study of 11 large construction projects in Tanzania (ILO 2005)

Privatisation is mostly associated with utilities where there is increasing evidence that private provision is broadly associated with greater efficiency and improved outcomes (Kenny 2009b). Such evidence can be found in energy and water (Gassner et.al.2007: Estache and Kouassi 2002) and in telecommunications (Rossotto et.al. 2004). Commercial losses in private electricity provision in Kolkata and Mumbai are between 12% and 15% compared with 30-35% with state owned utility provision in India (Gulati and Rao 2006).While we do not know the extent to which improved efficiency involves fewer losses due to corruption, it is considered likely. In an efficiently run utility there would be limited rent for corrupt agents to appropriate, providing that prices are reasonable. *"If quality services are being delivered for a reasonable price there are no resources left over for a firm to finance large bribes or an official to 'pad' expenses"* (Kenny 2009b p.160).

Pressure on prices depends on competition. If there is competition between private providers, efficiency gains may be passed on to consumers in the form of lower prices. This has generally been the case in telecommunications (Rossotto et.al. 2004) but is less common in other sectors. Mortimort and Straub (2009) use an economic model to show how higher prices paid for water by consumers in Latin America increases their *perception* of corruption in the sector and discontent with privatisation. This explains the apparent contradiction in Latin America between improved efficiency in the service and increased dissatisfaction with privatisation.

Where competition is missing, tighter regulation of private providers is needed to ensure that prices are reasonable and limit the extraction of rents and hence the surplus available for corruption. A number of econometric studies suggest that the introduction of an Independent Regulatory Authority can have at least a partial effect on the consequences of corruption for access, affordability and quality of utilities services (Estache et.el.2009): or that it can reduce the negative association between measures of corruption and efficiency (Wren-Lewis 2011).

4.9 Sector regulation

Writing on utilities, Kenny (2009b) notes that the difficulties in measuring corruption, and particularly in measuring the impacts of corruption, means there is limited empirical evidence to support particular corruption-focused interventions. But corruption is a result of the failure of governance. He argues that if governance were improved, outcomes would improve and corruption would reduce as a consequence. As we know broadly what measures would improve governance, the best approach to reducing corruption is to focus on these. Measures that have been put forward over the past 20 years to improve governance of the infrastructure sector include countering incentives to build the wrong thing and then to build and operate it badly. This means parliamentary oversight of budgets, rational procedures in project selection, ensuring adequate funds for maintenance, financial and technical audits of projects. If the process for selecting projects picks those with high economic returns and if the new infrastructure is well constructed and well maintained, the impact of corruption on overall development will be comparatively small. Attributing improved outcomes to reduced corruption (as opposed to improved knowledge and competence) may be difficult but should not matter. Measures on the demand side of governance include greater transparency,

citizen charters that clarify the standards that consumers can expect of infrastructure services, report cards that survey citizens' experience and social audits (*ibid)*.

4.10 Key Conclusions

- Corruption is widespread in infrastructure and a barrier to growth and development. Investing resources to reduce corruption is likely to provide value for money. But there

is no magic bullet. Reliance on competition at tender stage or special initiatives can't replace proper oversight by government/public officials.

- There is a danger of focusing on corruption at the expense of mismanagement and inefficiency. Consideration should be given to interventions that tackle these problems comprehensively, for example by focusing on delivering better outcomes through the following:
  - More time spent on project preparation, design and planning
  - Improving procurement and delivery systems and management
  - Strengthening monitoring of project execution and imposing sanctions
  - Ensuring prompt payment

- Improving transparency might create an environment in which corruption is less likely to occur, but there is a need to gather evidence of the relationship between transparency and accountability. The costs of improving transparency are also poorly understood and evidence is needed of the costs relative to the benefits.

- Efforts to increase transparency should focus on the critical points in decision-making where the damage from corruption is greatest – such as project selection and implementation.

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Review 09

Trade corridors

By Graham Walker

1. Introduction

This paper is designed to provide an input into the Infrastructure Position Paper (IPP) being prepared by DFID in response to the recent International Development Committee's inquiry into its role in Financing Infrastructure for Development.

Its objective is to provide a comprehensive appraisal of available global evidence relating to infrastructure's role in growth and poverty reduction, with particular emphasis on Trade Corridor Approaches especially with respect to Africa.

Critical areas, which will be examined include:

- The problems encountered by developing countries in stimulating regional and international trade with a brief reference to experience in developed economies.
- The potential benefits that the development of trade corridors can bring in alleviating poverty and stimulating growth and regional integration especially with respect to landlocked countries (LLDCs) in Africa.

- The key issues relating to the establishment and operation of trade corridors, especially with respect to institutional arrangements; evaluating and financing infrastructure projects; the harmonisation of transit regimes and the elimination of non-tariff barriers to trade; and the regulation of service providers.

2. Trade and development

There is a substantial body of evidence to show that trade is a key element in driving growth and development, in alleviating poverty in least developed countries (LDCs) and in reducing aid dependency. A commonly accepted estimate is that 'a 10 percentage point increase in trade openness translates into a 4% increase in per capita income. Economic growth accounts for approximately 80% of poverty reduction, which has lifted 500 million people over the poverty line over the past 15 years.' [1] Major contributory factors identified include the transmission of technological innovation, facilitating competition and the realisation of economies of scale by allowing firms to operate in larger and more diverse markets.

One of the conclusions of the Growth Commission[2] was that trade was a vital ingredient for growth and poverty reduction and that those countries that had lowered trade barriers had performed significantly better in growth terms than other developing countries. Whilst trade openness has many positive effects, it needs to be accompanied by complementary policies if the impact of increased competition from imports is not to have a negative effect. Policies need to be put in place to assist with retraining, social protection, etc. with adequate time provided for adjustment, and it is here that DFID can play a positive role. The June 2012 Joint Statement to the Rio+20 UN Conference on Sustainable Development draws attention to the essential role that sustainable transport plays in sustainable development and green growth.[3]

The countries of Sub-Saharan Africa (SSA) have particularly acute problems with regard to stimulating trade, not just because of difficulties in competing in global markets as a result of being relatively small demographically with limited domestic markets, but also because they have poor infrastructure and high transport costs. Added to poor infrastructure there are normally numerous formal and informal tariff barriers (onerous customs procedures, port delays, poor logistics, diffuse transit regimes and restrictive regulatory environments) which cause excessive delays and inhibit market access, both regionally and internationally.

Although the cost implications of corruption are generally negligible, there are huge costs associated with the delays that occur at borders, especially at key transit points. These are additional costs to traders compounding the delays due to inadequate infrastructure. The lack of transparency in terms of transit regimes especially for landlocked countries (LLDCs) is also a major impediment to reducing transit times.

In Africa, there are 15 landlocked countries, and almost all of these are classified as least developed countries (LDCs). [4] Many landlocked countries are isolated from world markets and experience extremely high transit costs. These high costs have a negative impact on competiveness, reducing the volume of exports and raising domestic costs for consumers. They also impact significantly on poverty alleviation. Research has found that transport costs

[1] http://www.bis.gov.uk/policies/trade-policy-unit
[2] The Growth Report: Strategies for Sustained Growth and Inclusive Development (2008)
[3] The Growth Report: Strategies for Sustained Growth and Inclusive Development (2008)
[4] Botswana, Burkina Faso, Burundi, Chad, Central African Republic, Ethiopia, Lesotho, Malawi, Mali, Niger, Rwanda, Swaziland, Uganda, Zambia and Zimbabwe

for LLDCs can be as high as 77% of the value of exports[5] and that these are far more restrictive barriers to trade than tariffs.

It is estimated that, generally, it costs around $800 per day to transport a single container along the major corridor in East Africa with delays of up to 10 days at the border crossings not uncommon, owing to the predominance of red lane inspections; inadequate infrastructure; lack of cooperation amongst Government agencies operating at the borders; corruption; and inadequate facilities for inspection, parking, etc.

3. Trade corridors

Developing an integrated approach to these problems, by concentrating on regional routes as Trade Corridors, is seen as crucial to developing trade and deepening the process of regional integration. [6] Trade corridors are particularly important to LLDCs, which have no maritime access and are therefore reliant on transit regimes and infrastructure in countries connecting them with their seaboard and/or key markets. Trade corridor projects are now intentionally developed in Asia, in Europe, in Latin America, and in the Caribbean basin. Thus they may involve institutional development, software, integrated border management, one-stop border posts as well as improvements in the roads themselves, and an extensive body of literature on the subject now exists. [7]

The benefits of such corridors include the following:

- The development of a coherent framework of bilateral agreements by all countries along the corridor to promote internal and external trade and transit.
- The harmonisation of policies with respect to infrastructure planning, upgrading of border posts including conversion to one-stop border posts, intermodal linkages, etc.
- The leverage of financial support from international sources, both from the public and private sectors.
- Providing platforms for more specific regional and sub-regional economic development projects along the corridor designed to promote new production activities and alleviate poverty.
- Channelling resources specifically into the reduction of transit times and transport costs along the corridor though measures to improve customs and clearance procedures, promote competitive trucking industries and logistical support industries.
- Indirect benefits through the generation of economies of scale and the development of services.
- Increased social and economic integration within the expanded market.

[5] The Development of Trade Transit Corridors in Africa's Land locked countries in UNECA (2010), Assessing Regional Integration in Africa IV-Enhancing Intra-African Trade

[6] Trade corridors are streams of products, services, and information moving within and through communities in geographic patterns according to a matrix or "culture of trade agreements and treaties, statutes, delegated legislation, and customs that govern and guide trading relationships, institutions and structures.

[7] http://www.cardus.ca/research/workandeconomics/tradecorridors/

In order to become the catalyst for increased trade and economic growth, the availability of reliable energy and telecommunications are critical areas of concern for the success of the corridors since reliability of power supplies and access to the internet with fast broadband speeds, mobile phone networks and other communication facilities are vital if countries are to compete in the global economy.

A notable success is EASSy[8] - a 10,000km submarine fibre optic cable system deployed along the east and south coast of Africa to service the voice, data, and internet needs of the region. It links South Africa with Sudan via landing points in Mozambique, Madagascar, the Comoros, Tanzania, Kenya, Somalia and Djibouti. The cable incorporates the latest developments in submarine fibre optic technology, making it economical to connect the eastern and southern coast of Africa into the high-speed global telecommunications network. The system is owned and operated by a group of 16 African (92%) and international (8%) telecommunications operators and service providers. In a related project, investors in the EASSy system are building terrestrial fibre backhauls to link the landlocked countries of the region to the cable.

It should also be added that the success of trade corridors will be also be dependent on the degree to which the overarching trade policies of the Regional Economic Communities (RECs) are implemented. It is, however, important to note that RECs powers are limited and it is agreements between neighbouring heads of state which are a better guarantee of implementation.

In Africa, in recognition of the need to take positive steps, and as part of a maturing political economy of cooperation, a number of corridors have been established including:

- North-South Corridor. This is an initiative undertaken by three RECs (COMESA, EAC and SADC) and is one of the first projects to be undertaken by the Tripartite RECs as a core element of its regional integration agenda along with the development of a Free Trade Area encompassing 26 countries. It traverses eight countries and embraces the Dar es Salaam corridor and the original North-South Corridor, stretching from the port of Dar es Salaam to the ports of Southern Africa. It has a broad mandate including the upgrading and maintenance of roads; improvements in trade and transport facilitation; reduction in border crossing delays; rehabilitation of the railways; and improvement in the supply and transmission of power. One of its principal aims, however, is the reduction of transit times and costs. DFID South Africa through TradeMark South Africa (TMSA) and DFID's Africa Regional Department (ARD) played a catalytic role in galvanising support from the international community for this endeavour, and provided some £90 million finance for initiatives to be managed by DBSA. [9]

- Northern and Central Transport Corridors. These connect Burundi, Kenya, Rwanda, Tanzania and Uganda and also provide port access for the Democratic Republic of Congo and Southern Sudan. Again ARD through its support in the design and establishment of TradeMark East Africa have been critical in helping to galvanise a single, multi-donor programme of support to the process of regional integration in East Africa. Support to improve the efficiency of both the Northern and Central Corridors is a critical component of the $465 million TradeMark East Africa programme.

[8] www.eassy.org

[9] http://www. trademarksa.org
DFID and the Development Bank of Southern Africa (DBSA)have established a Tripartite Trust Account as agreed at the North South Corridor High Level Conference

- NEWCOR (NEPAD East-West Corridor). This is an integrated corridor linking the East-West and North-South transport corridors into a single backbone running from Dakar in Senegal to Abuja in Nigeria via Tamale (Ghana), Kara (Togo) and Paragou (Benin).The project has numerous objectives including poverty reduction, regional integration, promoting regional trade and optimising the use of transport corridors.

- Maputo Development Corridor. Launched in 1996, this is primarily a transport corridor and is designed to assist the landlocked regions of South Africa (Mpumalanga, Gauteng and Limpopo Provinces) and connect Johannesburg with the port of Maputo in Mozambique. Whilst the focus is on road and rail improvement, border posts, ports and terminal facilities, the project's overall objective is to provide access to a deep water port for some of South Africa's most industrialised and productive provinces and stimulate further development along the corridor. This is one of several corridors identified as development zones in Mozambique.

- Mombasa-Nairobi-Addis Ababa road corridor. The Mombasa-Nairobi-Addis Ababa Road Corridor Project, Phase III is part of the Trans-Africa Highway network designed to promote trade and regional integration, and to alleviate poverty through highway infrastructure development and the management of road-based trade corridors. This project, which is in its third and final phase, involves the construction to bitumen standard of 320km road sections including the 122km Turbi-Moyale road section in Kenya and the 198km Hawassa-Ageremariam road section in Ethiopia. It also includes trade and transport facilitation and capacity building consultancy services. The total cost of the project is UA 241.59 million (AfDB Units of Account).[10] The project is co-financed by the AfDB (93.1%), the Government of Ethiopia (3.5%) and the Government of Kenya (3.4%). The overall project implementation time is five years (2012-2017). Project beneficiaries are corridor residents who have greater economic opportunities and access to social services and goods.[11]

- The U.S. Department of State, in conjunction with several U.S. Government agencies, hosted the eleventh annual U.S.-Sub-Saharan Africa Trade and Economic Forum, commonly known as the AGOA Forum, June 14-15, 2012 in Washington, D.C. The African Growth and Opportunity Act (AGOA) is the U.S. Government's signature trade initiative with Sub-Saharan Africa, and is the parent legislation of the Forum. The 2012 AGOA Forum will focus on enhancing infrastructure development in Africa in several ways including regional integration through trade corridors.

Other important transport corridors in Europe and Asia include the following:

- Greater Mekong Sub-region Programme. This began in 1992 and involves Cambodia, Laos, Myanmar, southern PRC, Thailand and Vietnam. It consists of three corridors: the East-West Corridor connecting Thailand, Laos and Vietnam; the Southern Corridor connecting Thailand, Cambodia and Vietnam; and the North-South Corridor connecting southern China through Laos or Myanmar to Thailand. The key element in the programme is infrastructural development and cross-border cooperation but it has expanded to include economic development and environmental measures along the corridors.

[10] http://www.trademarksa.org/news/mombasa-nairobi-addis-ababa-road-corridor-project-appraisal
[11] http://www.afdb.org/fileadmin/uploads/afdb/documents
JICA have produced an interactive map showing corridors in Africa and Asia. http//transportgis.jica-net.com. The same map has been incorporated in the East Africa corridors website www.eastafricancorridors.org

- Indo-Pakistan – Asia National Trade Corridor:[12] The World Bank is reviving and restructuring the National Trade Corridor programme aimed at reducing the cost of trade and improving logistics infrastructure between Pakistan and regional peers. Once completed, the multi-billion-dollar project is expected to bring down losses, estimated to be in the range of 4-5% of gross domestic product, owing to poor road and rail infrastructure, according to various studies. Economic cooperation hinges on the space being provided by political developments and currently politics between India and Pakistan are giving room to work on mutually beneficial regional integration.

- Trans-European Transport Network (TEN). In 2006, the TEN-T EA[13] was established by the European Commission (EC) to manage the technical and financial implementation of the TEN-T Programme, amounting to some 198 projects valued at €6.2 billion for the period 2007-2013, and for 208 projects valued at €803 million for the previous financial period. It reports directly to DG MOVE (Directorate-General for Mobility and Transport) at the EC, which is responsible for policy-making/strategy/financing. The EA manages the whole project cycle. The overall programme is presently being strategically revised because of significant changes in the fields of: [14]

  - Geopolitical environment,
  - Economy,
  - Environment and climate policy,
  - General transport policy.

  Overall EU Energy security in the 21st Century where geopolitics and trade corridors are intertwined has recently been reviewed by Quemada, García-Verdugo, & Escribano. [15] Two innovative indicators have been developed to estimate geopolitical energy risks and energy-related relations with other countries. The book also examines the process of convergence of member states' energy security policies, the path towards a common European energy policy, and the process of Europeanization projected towards the energy corridors through which the EU receive energy imports.

- The Europe-Caucasus-Asia Transport Corridor (TRACECA)[16] In February 2012, the European Commission hosted the Transport Corridor Europe-Caucasus-Asia (TRACECA) Investment Forum with the proposal to attract investments into transport infrastructure between the EU and Central Asia and to discuss potential funding for priority projects. TRACECA had been launched in 1993 by the EU as a programme to develop a transport corridor from Europe to China, via the Black Sea, the Caucasus and the Caspian Sea. TRACECA also aims to strengthen economic relations, trade and transport links between the countries. The development of the TRACECA is based on a partnership among 13 countries in the Black Sea, Eastern Partnership and Central Asia regions and the EU. The Basic Multilateral Agreement was signed in 1998 by the EU and the following countries: Armenia, Azerbaijan, Georgia, Republic of Moldova,

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[12] http://tribune.com.pk/story/393213/world-bank-to-restructure-trade-programme

[13] TEN-T EA. Trans-European Network Executive Agency

[14] www.bothniangreen.se/wp-content/uploads/2012/02/Helmut-Adelsberger Trans-European Networks Energy & Transport

[15] www.amazon.com/**Energy**-Security-21st-Century-ebook/dp/B007JL21VE
By José María Marín Quemada , Javier García-Verdugo , Gonzalo Escribano 2012, Energy Security for the EU in the 21st Century: Markets, Geopolitics and Corridors (Routledge Studies in Ecological Economics) [Kindle Edition] 360pp

[16] http://beleuz.wordpress.com/2012/03/02/the-europe-caucasus-asia-transport-corridor-traceca/

Ukraine, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Romania, Bulgaria and Turkey. A 2003 review of the overall programme concluded that over a decade, emphasis had shifted from the single corridor focus to a multi-country "dialogue driven" approach as envisaged in the MLA and that the scope had usefully expanded from purely transport to transport and trade facilitation. [17] By 2008 76 projects had been implemented, (62 TA euro 105M; 14 investment euro 52M). [18] Any additional and more recent data can be reviewed on the TRACECA home webpage.[19]

4. HMG & DFID'S trade initiatives

As part of a wider HMG Trade Policy[20], The African Free Trade Initiative (AFTi) launched in early 2011 is specifically designed to address many of the trade and transport facilitation problems alluded to above. [21]

AFTi adopts a multi-stranded approach including:

- Supporting regional economic communities in East and Southern Africa in securing free trade agreements as part of the process of developing African Economic Community.
- Short Term soft measures to improve trade facilitation through the streamlining of bureaucracy especially at the border crossings on the main transit routes, the modernisation of customs facilities and procedures and the removal of restrictive trade practices.
- Raising public and private finance to support investments in transport infrastructure and providing seed capital to reduce commercial risk.

In Southern and Eastern Africa, AFTi aims to reduce the travel time on the North-South Corridor from nine to seven days with, for example, investment in one-stop border posts that can reduce crossing time from three days to three hours[22] , and on the East-West Corridor from Kampala to Mombasa by three days. The 2012 Annual Review of the Support to West African Regional Integration Programme (SWARIP) highlights the over-ambition of the original design, and advises on a range of re-design features, including enhanced emphasis on private sector involvement. [23]

These investments reflect the need to adopt policies at both the macro and micro-economic levels, to target established corridors as the focus for assistance and to provide a combination of both hard and soft measures. The DFID Burundi Operational Plan 2011-2012 (May 2011) includes a target to reduce the number of days required to export a container from 47 (2010) to 45 (2012) as part of its wealth creation indicators.

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[17] http://www.traceca-org.org/fileadmin/fm-dam/Tacis/tacis_traceca_eval.pdf
Jacobs Consultancy Review, July 2003, 195pp

[18] http://eurasiacritic.com/articles/evaluation-traceca-programme
[19] http://www.traceca-org.org/en/home/

[20] http://www.bis.gov.uk/policies/trade-policy-unit

[21] http://www.dfid.gov.uk/news/latest-news/2011/uk-government-ramps-up-trading-in-africa/

[22] http://www.dfid.gov.uk/Stories/Case-Studies/2010/Trading-across-borders-North-South-Corridor/

[23] http://www.dfid.gov.uk/Site-search/?q=east+west+corridor
See SWARIP Annual review April 2012.

5. Key issues

5.1 Infrastructure

One of the keys to the success of the Trade Corridor is the upgrading of its infrastructural network especially transport, energy and telecommunications. This will require substantial investments and the provision for on-going maintenance. Given the paucity of the infrastructural network in LDCs and especially in Africa, the magnitude of assistance is enormous. In Africa alone, the World Bank estimated that investment in infrastructure needed more than 5% of each country's GDP and that an additional 4% was needed to meet maintenance and operational costs if the goals of the Millennium Challenge were to be met.

Subsequent estimates by AICD[24] doubled this figure. Responsibility for the management and maintenance of AICD has now migrated to the AfDB through the Africa Infrastructure Knowledge Program.[25] The anticipated costs for the Programme for Infrastructure Development for Africa (PIDA) to 2040 amount to some $360 billion and for the Priority Action Plan, PAP (2012-2020) some $68 billion. Energy and Transport sectors comprise 95% of an aspirational budget that amounts to a demand for resources of circa US$7.5 billion for the next nine years. The projects are varied, representing both short-term and long-term plans (e.g. INGA phases in DRC), and water/watsan and ICT are arguably under-represented in the portfolio. [26]

For countries that are experiencing sustained economic growth especially in Africa, there needs a substantial re-focusing of national budgets and the channelling of a much greater proportion of finance to infrastructure with a key element being the designated trade corridors. For PIDA it is anticipated that domestic sources will provide 50% of the funding by 2020 and 75% by 2040. Although this has been recognised by PIDA, political support for regional projects is notoriously difficult to achieve, as they are unpopular when domestic spending appears to be benefiting neighbouring countries.

ODA will continue to play a key role but countries will need to re-orientate themselves to utilising a range of financial mechanisms. These include infrastructure bonds, which have been used in South Africa to fund toll roads and extensively in Kenya; and loan guarantees, which provide incentives to potential investors interested in PPP schemes. The provision of an attractive investment climate with clear and transparent legislation is an essential element in developing confidence. The September 2011 Joint DFID Mozambique and DFID Southern Africa Business Case for the Mozambique Regional Gateway Programme (MRGP) provides useful insight into how a variety of PPP schemes have worked (e.g. internal container depot in Mwami, Malawi; one-stop border crossings; preparing projects for financing; and convening stakeholder using TA). [27]

There are, however, a number of critical problems that need to be addressed including:

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[24] Africa Infrastructure Country Diagnostic
http://www.infrastructureafrica.org/aicd/library/doc/552/africa's-infrastructure-time-transformation

- [25] www.**afdb**.org/fileadmin/uploads/**afdb**/Documents/Publications/**AIKP**%20... · PDF file
  Africa Infrastructure Knowledge Program Bulletin No. 1, March 2011 1 This is the first issue of the Bulletin that the **African Development Bank** (**AfDB**)
- [26] www.**afdb**.org/.../**PIDA**%20note%20English%20for%20web%200208.pdf · PDF file Development Bank (**AfDB**), have worked for years to address the ... **PIDA** Priority Action Plan: **summary** tables of sector projects and programmes

[27] http://www.dfid.gov.uk/Site-search/?q=ppp+trade+corridors

- The prioritisation of projects where political considerations often override economic ones and competition between countries along the corridor militate against unified and coherent actions.
- The lack of coherent actions on the corridor amongst aid donors and indeed competition amongst them for priority projects.
- Inadequate coordination between national and regional agencies in defining key projects and maintaining coherence in delivery and sequencing to achieve maximum impact.

Project preparation, following generally accepted internationally recognised preparation guidelines and processes, is, therefore, vital for involving the private sector and for co-ordination among the various funding agencies.

There have been a number of initiatives to overcome these problems.

- In Africa, the establishment of NEPAD (New Partnership for African Development) was a very positive step in this process with its focus on RECs and its IPPF (Infrastructure Project Preparation Facility). The decision to establish an Infrastructure Consortium for Africa (ICA) at the Gleneagles summit in 2005 to support NEPAD also led to the concentration of funding by the G8, the G20 and other major funders.[28] It also provided a mechanism for new funders such as China and India to participate in infrastructural ventures

- EU-Africa Infrastructure Trust Fund
  To support the implementation of the Partnership, the EU-Africa Infrastructure Trust Fund (the Trust Fund) was launched in 2007. It encourages the financing of infrastructure programmes which facilitate interconnectivity and regional integration on the African continent. It aims to support synergies between European development agencies for the benefit of Africa, leveraging additional funds by blending grants from the European Commission and EU Member-States with long-term loan finance made available by eligible Financiers.[29]

- PIDA (Programme for Infrastructure Development for Africa), launched in 2010, this is designed to bring together under one coherent programme, existing infrastructure initiatives and to develop concrete, affordable projects aligned with Africa's long term development goals. The essential elements of this programme is that it has been based on lessons learnt from infrastructure planning initiatives in Asia, Europe and South America and involved a detailed gap analysis resulting in some 50 key projects and a Priority Action Plan (PAP). It also emphasised regional integration, development impact, affordability and readiness amongst the criteria for selection.

- In the MEDA countries, the EUROMED[30] Transport Project was specifically designed to prepare a detailed diagnostic study of the transport infrastructure around the Mediterranean as well as appraise the institutional framework. More importantly, it identified a core of key projects that were a priority in short term. The Regional Transport Action Plan (RTAP) is designed to translate this into a coherent set of actions and selected corridors to build a sustainable Mediterranean Transport Network.

[28] G8, World Bank Group, AfDB Group, EC, EIB, Development Bank of South Africa, now in the process of expanding to new donors.
[29] http://eu-africa-infrastructure-tf.net/

[30] http://www.euromedtransport.org/En/home_4_46

- In the European Union, the TEN-T[31] Programme provides a package of strategic projects covering all transport modes clearly identified and evaluated in conjunction with partner countries and supporting some 198 projects amounting to some €6.2 billion for 2007-2013.

- PIDG[32] (UK-initiated/co-sponsored Private Infrastructure Development Group) has founded a range of specialised financing and project development subsidiaries designed to overcome the obstacles to generating private sector investment in infrastructure projects in poor countries. As new obstacles emerge, the suite of distinct companies respond with custom-made solutions to address:
    - Lack of suitable infrastructure projects for commercial investment.
    - High upfront costs of project development.
    - Shortage of long-term debt.
    - Lack of local currency investment.
    - Inadequate capacity in public and private sectors.

With respect to transport, the key objective of the corridor is to stimulate trade and development by reducing the time and thus costs that traders incur transporting goods along these corridors. Whilst substantial investments are needed for infrastructure upgrading, many efficiency gains can be generated by measures to improve trade facilitation especially at the borders. These incur much lower costs and generate huge returns with a much shorter time span for implementation. This is discussed in the next section.

With regard to modal choice, emphasis has traditionally focused on road transport, which normally provides the least cost solution. Certainly, there is a need for substantial capital investments in the road networks but, where appropriate, these should form part of an overall multi-modal approach, from port to final destination and vice versa, where necessary, building new links to avoid congested urban areas, that seeks to maximise transport usage and linkages amongst all transport modes. Adequate provision must, however, be made, for effective maintenance and consideration must be given to the financial implications for this provision.

A vital aspect in meeting the goals of poverty alleviation is ensuring that there is adequate provision for the connection of the rural road network to the major road arteries. Without this, the economic development aspects of specific corridors will lose much of their focus.

Whilst railways offer least cost options for bulk transport and are more environmentally-friendly, many LDCs and especially those in Africa have railway systems that lack interconnection, have differing gauges and limited axle load limits, and do not generate sufficient traffic volumes to make them economically viable. However, the increasing importance of extractive industries and mining as a key driving force in the rapid growth of many economies especially in Africa necessitates a re-appraisal of their potential on a project by project basis using private sector investment wherever possible.

Investments in ports are vital to the development of corridors since they provide the major connection to international markets. Port efficiency, however, is very much dependent not only on investments in berths, handling and storage facilities especially containerisation but also on the processing and clearance procedures in place. Transit times through the ports and the turn-around times for vessels very much depend on the speed of customs clearance, the cooperation amongst all agencies operational in the port and the

[31] http://ec.europa.eu/transport/infrastructure/index_en.htm

[32] www.**pidg.org**

effectiveness of the clearing agents. The physical linkages to the main transport arteries, in each country, are also extremely important. In this regard, consideration of intermodal solutions is vital. The choice of the port management system is also crucial in raising their efficiency.

5.2 Modernisation of Customs and Related Services

Upgrading infrastructure at border crossings on the trade corridor is an essential element in expediting transit and the provision of equipment such as scanners, electronic gates, weighing stations combined with laboratories and adequate parking and inspection areas are positive elements in achieving these goals.

These investments in hardware, however need to be matched with soft measures, such as integrated border management systems (working at one stop border posts), that are much less capital intensive and yet have a major impact on reducing transit times and lowering transport costs.

Critical to this are measures specifically designed to improve transit times at the border crossings on the key transport arteries. Research has shown that even without major investments in infrastructure, substantial gains can be made by measures to promote trade facilitation.

The PIDA evaluation of Africa's transport sector estimated the total economic costs of ARTIN's inefficiencies to be in the order of $172 billion and identified costs due to the failure of trade facilitation measures and trade policies as the key element in these costs.

Measures to eliminate these problems include:

- The development of a Single Window at border crossings. This allows traders to lodge standardised documents through a single entry point to fulfil all import, export and transit regulatory requirements.

- The introduction of a standardised system for customs clearance. Over 33 African countries use ASYCUDA[33] in one form or another and steps need to be made to upgrade these to ASYCUDA World, which allows traders, brokers, clearing agents etc. to input their declarations on to the computer prior to shipment.

- The introduction of Authorised Operator Programmes and Golden Lists. [34]

- Risk management, pre-clearance and post-audit. The difficulty is that even where risk management systems are in place, red lane inspections are common either because traders deliberately undervalue their goods and/or because custom's officer's salaries are linked to the quantity of inspections/seizures. Risk management will only work effectively, however, where all key agencies subscribe to it and there is a unified approach. [35]

[33] ASYCUDA. Automated System for Customs Data. Developed by UNCTAD in 1981 and has progressed from ASYCUDA AV2 to ASYCUDA++ and now ASYCUDA WORLD.
[34] Golden List. Preferential list of operators who have been pre-screened and selected to operate with limited inspections at border crossings.
[35] Risk management also only works with larger firms when you have large number of small importers as is the case of Dar es Salaam. Where the majority of importers import 1 2 or 3 containers at a time it is difficult to apply effective risk management.

- The provision of hardware such as fixed or mobile scanners, electronic gates, unified weighing stations.

- The harmonisation of standards for laboratory testing at all borders on the corridor. The problem is, however, that laboratory facilities at the border crossing are often inadequate and goods have to be sent many miles to the capitals for detailed examination. The provision of mini labs at border posts would be a positive step in overcoming this problem.

In recent years, there has been a further step forward on this issue with the development of the One Stop Border Post (OSBP). [36] DFID (TMEA and TMSA), AfDB, and WB in conjunction with JICA, have been instrumental in supporting this initiative, including one at Chirundu on the border between Zambia and Zimbabwe, which handles 400 to 500 trucks per day. By establishing one combined facility for entry/exit on each side of the border, excessive duplication is removed and transit times are dramatically improved. [37] Prior to the OSBP, waiting time averaged four to five days in 2009, compared to 13 hours for exports from Zambia recorded at the end of 2010.

DFID sees these OSBPs as positive developments in reducing transit times and is funding a further seven in East Africa alone. Critical to their success, however, is the harmonisation of systems on both sides of the border and, if possible, consistency in training, payment of each country's customs officers and compatibility in risk management procedures.

Delays can also be reduced by the introduction of electronic cargo tracking systems, which reduce the need for convoys (except in the case of dangerous goods), thereby alleviating congestion at the ports and accelerating transit through countries. Similarly, holding yards can use electronic tagging to track movements of containers through the ports and thereby highlight potential trouble spots. These systems have been used very effectively in Jordan. [38]

What is required is integrated border management with one stop border procedures that ensures the participation of all Government agencies involved at the borders, the modernisation of equipment and systems, greater independence by the broking firms and a system that relies more on risk management and less on physical inspections.

Coordination between all the border crossing agencies including Customs and Excise, Ministry of Agriculture, Ministry of Transport for axle load control security is also essential with their integration into a unified approach. The signing of MOU among them would be a positive step to harmonising systems, as would bilateral agreements covering topics such as which information will be collected and how it will be shared.

The development of inland ports (dry ports) and/or logistical centres is also a step forward in simplifying the logistical chain and in relieving port congestion.

A further critical area that needs to be addressed is the legislative framework. Without adequate penalties in place for smuggling and corruption, there will be no deterrent. This requires a review of customs legislation and the introduction of much more punitive measures for transgressors.

5.3 Logistics and transport Services

[36] Where entry and exit formalities happen only once, effectively in the country the truck is entering.
[37] Average waiting times were reduced from approximately 72 hours to 37 hours for imports to Zambia and to 13 hours for exports from Zambia between December 2009 and September 2010.
[38] Altifani, A (2011) Jordan Customs. Electronic Transit Monitoring and Facilitation System

In conjunction with problems associated with diverse customs procedures, which impact adversely on traders through time delays, inefficient logistics and transport services impinge on the efficiency of trade corridors. Traders require common standards for service providers be they freight forwarders, customs brokers, logistics providers or trucking companies.

Issues associated with trucking companies relate to outdated and often dangerous vehicles, low profitability and lack of markets for contract haulage. Given that road transport is likely to offer the least-cost option and the fastest time mode for freight transport, at least in the short and medium term, this is an area where policy changes providing regulatory reform with financial incentives to upgrade vehicles would produce substantial returns. It would drive down transport costs and generate considerable benefits for consumers. Improved regulation especially with respect to axle loads and gross vehicle weight limits, if enforced would also generate safety benefits and reduce road pavement and vehicle life cycle costs. Harmonisation of truck manufacturing standards would also help as would the expansion of the TIR scheme. [39] There are, however, wide variations in the severity of the problem between regions. In Africa, for example, the permit system is a major problem in West Africa but is not so acute in Southern Africa.

Deregulation of trucking industries can also have significant effects. The elimination of queuing systems in Jordan especially at the port of Aqaba had a major effect on streamlining the trucking industry, introducing much greater competition and driving costs down to consumers and producers.

There is also a critical need for improvement in brokerage and forwarding agencies both in terms of the numbers operating in specific countries and their lack of technical expertise.

Huge delays are also caused by the need for a multitude of documents rather than a SAD[40] and brokers inability to access the customs document system.

5.4 Institutional arrangements

One of the critical issues that need to be addressed once the overall framework for the corridor has been agreed is the institutional arrangements for its management. [41] It is essential that all stakeholders (government and private sector) are involved in such institutional arrangements and that the various corridor activities are prioritised, synchronised and harmonised. Without this, there is a distinct danger of fragmentation and lack of cohesion and consensus.

The World Bank[42] is very supportive of Corridor Management Agencies since it believes that they are vital for bringing all the parties together in all the countries concerned and act as the main driving force in planning and financing, establishing legislative and regulatory frameworks, operating, monitoring and corridor promotion.

It points to the establishment of the Trans-European Transport Network Executive Agency (TEN-T EA) [43] as a prime example of success in this area. Other options have included the development of Trade and Transport Facilitation Committees (TTFs) strongly supported by

[39] TIR. Transit International Routier. A system of bonds operated by UNECE in some 70 countries that guarantees that customs and duties will be paid on goods in transit.
[40] Single Administrative Document.
[41] The Walvis Bay corridor group (privately run) is a very successful model. Trans- Kalahari Corridor secretariat (funded by member states)
[42] Best practices in Management of International Trade Corridors. Transport Paper 13, World Bank, 2006.
[43] TEN-T EA: Trans-European Transport Network. Executive Agency

UNESCWA and operational throughout the MASHREQ[44] region; and Corridor Steering/ Management Committees which have a much more technical focus.

Whilst it is recognised that there is no uniform approach to this central issue, whatever institutional arrangements are introduced, they must operate at three separate levels - the regional level, which requires inter-Governmental collaboration; the national level, which requires consensus among all stakeholders, be they public or private and the Corridor-specific level, which demands the interaction of all technical agencies especially with regard to trade and transport facilitation. Of over-arching significance is concord and agreement between affected Heads of State and state institutions.

One of the problems in SSA is the number of corridor management systems each with differing trade regimes and the propensity of certain countries to be members of a wide range of corridor systems with conflicting aims and objectives. This only serves to produce fragmentation, the dilution of efforts and competition in soliciting donor support. Causes are many and various, and may be attributed to differing national or regional priorities, opportunistic sponsorship by donors or frustrations over trade delays.

The critical issue with these institutions, however, is the capacity of the corridor management agencies to enforce their directives and in many cases their efficiency is diluted by their inability to exert effective controls.

Clearly there will be a need for some economically sustainable financing provision to enable key staff to be recruited and retained to coordinate corridor management. Whilst many of the sub-committees will be funded from member country provisions, permanent staff whether they are administrative or technical will need financial support to ensure sustainability. Given that the private sector will benefit considerably from measures to improve transit times, especially at ports, many corridor management committees impose a levy at the port. The Walvis Bay Corridor Group has an 'ability to pay' formula in place. Alternatively, a levy can be imposed at the port, based on cargo value or tonnage as is used by the Northern Corridor Transit Transportation Authority. Care needs to be taken not to deter users from switching to alternative ports.

6. Lessons learned

Stakeholder Involvement: The development of Trade Corridors can be a crucial element in the strengthening of regional integration. Crucial to the success of these programmes, however, are the involvement of all stakeholders at the governmental level in the participating countries and consensus amongst them on the goals and objectives, the strategic priorities and the allocation of resources. A tension sometimes exists between national and regional priorities, particularly with trans-boundary water and trade/transport, and energy programmes. Equally important, however, is the participation of the private sector both at the industry and financial levels, and the donor community. There needs to be consistency in approach and the synchronisation of delivery mechanisms, where stakeholders are involved but executive decision making is implemented.

Strategic Planning: One of the key lessons that has been learnt from PIDA is the need for the development of an overall strategic development plan covering the short, medium and long term planning horizons. Although difficult, within a country where short term budget and political timelines take precedence, this needs to be coherent in approach, based on stakeholder consultations, at all levels and realistic in terms of its goals and objectives. It also needs to be based on a comprehensive gap analysis covering all countries involved,

[44] Iraq, Israel, Jordan, Kuwait, Lebanon, Syria

covering not just capital investment costs but the institutional arrangements needed. It needs to be set within an overarching macro-economic framework, have a sound implementation strategy and generate projects that are affordable, have a major impact on regional integration and have widespread development potential. In truth, PIDA is not completely comprehensive, and builds on previous priority lists from African nations and institutions. However, and importantly, what it does represent is engagement in a political (and semi-technical) prioritisation process endorsed by African Heads of State. Resources to fully implement the PAP have yet to be identified.

Project Identification and Preparation: There is a critical need for the identification and evaluation of a package of projects to support the strategic objectives of the specific corridor. These need to be carried out in accordance with international recognised methodologies for cost benefit analysis and environmental impact assessment. The IPPF developed under NEPAD has proved a very positive element in identifying and evaluating key projects, but is only one of some 60 or more Project preparation facilities now being critically evaluated by the ICA (contract let to CEPA). The PAP developed under PIDA (which itself followed the AICD work) has been instrumental in translating a diagnostic study into a series of generally agreed infrastructure projects for the period 2012-2020. Similarly, the TINA programme funded under the PHARE Multi-Beneficiary Programmes was instrumental in identifying key projects along the PAN European corridors. The EUROMED programme also identified key projects for the MEDA region. The securing of finance to undertake these feasibility studies is an essential element in this process.

The role and value of the EU Infrastructure Trust Fund and other programmed investments supporting regional trade are summarised in the DFID Africa regional programme Operational Plan 2011-2015 (April 2011)[45], with the regional programme summarised in a May 2011 flyer, and the overall range of trade support investment mechanisms/windows listed on DFID's "Countries and regions" webpage[46] .

Hard and Soft Measures: Whilst there is an essential need for capital investments to upgrade infrastructure on the corridors, the potential impact of soft measures should not be understated and these should form part of a cohesive plan. In the transport sector, there is a substantial body of evidence to support the thesis that measures to improve trade facilitation can have a major impact on reducing transit times along the corridor and that they can achieve significant results in the short term without excessive costs. Harmonisation of transit polices combined with integrated border managements systems can yield very positive effects. Eliminating corruption and reinforcing transparency are critical elements. The transparency possibility lessons from a seven-country infrastructure construction pilot (including from the UK) which was co-sponsored by DFID and the World Bank are now being rolled out through the CoST programme. [47]

Financing: The sheer scale of funding requirements for the development of Trade Corridors will require a fundamental re-appraisal of financing options. The implementation of PIDA projects alone to 2040 are estimated to amount to some $360 billion with the PAP costing some $65 billion in the period 2012 to 2020. Whilst ODA will continue to play a pivotal role, financing will be very much based on mobilising domestic public and private resources and

[45] http://www.dfid.gov.uk/Site-search/?q=eu+africa+infrastructure+trust+fund
EU Africa Infra TF in DFID ARD Operational Plan 2011

[46] http://www.dfid.gov.uk/work-with-us/funding-opportunities/countries-and-regions/
DFID trade funding windows

[47] www.constructiontransparency.org
Construction Sector Transparency Initiative - CoST is a targeted initiative to improve the value for money spent on public infrastructure by increasing transparency

in utilising much more innovative sources of financing including infrastructure bonds and loan guarantees such as those used in the Maputo Development Corridor. The mobilisation of domestic resources and the private sector will be crucial elements in corridor development and will require sound legislation to provide assurance to investors combined with competitive markets. A positive role for DFID and other donor institutions is to provide soft or blended financing for strategic planning and project preparation to ensure that feasibility studies comply with international standards and provide sufficient information to attract potential private sector (co-)investors

Lessons from West Africa & USAID-sponsored studies: [48]
Many of the findings show that few transport and logistics issues are corridor specific. In fact, the corridor-specific differences are mainly limited to the following:

- On the Lomé-Ouagadougou corridor a bilateral cargo sharing agreement is strictly applied, which is not the case on the Tema-Ouagadougou corridor.

- Transit traffic through Togo has to travel in convoys with escort, something that is not the case on the Tema-Ouagadougou corridor where customs use GPS tracking in order to know the whereabouts of trucks carrying transit cargo.

- The Lomé-Ouagadougou corridor has, at Cinkassé, the region's first Joint Border Post. However at the time of writing this referenced report (Autumn 2011) the border post was open but procedures were still the same as before the Joint Border Post became operational.

- Lomé port and Tema port each has its own bottlenecks to resolve.

Most issues and the ones with most potential for bringing far reaching improvements are common to the region as a whole. The five most important recommendations identified by the Reports in terms of potential savings are:

- Liberalise the West African trucking market. A free market in trucking services would replace cargo sharing rules between transporters from the port country and the landlocked country, and the "first come, first served" cargo-truck allocation system existing at Lomé port. This would result in more competition based on price and quality of service, and lead to a more professional trucking industry with newer and better maintained trucks, making the Lomé-Ouagadougou corridor faster and less costly. The study encourages ECOWAS member states to consider not only the deregulation of transit traffic but the creation of a single market for transport and logistics services in the region.

- Create a single market in the ECOWAS region. This would solve many problems as it would eliminate internal borders between ECOWAS countries and thus remove the landlocked status of Burkina Faso and other Sahelian countries from the perspective of transport and trade.

- Eliminate corruption and road checkpoints. This is a difficult subject but the road governance initiative has achieved important reductions in the number of barriers and related bribes and delays on all corridors that are part of the program, which suggest that a sustained effort supported by effective advocacy does bring results.

[48] www.watradehub.com/.../apr12/jan-2012-rev-final-corridor-ii-lome-ouaga... · PDF file Lomé-Ouagadougou Corridor West Africa Trade Hub Technical Report No. 47 January 2012 This publication was prepared for review by the United States Agency

- Implement ECOWAS and UEMOA axle-load regulations. This is of paramount importance in order to protect the regions road infrastructure and reduce maintenance and replacement costs. It will also create a level-playing field in which transporters adhering to the rules are not subject to unfair competition from transporters who can offer lower prices because they overload their trucks. It will also increase road safety as overloaded trucks are more difficult to drive and subject to more breakdowns, both of which increase the risk of accidents.

- Reduce container handling charges at the Terminaux routiers à conteneurs du Burkina (TRCB) This would promote the use of containers for all transit cargo and thus improve speed and security in clearing goods and also reduce the occurrence of overloaded trucks, reduce loss and damage to the goods and make it more difficult to tamper with the goods while in transit.

The complete list of recommendations can be found in Section 6 of the report with estimated potential annual savings to be almost US$ 80 million: US$ 71.2 million for imports and USD 8.3 million for exports.

The biggest surprise of the Tema-Ouagadougou study was that delays and bribes at road barriers – although a serious and highly visible “cancer on society” – are a small part of the total bribes and delays suffered by traders and transporters on the Tema–Ouagadougou corridor. For imports, bribes paid at road barriers on the Tema-Ouagadougou corridor amounted to less than 10% of the total amount of bribes paid by traders on imports. For exports, bribes paid at road barriers are similar to those paid for imports, but overall bribes for exports are only about one fifth the bribes paid on imports. A similar situation was found on the Lomé-Ouagadougou corridor where bribes at road blocks represented only 14% of total bribes paid on imports.

In fact, most obstacles to trade and transport were found to be perfectly legal. Examples include cumbersome clearing procedures in ports, at border crossings and at inland terminals, which encourage corruption in order to speed up the processes. Other examples involve the customs requirement that transit traffic travel in convoys, and the inefficient truck-cargo allocation procedures.

One of the aims of the corridor studies was to allow users to compare the performance of different corridors and their components so as to help users chose the best option. In this study the team was able to compare the performance of Ouagarinter in 2009 and 2010 as well as Lomé port in 2009 with Tema port in 2008 and 2010. The team discovered that things do change, and often for the better. For example, the time required for clearance at Ouagarinter was reduced from 6.0 days in 2008 to 2.4 days in 2009-10 while Tema port operations were reduced from 10.7 days in 2008 to 6.9 days in 2010. These comparisons of performance over time show that in order to compare the performance of different corridors, it is essential to do so at the same point in time.

Annex 1: Table of acronyms

AFTi	Africa Free Trade Initiative
AICD	Africa Infrastructure Country Diagnostic
ARD	Africa Regional Division DFID
ARTIN	African Regional Transport Infrastructure Network
ASYCUDA	Automated System for Customs Data
COMESA	Common Market of East and Southern Africa
DBSA	Development Bank of Southern Africa
DFID	Department for International Development
EAC	East African Community
EC	European Commission
ECA	Economic Commission for Africa
ECOWAS	Economic Community for West Africa
EU	European Union
GPS	Global Positioning System
ICA	Infrastructure Consortium for Africa
IPPF	Infrastructure Project Preparation Facility
LDC	Least Developed Country
LLDC	Landlocked Developing Country
MOU	Memorandum of Understanding
NEPAD	New Partnership for Africa's Development
PAP	Priority Action Plan
PIDA	Programme for Infrastructure Development in Africa
PIDG	Public Infrastructure Development Group
OSBP	One Stop Border Post
REC	Regional Economic Community
SAD	Single Administrative Document
SADC	Southern African Development Community
SSA	Sub-Saharan Africa
TEN-T	Trans-European Transport Network
TMEA	TradeMark East Africa
TMSA	TradeMark South Africa
TTF	Trade and Transport Facilitation
UNCTAD	United Nations Conference on Trade and Development
UNESCWA	United Nations Economic and Social Commission for West Africa

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Review 10

Review of donors' infrastructure strategies

By Xochitl Benjamin

1. Introduction

This paper was drafted as part of an Evidence Review to provide background for a DFID Infrastructure Position Paper. The topic covered here, as requested by the Terms of Reference, is an overall review of other donor's infrastructure strategies, including emerging donors, and overall financing trends with a view to providing information to support informed decision-making within DFID.

This paper was prepared primarily through a review of key resources and analysis. Limited time and resources were available for what is a broad and far-reaching topic, which was also requested to be reasonably brief, therefore this is not an exhaustive review but rather an overview to identify salient trends that have emerged, based on the available evidence.

This review considers emerging trends in the financing for infrastructure in terms of multi and bilateral agencies (the so-called 'traditional' or 'established' donors), new players (including philanthropic foundations, emerging-market countries and sovereign wealth funds) that are re-shaping the landscape, particularly in the wake of the financial crisis, but also in light of the fact that there is a major infrastructure financing deficit, particularly in Africa, the closing of which, will mean mobilizing support from a broader range of sources.

The review aims to provide evidence that can be used to make strategic decisions in the infrastructure sector.

'Infrastructure' here refers to that which is needed for economic development and poverty reduction – economic infrastructure – e.g. energy, transport, ICT, irrigation, water and sanitation and other infrastructure components of rural and urban development. It does not include 'social' infrastructure – such as schools, hospitals or housing.

2. Overview of investment in infrastructure

Starting around the early 1990s, traditional donors largely shifted focus from infrastructure towards stability, governance, human rights and various social issues (gender, healthcare, education, etc.). This shift was driven primarily by the failure of large-scale investment in infrastructure to become a catalyst for growth in the face of instability, corruption and mismanagement. Donors came to the view that unless broader governance and political structures could be improved, recipient countries would never reach the 'take-off point' of self-perpetuating development and growth[1].

As a result, investment in infrastructure declined sharply in favour of support for governance, institutional reform and social issues. This shift has also been driven by factors such as the MDGs and the PRSPs, emphasizing social and political transformation and poverty reduction, with no specific targets for infrastructure (and with little recognition that successfully achieving development goals would need to be underpinned by improvements in infrastructure).

Successive UN Least Developed Country (LCD) Reports noted significant and sustained declines in ODA for economic infrastructure provided to LDCs since the 1990s, despite increased rhetoric of its importance[2]. A 2004 OECD report on donor's approach to infrastructure found that: "70% of infrastructure investment in developing countries in the 1990s was financed by national governments, 25% from the private sector. In spite of the recognised importance of infrastructure to poverty reduction and strong commitments of bilateral and multilateral donors to reducing poverty, ODA accounted for 5%. Bilateral ODA commitments to infrastructure declined over the 1990s and multilateral donors did not compensate for the shortfall."[3]

The UK government's 2011 Select Committee Report on DFID's Role in Building Infrastructure in Developing Countries calls the move away from infrastructure "a mistake", along with the assumption that the private sector would play a greater role in funding infrastructure in developing countries.[4]

There is evidence to suggest that the tide is turning again, and that infrastructure is back on the donor agenda. The Gleneagles Summit of 2005 played a part, particularly at focussing on critical infrastructure needs in Africa, as did the financial crisis, which refocused attention on infrastructure as a driver of growth, poverty reduction and the attainment of the Millennium Development Goals (MDGs).

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[1] Numerous sources, including DFID and World Bank's 2008 Building Bridges report.
[2] For example, the 2008 report found: "Aid commitments to improve economic infrastructure decreased from 18 per cent of total commitments to LDCs in 1995–1999 to 12 per cent in 2006. Commitments to transport and storage infrastructure decreased from 11 per cent of total commitments to LDCs in 1995–1999 to 6 per cent in 2006, and disbursements to energy-related sectors shrunk from 5 per cent to 2 per cent in 2006." (Pg. 30-31)
[3] Braithwaite and Meade, 2004, pg. 1
[4] International Development Committee (IDC), 2011, Para. 6

2. Background – the scope of the problem

There is a significant gap between the size of investments in infrastructure needed by developing countries and what is being provided from all sources.[5] According to the MDB Working Group on Infrastructure's report to the G20, though data is inadequate, "underinvestment [by countries] is particularly large in Sub-Saharan Africa and South Asia. Investment levels appear broadly adequate in East Asia. No data is available for Eastern Europe and Central Asia."[6] Fragile states face a particularly large funding gap and have a particular difficulty in attracting funding from both official development assistance (ODA) - receiving just 10% and private capital (6%)[7].

It is estimated that over the next decade an average of 7% of developing country GDP will need to be invested in infrastructure per annum to meet basic needs and build the infrastructure required for rapid growth – and the figure may be much higher, particularly in Africa where it has been estimated at closer to 15%. Quality, reliability and maintenance are further challenges.[8]

Existing spending in Africa is estimated to be about $ 45bn a year (including budget, off-budget and external financing) while the need is estimated to be around $ 93bn[9]. Recent years have seen increased external support for infrastructure in Africa – from $ 7 bn in 2002 to $ 27 bn in 2009 but this is far short of what is needed[10].

The proportion of funding for the infrastructure sector in LDCs has hardly changed – from 4% in 2002 to 4.1% in 2009. Furthermore, low-aid LDCs are the only country grouping to be receiving a lower proportion of aid for economic infrastructure in 2009 (0.9%) than in 2002 (1.8%).[11] The Infrastructure Consortium for Africa (ICA) reported that in 2010, its members, which include G8 countries and large multilateral donors, provided the largest proportion of its aid (33%) to the relatively wealthier North Africa, with 25% going to the Republic of Africa. Just 6% went to Central Africa. North Africa also benefited from the largest proportion of external financial investment.[12]

In 2006, analysis by Estache found that large-scale private sector presence is less widespread than sometimes though. Roughly only one third of developing countries count on these for the delivery of electricity, water, or railways services. The largest presence is in fixed line telecoms where about 60% of countries rely on private operators. Overall, the private sector has roughly contributed to 20-25% of the investment realized in developing countries on average over the last 15 years or so. In Africa, it has likely contributed less than 10% of the needs[13].

The financial crisis has had a somewhat paradoxical impact – on one hand, it has underscored and led to a resurgent emphasis on the importance of infrastructure for growth and development – a number of bilateral donors and development banks increased spending on infrastructure and introduced or supported crisis funding mechanisms[14]. On the other hand, the private sector was constrained and this affected infrastructure investment

[5] Kingombe, 2011, Pg. 1
[6] MDB WG, 2011, pg. 7
[7] Kingombe, 2011, Pg. 3
[8] MDB WG, 2011, pg. 1, 2
[9] Kingombe, 2011, Pg. 3
[10] Kingombe, 2011, Pg. 3
[11] Development Cooperation Forum (DFC), 2012, Pg. 27
[12] ICA, 2010, Pg. 11
[13] Estache, 2006, Pg. 2
[14] For example, the DFID-supported Private Infrastructure Development Group (PIDG) introduced the Infrastructure Crisis Facility – Debt Pool (ICF-DP) in response to the lack of available credit for co-financing or re-financing of infrastructure projects as a result of the financial crisis.

across all sectors. The amount of investment and the number of projects declined, and those projects that were initiated tended to be concentrated in India, China and Brazil[15].

3. The current state

This section provides a brief overview of current infrastructure spending in different sectors.

Analysis has shown that ODA, private sector and non-OECD financiers combined exceed domestically sourced public finance for infrastructure, with the private sector being the largest single external source – particularly in the ICT sector. Smaller, but significant, capital is provided by ODA – concentrated in transport and water. Non-OECD financiers have provided support to a lesser extent, mainly for energy and rail[16].

3.1 Transport

In private participation in infrastructure (PPI), the financial crisis saw a decline in spend for transport projects. Prior to 2006, there was a heavy concentration of PPI involvement in Latin America and the Caribbean but since 2000, there has been a relatively faster growing share in Asia and Africa. LDCs remain largely locked out of this trend – receiving only 2% of trans-national corporation (TNC) investment.[17]

PPI activity in total declined between 2006 and 2009. The size of investment fell 37% from a peak in 2006, with a decline in number of projects of 58%. Activity concentrated on roads projects in a few large emerging countries such as India, Mexico and Brazil.[18]

The ICA noted that ODA from its members increased steadily from 2007 to reach $ 6.9bn in 2009, though it declined somewhat in 2010.[19]

3.2 Telecommunications

2009 was the end of rising PPI investment in telecoms which had marked out the period since 1990. Kingombe cites the financial crisis and market saturation in many countries to be the main reason for the decline.

Notably, telecoms investment is much more widely dispersed across countries that the other infrastructure sectors; in 2009, 28% of investment was in Brazil and India while for power, water and transport, the combined concentration was 63%.[20]

In Africa the picture was somewhat different; telecoms investment by the private sector led a recovery in private sector activity, with strong commitments in the ICT sector. More than 80% of private sector activity in Africa is in telecoms. Conversely, support provided by ICA members in ICT decreased significantly.[21]

The spread of internet across Africa has been much slower than the spread of mobile phone technology and general ICT access remains lower than in most other parts of the world but new infrastructure is being built using private African capital, public-private partnerships (PPP), and international investment. The EU has provided money through the EU-Africa

[15] Kingombe, 2011, Pg. 3-5
[16] Kingombe, 2011, Pg. 3
[17] Kingombe, 2011, Pg. 3
[18] Kingombe, 2011, Pg. 3
[19] ICA, 2010, Pg. 12
[20] Kingombe, 2010, Pg. 4
[21] ICA, 2010, Pg. 10

Infrastructure Trust Fund for the East African Submarine Cable System (EASSy) which is delivering high-speed internet access to 20 countries is Eastern and Central Africa[22].

3.3 Water and sanitation

PPI activity in water and sanitation has failed to provide the hoped-for resources to close the gap in investment more than in other sectors. At the same time, public providers have largely failed to become financially viable. Water providers often rely on cross-subsidy and direct subsidy making them a good candidate for output-based aid (OBA) arrangements, which can attract further funding.[23]

The cost of meeting the MDG target for water is estimated to be $ 16.5bn in Africa alone – and spending is only a quarter of that. Kingombe cites findings that in 2009 the number of LICs or MICs implementing new private water projects was just seven – the least since 1994.[24]

The ICA reported that support from its members recovered in 2010 to reach $ 3.8bn – the highest level since 2006[25].

3.4 Energy

Between 2003 and 2008, bi- and multi-lateral aid flows to energy mainly targeted Asia (61%), followed by Africa (26%). Lower middle income countries received the majority of aid to energy (56%), and low income countries 38%.[26]

Clean energy is a stated priority focus area for a number of bi- and multilateral donors, reflected in a number of projects selected for funding, such as, hydroelectric and wind power, and support for energy policy.[27]

In 2009, total investments to the energy sector reached $16.5bn, including $10bn in new private sector investment, reaching a twenty-year peak. However, private-sector investment was highly concentrated on a few countries (mainly India and Brazil) and on electricity generation projects.[28]

Africa stands out particularly in the energy sector – it has huge potential, but also one of the lowest usage rates of modern energy sources and a financing gap of about $23bn. Public expenditure is about a quarter of what it needs to be and mainly covers operations. Maintenance and investment are additional.[29]

ICA members' commitments in Africa doubled between 2009 and 2010 – to $12.9bn. This was largely accounted for by some large commitments to North Africa[30]. The New Partnership for Africa's Development (NEPAD), the AfDB and the EU-Africa Infrastructure Fund are promoting or prioritizing a regional approach to energy.[31]

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[22] Kingombe, 2011, Pg. 4
[23] Kingombe, 2011, Pg. 4
[24] Kingombe, 2011, Pg. 4
[25] ICA, 2010, Pg. 12
[26] OECD, 2010
[27] OECD, 2010
[28] Kingombe, 2011, Pg. 5
[29] Kingombe, 2011, Pg. 5
[30] ICA, 2010, Pg. 12
[31] Kingombe, 2011, Pg. 5

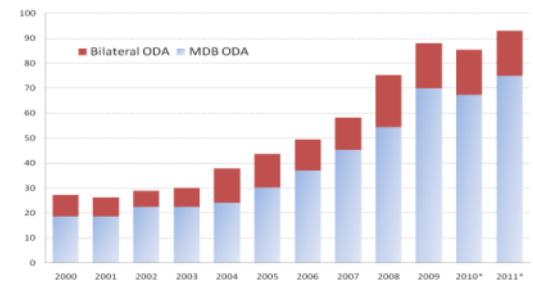
China has become a significant investor in power generation in Africa. Its investments helped to install 9GW of additional capacity, including 10 major hydropower projects.[32]

4. Sources of finance: traditional donors

4.1 The role of traditional donors – Development Finance Institutions

This section looks at the traditional bi and multilateral donors providing support through Development Finance Institution (DFIs). Table One below presents the picture for the traditional bi- and multilateral donors.

Table One: Estimated MDB and traditional donor ODA to infrastructure, 2000-2011* ($bns)[33]



Sources: OECD, AfDB, AsDB, EIB, EBRD, IADB, IsDB, a
*Estimates for 2010 and 2011.

Note: Bilateral category only includes OECD donors who report ODA to the OECD DAC. In 2009, total ODA reported to the DAC from non-OECD members (mostly Eastern European and Arab donors and not including China) amounted to $285 mn. It is unknown how much of this was allocated to infrastructure. While the graph above is clearly an underestimation – likely substantial – of *total* infrastructure ODA, it is useful in providing an estimate of the magnitude of resources provided to infrastructure by traditional ODA funders.

In November 2011, the MDB Working Group on Infrastructure submitted an Infrastructure Action Plan to the G20. The Plan has two key overall goals, with a number of sub-categories outlining how they intend to achieve their infrastructure plan.[34]

The key goals and points of their Action Plan are as follows:
Unblocking the project pipeline with technical assistance and targeted financial support, which entails:

- Improving project preparation funds (PPF) effectiveness
- Developing catalytic regional projects
- Expanding technical assistance through expanded PPP practitioners' networks
- Increasing incentives for MDB staff to engage in PPP transactions and regional projects
- Piloting an Africa infrastructure marketplace
- Improving procurement practices to facilitate collaboration with the private sector and amongst MDBs

Helping countries improve spending efficiency, which entails:

- Launching a global infrastructure benchmarking initiative
- Scaling up the Construction Sector Transparency Initiative (CoST)

[32] MDB Working Group in Infrastructure (MDB), 2011, Pg. 13
[33] MDB, 2011, pg. 9
[34] MDG Working Group on Infrastructure Submission to the G20, Infrastructure Action Plan, October 2011.

The World Bank Group (WBG)[35]

The WBG is in the process of developing a new strategy for infrastructure to replace its Sustainable Infrastructure Action Plan 2009-2011. According to interim briefing notes, in 2010, the WBG provided record level support of $28bn in financing for infrastructure and emerged as the largest multilateral development financier in infrastructure for both low-income (LIC) and middle-income (MIC) countries. Infrastructure now accounts for about 40% of WBG commitments. Its core areas are transport, water, energy and ICT, with transport having the largest share of commitments (65%). The WBG maintains a strong focus on partnering with the private sector and facilitating market-driven approaches. According to the MDB Working Group on Infrastructure the WBG's infrastructure lending flows are expected to stabilize at around $14 to $15bn per year.[36]

The International Development Association (IDA) is the WBG's public sector lending arm for the poorest countries (the IBRD provides a similar service for higher income countries). It provides interest-free grants and highly concessional loans. It lends to 81 countries, with Bangladesh being the top borrower, followed by India and Pakistan. Six of the countries in the top ten for borrowing are in Africa (Ethiopia, Ghana, Nigeria, Tanzania, Kenya, and Mozambique). While the IBRD raises most of its funds on the world's financial markets, IDA is funded largely by contributions from the governments of its richer member countries. The latest replenishment of its funds received $ 49.3bn for 2011 to 2014 – critical years for the lead up to accomplishing the MDGs. The UK contributed 12% of this. Infrastructure accounts for 42% of IDA funding activities.[37]

The DFID Multilateral Aid Review ranked the IDA highly in its contributions to UK development objectives, noting that it delivers funding where it is needed most, though focusses too strongly on approvals and disbursements, rather than on results.[38]

The International Finance Corporation (IFC)

The IFC helps increase access to power, transport and water by financing infrastructure projects and advising client governments on designing and implementing PPPs. IFC adds value by devising innovative projects and PPPs in difficult markets – around half of IFC support goes to the countries with the most acute needs. IFC mitigates risk and leverages specialised financial structuring and other capabilities. In 2010 IFC invested $1.5bn in infrastructure projects. IFC strives to deliver what cannot be obtained elsewhere by offering its clients a combination of investment and advice designed to promote sustainable private sector development in emerging markets, which it calls its 'additionality'[39]. In all of IFC's financings, its primary objective is to strengthen the borrower's ability to deliver key infrastructure services such as water, wastewater management, transportation, gas and electricity, and to improve their efficiency and accountability as service providers. The IFC cites 'increased concern about global climate change' leading to its resources being increasingly focused on renewable energy and energy efficiency projects. They have also become increasingly active in supporting water projects to address drought and chronic water shortages.

In 2010, the IFC Board created the subsidiary, IFC Asset Management Company LLC, to act as a fund manager for third-party capital. The goal of the IFC AMC is to address the shortage of equity capital in developing and emerging markets while meeting the IFC's development objectives and earning profit for investors. It provides a fund management

[35] WB website, Interim Briefing Note (Transformation through Infrastructure: Issues and Concept Note, 2011)
[36] 2011, pg. 9
[37] IDA website
[38] DFID MAR, 2011, Annex 6, Pg. 20
[39] IFC website

platform to raise money from sovereign wealth funds, pension funds and other institutional investors, and invests it using the IFC's approach.[40]

The DFID MAR rates the IFC to be satisfactory in terms of its contributions to the UK's development objectives – its performance in Africa is deemed weak, and it needs to continue to improve in its services to fragile states. It rates well as an organization and is likely to continue to improve.[41]

Regional Development Banks

African Development Bank (AfDB)[42]
The AfDB is currently guided by its Medium Term Strategy 2008-2012 (MTS), which has infrastructure as a core objective. Between 2008 and 2010, total sovereign and non-sovereign approved investments in infrastructure operations represented 60.4% of the Bank's total investment (this figure includes privates sector investment) in its four core infrastructure areas. Energy and power received the largest share (47%), followed by transportation (39%), water supply and sanitation (12%), communications (1%) and other infrastructure (2%).

The energy sector has seen an emerging emphasis on energy efficiency, clean and renewable energy and support to regional power pools. In the transport sector resources have been mobilized towards the expansion of regional corridors, trunk and rural roads, railways, and urban programs that support or open up economic hubs. The bank aims to direct a significant proportion of its new commitments to infrastructure investments, especially in the transport, power and ICT sectors. In the ICT sector, priority has been given to broadband and backbone infrastructure that connect countries to one another and to the rest of the world. Approvals in the water and sanitation sector are expected to boost access to water and sanitation focusing on peri-urban centres and the poorest 65% of rural populations, and to improve water management. The Bank will exercise leadership in continental initiatives for regional cooperation and integration, such as NEPAD and the Infrastructure Consortium for Africa. According to the MDB Working Group on Infrastructure, the AfDB aims to increase its funding for infrastructure by 5% over the next five years.[43]

The AfDB has a lending arm - the African Development Fund (AfDF) which makes highly concessional loans to regional member countries.The DFID MAR ranked the ADF to be strong as an organization, with a high chance of positive change, but only satisfactory in the way in which it meets UK development objectives, though a positive point noted was that it places a strong emphasis on infrastructure, regional integration and governance.[44]

Asian Development Bank (ADB)
The ADB's policy focusses on what it calls 'inclusive infrastructure' in line with its key priority area of inclusive growth. The four sector areas within its inclusive infrastructure platform are energy, transport, water and urban development.[45] The ADB is guided by its long term ADB Strategy 2020 policy document and infrastructure is a central focus, both as its own category, and as part of the ADB's other priority areas, such as at financing vehicles for infrastructure, regional integration in terms of infrastructure (for example road linkages) and

[40] Kingombe, 2011, Pg. 7
[41] DFID MAR, 2011, Annex 6, Pg. 23
[42] AfDB Website, MTS Mid-term Review, 2010
[43] 2011, pg. 9
[44] DFID MAR, 2011, Annex 6, Pg. 2
[45] ADB Annual Report 2011, pg. 39-40

investing in ICT infrastructure within its Governance and Capacity Development theme.[46] Its partner country strategies have a strong focus on infrastructure as well.

Asia is a fast-growing region and the challenge for the ADB will be to bring the poorer countries along. It has a growing focus on environmentally sustainable technology, such as green energy projects. In 2011, the ADB's cleaning energy investments reached $ 2.1bn, exceeding their target. They recently approved an equity contribution of $ 150mn for the Association of Southeast Asian Nations Infrastructure Fund to promote regional integration and this will continue to be a theme with key implications for infrastructure and joint management of cross-border infrastructure such as roads and energy schemes. Urban development and management will also continue to be a strong focus area for the ADB, taking in other aspects of infrastructure provision such as urban transport. According to the MDB Working Group on Infrastructure, the ADB's infrastructure financing is likely to stabilize at around $10.5 bn annually after peaking at about $11bn in 2011.[47]

The ADB's lending arm is the Asian Development Fund (AsDF) which is rated strongly all around in the DFID MAR. It was found to have a good presence in difficult environments, and to maintain staffing throughout conflicts. It was also found to have a strong focus on wealth creation through growth and infrastructure, in line with the UK's own development objectives.[48]

Other multilateral investors in infrastructure

There are a number of other multilateral investors in infrastructure, including the European Bank for Reconstruction and Development (EBRD) and other regional banks such as the Caribbean Development Bank. DFID's 2011 Multilateral Aid Review has a detailed look at those which are supported by DFID. The PIDG, outlined below, is emerging as a strong and innovative means of investment in infrastructure which draws in the private sector, overcomes deficiencies in the market and has a development focus. The Global Partnership for Output Based Aid (GPOBA) is another initiative with strong DFID support which is also considered below.

Private Infrastructure Development Group (PIDG)

The PIDG is a group of investment vehicles designed to respond to market deficiencies and overcome obstacles to investment in infrastructure in developing countries and emerging markets. It does this through its group of companies, each structured to fulfil a particular purpose or overcome an obstacle. PIDG facilities fall into two broad categories: financing facilities (including GuarantCo which provides local currency guarantees and Emerging Africa Infrastructure Fund (EAIF) which provides capital); and project development facilities – carried out by DevCo, InfraCo Africa and InfraCo Asia. The Technical Advisory Fund (TAF) provides grants for technical support.[49]

The PIDG is supported by a number of donors, including DFID. DFID has played a key role in engaging with and supporting PIDG from the beginning and PIDG's performance has attracted other donors as well, most recently Australia.[50] It was rated strongly in the DFID MAR – both organizationally and in meeting the UK's development objectives. It was noted

[46] 2011, pg. 42-43
[47] 2011, pg. 9
[48] DFID MAR, Annex 6, Pg. 3
[49] Pidg.org
[50] Pidg.org

that it has attracted $ 10.5bn in investment from the private sector.[51] PIDG's weaknesses include a lack of focus on impact on women and girls and a lack of focus on fragile states.[52]

PIDG has a good track record of working on projects with a 'demonstration effect' – that is, coming into a sector early, demonstrating success and backing off once the private sector has taken over. For example, it used to have a large proportion of mobile telephone projects but the success of that sector means that it has largely moved away from mobile phone projects in favour of less well-demonstrated sectors – energy, water, transport and others.[53]

Output-based Aid (OBA)

Output-based Aid (OBA) is a mechanism for providing infrastructure and social services to the poor, usually via public-private partnerships.

Unlike traditional aid approaches, OBA links the payment of aid to the delivery of specific services or "outputs." These can include connection of poor households to electricity grids or water and sanitation systems, installation of solar heating systems, or delivery of basic healthcare services.

Under an OBA scheme, service delivery is contracted out to a third party, usually a private firm, which receives a subsidy to complement or replace the user fees. The service provider is responsible for "pre-financing" the project until output delivery.

The GPOBA is the largest coordinating body for Output-based Aid, of which DFID and the World Bank were founding partners – later joined by Sida, DGIS, IFC and AusAID.

OBA is an innovative means of providing to poor with access to services that they would otherwise struggle to afford, however there is no evidence to suggest a significant acceleration in its use.

Though it may increase aid effectiveness and efficiency of procurement, OBA still depends on public and aid financing as private sector providers are subcontracted to provide services and paid on delivery of results. GPOBA has made efforts to expand activities into other sectors but transport projects account for nearly 75% of its financing. [54]

Bilateral organizations and DFIs

It is relatively more difficult to get an idea of the trends emerging from bilateral organisations due to the large number of them and the large number of channels through which they may direct aid. Bilateral aid is regularly assessed in terms of effectiveness – emphasising issues such as un-tying aid, increasing predictability and reducing fragmentation and bureaucracy, but less regularly analysed in terms of infrastructure spending trends. The most recent analysis comes from work done for the DAC Network on Poverty Reduction Task Team on Infrastructure's 2004 series, however much changed following the global financial crisis.

[51] DFID MAR, 2011, Annex 6, Pg. 28
[52] In 2012, PIDG commissioned two studies, one to look at impact on women and girls of PIDG supported projects and one to look at the wider evidence. These are on-going. PIDG has a larger problem attracting funding for projects in fragile states as it works on commercial terms and these projects can come with higher risks.
[53] The author of this paper previously contributed to the study the Impact on Women and Girls of PIDG Supported Projects (an internal document) through which this information was gathered.
[54] GPOBA website 2011

DFID committed approximately 13% of its ODA budget to economic infrastructure in 2010, yet its business plan makes no mention of infrastructure and few of its country plans cite infrastructure as a priority, a fact which led to criticism in the International Development Committee's 2011 Report on Infrastructure and Development. It is only by looking at the project level that it is possible to get an idea of what DFID is actually doing. Its 2011 Bilateral Aid Review (BAR) identifies countries in which investing in infrastructure is a priority but does not consider it otherwise. Though clearly a number of the pillars identified as priority in the BAR have an infrastructure component.

Table 2: Proportion of ODA for infrastructure

Country	2009-10
Japan	40%
Germany	22%
UK	13%
US	10%
EU	10%
Sweden	7%

Source: OECD Statistics

One significant area of focus among bilateral donors is bilateral development finance institutions. In the UK, the main BDFI is the CDC, which spends 34% of its investments on infrastructure, compared with other BDFIs, DEG (Germany) spends 19%, FMO (Netherlands) which devotes 24% and Proparco (France) which devotes 36%.[55]

4.2 The role of other players

Emerging country donors

Emerging countries such as China, Brazil, India and the Arab states have all become increasingly important regional and international players – both politically and financially. This 'south-to-south' aid is particularly significant when it comes to infrastructure.

Emerging countries are proving more willing than their traditional counterparts to invest in infrastructure. This is often, but not always, associated with resource extraction. Fast-growing emerging economies are providing investment in resource-rich developing countries in order to fuel their own growth. See Box One below on Chinese investment in infrastructure in Africa.

As of December 2010, China held an estimated $20bn portfolio in active infrastructure projects in more than 40 African countries. Chinese financing for African infrastructure projects is estimated to have reached record levels of roughly $5.1bn in 2009, though it fell to around $2.3bn in 2010. China's spending has in particular contributed to Africa's power generation, helping install 9GW of additional capacity, including 10 major hydropower projects.[56]

Other emerging economies have also taken an active interest in African infrastructure financing during the past decade. On average India invested $1.2bn and the Arab States $1.5bn from 2005 to 2009[57]. In 2010, Arab investment jumped to $3.3bn while Indian investment declined to $0.2bn.[58]

Emerging donors are often referred to as a bloc but there are key differences in their approaches and priorities. Gaining a full view of their role can be difficult as they often do not make their strategies and priorities public, and they tend to channel the majority of their financing through import-export banks rather than aid agencies.[59] A number of them are investing large sums of money in infrastructure though loans, grants and technical assistance, with few conditions, which is attractive to a number of developing countries. At

[55] Kingombe, 2011, Pg. 6, which includes telecoms, power, water, roads and hotels, though the CDC itself suggests it spends 8% on 'narrow infrastructure' and 10% on energy and utilities.
[56] MDB Working Group on Infrastructure, 2011, pg. 13
[57] MDB Working Group on Infrastructure, 2011, pg. 13
[58] ICA, 2010, Pg. 9
[59] MDB Working Group on Infrastructure, 2011, pg. 14

the same time traditional donors worry that this aid is undermining structural reform, creating debt (sometimes with unnecessary or overly-ambitious projects) and leading to human rights and environmental abuses and corruption[60].

There are some signs that things are changing among emerging countries. Perhaps in response to criticism of its growing role, particularly in resource extraction in Africa, China in 2011 released its first White Paper on Aid which gave the breakdown of its concessional loans as: 61% for transportation, communications and electricity infrastructure, and 8.9% the development of energy and resources."[61] The White Paper itself was short on detail but may be an important first step towards greater communication, transparency, and ultimately coordination.

Other emerging donors are also making efforts to introduce environmental and social safeguards. For example, since 1986 Brazil has required environmental assessments for all public- and private-sector domestic investments. Several Brazilian companies are now applying these procedures, with adaptation to local conditions, in projects they are undertaking in Africa.

South Korea, which was once the beneficiary of large-scale development funding – it received $13bn between 1945 until the late 1990s – demonstrates the changing face of development aid, and the way in which emerging donors can be brought into the international regime. In 2006 Korea joined the OECD and in 2009, its aid program was assessed to meet the requirements and it joined OECD-DAC. In 2008, its aid to other countries was more than $800mn and is growing steadily.[62]

Box One: China's investment in Africa

Chinese aid particularly has received a great deal of attention and criticism from traditional donors and observers. Critics argue that the Chinese are self-interestedly trying to grab resources with few social, environmental or political safeguards and a lack of transparency. Others argue that it is as important that Chinese aid is filling an investment gap in infrastructure not being met other sources.

China's infrastructure development in Africa in numbers:

- China's financing investments in Africa started from less than $1bn per year before 2004, rose to over $7bn in 2006, dipping to $4.5bn in 2007
- China has committed $3.3bn for ten projects which can potentially boost Sub-Saharan Africa's hydropower generation by 30%
- China is financing the rehabilitation of 1,350 km of railway and constructing 1,600 km of new railway lines across the region.
- Nearly 70% of Chinese investments are in Angola, Nigeria, Ethiopia, and Sudan
- Financing terms vary by country but typically involve a grant element of 33%, close to the benchmark level for concessional finance.
- Some 35 African countries have received Chinese infrastructure finance.
- There have also been a handful of transactions worth more than $1bn.

Source: Building Bridges: China's Growing Role as Infrastructure Financier for Sub-Saharan Africa, World Bank, 2008

[60] Sato et al, Pg. 4, 5
[61] Brant, 2011
[62] OECD website press release, undated

Foundations and trusts

Large and well-funded foundations and trusts, such as the Gates Foundation and the Ford Foundation (sometimes called megafoundations), are a category somewhat apart from both traditional and emerging donors. Their ethos probably relates most closely to that of established donors and NGOs – with an emphasis on poverty reduction and social issues such as health care, education and human rights.

There is little evidence to suggest a comprehensive focus on infrastructure among foundations, however there are also a number of areas in which they tend to work which do provide some support for infrastructure. Water and sanitation tends to be prominent, as does sustainable development (particularly green energy projects), infrastructure related to the provision of healthcare, and some direct funding of infrastructure projects[63].

In 2010, the Gates Foundation has provided $20mn to the City of Harare to improve infrastructure in the Harare district of Mbare.[64] The Gates Foundation is becoming increasing integrated into the international donor system, even becoming the first (and so far only) foundation to report spending through the OECD DAC, which shows that they target the vast majority of their funding at healthcare.[65]

The number, size and focus area of trusts and foundations varies widely, making coordination and targeted approaches a challenge. A 2011 evidence report submitted by the UK Centre for Charitable Giving and Philanthropy to the International Development Select Committee reviewed a number of UK-based foundations and found "areas attracting highest numbers of funders were direct health, education and welfare services. Sustainable economic and agricultural development attracted 10% of funders, with utilities and infrastructure close to this at 9% of funders."[66] It is likely that many of the utilities and infrastructure projects are related to water and sanitation, though this is not specified.

Public-private partnerships (PPPs)

PPPs have been a popular means to try and increase private sector participation in the face of limited public finances, but they have proved to be a challenge for a number of reasons: identifying potential investors, raising resources, writing sound contracts, improving regulatory frameworks and predicting revenue streams. The limits to PPPs, the low capacity of a number of countries to implement them effectively, the mixed results over the past 20 years and the financial crisis mean that they are unlikely to provide a broad solution to financing constraints.[67]

Nevertheless, in transport and in the road sector, for example, the use of PPP has increased in recent years – particularly in the form of Build-Operate-Transfer concessions for roads building (of new roads and expansion of existing). Africa has a number of examples, including the Maputo Toll Road and developments in Chad and South Africa.[68]

Private equity, investment banks, impact investing and Sovereign Wealth Funds

This section considers some asset classes or sources of financing with the potential to have considerable impact on infrastructure finance. These vehicles are currently relatively little used (for infrastructure development in developing countries), have considerable wealth – SWFs alone are estimated to have combined assets of more than $4tn and can bear long-term financing risk.[69] However, these vehicles also may have limited utility, as they tend to

[63] Based on a review of the strategies of a number of large organizations, including Gates, Ford, Clinton and Open Society
[64] Bill and Melinda Gates Foundation Blog
[65] OECD, 2011
[66] CGAP, 2011
[67] Kingombe, 2011, Pg. 8
[68] Kingombe, 2011, Pg. 8
[69] MDB, 2011, Pg. 13

invest in low-risk, higher-return assets. The MDB Working Group speculated that "their greatest promise may lie in refinancing projects already underway or in projects with substantial financing guarantees."[70] This was specifically regarding SWFs, but may apply more broadly as well. It is also likely that they will be reluctant to invest in higher risk and less stable countries.

A number of private equity companies (PE) have an asset class of infrastructure funds which invest in a range of infrastructure services and look for a steady return for their investors and shareholders. At present they have limited involvement in developing countries as the rates of return do not meet their objectives – being too high risk with the returns to low.[71]

Investment banks, including Goldman Sachs, Standard Chartered, Barclays and Nomura facilitate financing in infrastructure in a number of ways. For example, Standard Chartered has a team focussing on infrastructure investments across Asia and manages the Standard Chartered Infrastructure Leasing and Financial Services Asia Infrastructure Growth Fund (SCI Asia), which has a primary focus on China and India. Detailed information on bank's activities is limited as they tend not to make it publically available.[72]

An emerging asset class known as 'impact investing', intended to combine social impact and financial return, may offer potential to harness financing from pension funds, philanthropists, banks and the private sector. It is a growing class, with a growing range of options and investment packages and products, though there is no evidence to suggest that infrastructure is an explicit target as yet.[73] If it were to become so, the risks and rewards would need to be adequately balanced, but the sector is making efforts to improve social impact metrics and develop benchmarks and other measurement tools.[74]

Sovereign Wealth Fund assets have grown enormously over the past 20 years, accumulated mainly by the fast-growing, export-led economies, particularly China, India and oil-producing Arab states. SWFs include the China Investment Corporation, the Abu Dhabi Investment Authority and the Norwegian Government Pension Fund. The role of SWFs has been given greater prominence by the shortage of liquidity caused by the financial crisis. They have considerable latitude in choosing assets to invest in, and tend to invest in a broad range of areas, with a long-term view. Infrastructure investment can fit well within their investment mandate, and there is speculation that SWFs will increase their infrastructure portfolio as they continue to diversify and seek alternative assets.[75]

5. Conclusions

The emergence of this new financing landscape raises questions for further study, and identifies some key trends that can inform policy. These are considered in this section.

It is clear that traditional donors and governments alone will not be able to meet the full need for infrastructure investment – particularly in the post-economic crisis climate. Even the growing contributions from emerging economies will be insufficient. A combination of funding types needs to be sought and utilized effectively.

[70] MDB, 2011, Pg. 13
[71] Kingombe, 2011, Pg. 8, 9
[72] Kingombe, 2011, Pg. 9
[73] Economist, 10 Sept. 2011
[74] For example, through the Impact Investing Policy Collaborative
[75] Kingombe, 2011, Pg. 10

This means engaging with new sources of finance, which are available through Sovereign Wealth Funds and other vehicle, but are also largely untested regarding how willing and able they are to finance infrastructure, and under what terms.

Greater harmonization of approaches among all actors, as well as across regions, will be increasingly important to harness all possible sources of finance for the greatest impact. This will likely mean an increasingly important coordination role for organizations like the G20, and for regional organizations such as NEPAD. Bi- and multilateral organizations can also play a role in engaging with emerging donors and actively seeking cooperation and coordination.

There is also the issue of poor environmental and social safeguards used or enforced by emerging donors, of particular concern in infrastructure projects, which often have large impacts. Greater coordination, dialogue and support for introducing and enforcing standards will be required.

Coordination with the private sector to continue to find innovative new ways of developing and financing projects will be critical and are as yet not being fully explored. The demonstration effect of DFIs such as the PIDG may be helpful in this regard, as will organizations such as the IFC for playing a catalytic and coordinating role. There may be a need to look at providing some incentives to attract interest and demonstrate success – particularly in more challenging sectors, such as water.

International events have recently played a part in returning infrastructure to the top of the agenda but greater communication can help keep it there by demonstrating to tax-payers in wealthy countries, as well as other prospective donors and financing sources its critical importance – from construction through to operations and maintenance.

Better and more robust ways of measuring the impact of improved infrastructure on poverty reduction and growth will be important in order to ensure that the benefits are accruing to those who need it the most. Benchmarking and on-going monitoring will be important to building evidence base for the beneficial social impact of investment in infrastructure. This is particularly important in public-private initiatives to be clear that public money is being used to support those who need it the most.

Sub-Saharan Africa (SSA), along with fragile and post-conflict states there and elsewhere will remain the most challenging areas in which to provide or restore infrastructure. Donors and the private sector alike tend to avoid investing in fragile states due to the high risk, however these are where the needs are the most acute, and the potential impacts are the greatest.

SSA has a great deal of potential and this is being increasingly recognized, however more must be done to increase levels of investment, as well as regional coordination, transparency, institutional strengthening and skills and capacity to build and maintain good quality infrastructure and services.

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Review 11

Energy

By Ray Holland

1. Introduction

This note summarises available information on the current status of energy infrastructure and energy services and the evidence for their potential to promote economic growth and reduce poverty in developing countries, while minimising their climate change impact and adapting to foreseeable climate change. See also (Tamsyn Barton, 2002)

A range of possible financing options is outlined, for DFID to address gaps and to play a catalytic role - to support a favourable enabling environment for scaling up energy investments to provide clean energy pathways, and to contribute to a more equitable availability of cleaner energy services, through private and public investment.

The note is structured as follows. Section 2 provides an overview of available information on existing energy infrastructure and the gaps and deficiencies in that provision. Section 3 assesses evidence on the relationships between energy provision, economic growth and poverty reduction. Section 4 examines the impact of energy on climate change, and the effects of climate change on energy use and resources. Section 5 summarises existing policies and approaches of first national governments and secondly suggests a range of possible financing strategies for development assistance programmes.

2. Overview

Energy infrastructure provides energy services to households for cooking, lighting, refrigeration, communications, cooling and heating; to businesses (including agriculture) for production of goods and services; to public services, such as those providing health, education, water supply, security; and energy for transport. The infrastructure can consist of fuel production, transformation and delivery systems or the production, transmission, and distribution of electricity. Energy can also be sourced directly by local users through biomass gathering or other local renewable electricity generation. The energy service at the point of use is provided through appliances, whose efficiency is key to their cost-effectiveness.

Globally over 1.3 billion people (or World Bank say 1.6 billion) are without access to electricity and 2.7 billion people are without clean cooking facilities. More than 95% of these people are either in Sub Saharan Africa or developing Asia and 84% are in rural areas (OECD/IEA, 2011).

The challenge then is to provide reliable and affordable energy services for economic growth and wellbeing without compromising the climate. Low-income countries now account for only 3 per cent of global energy demand and energy-related emissions and will likely remain small contributors by 2050, (by when many developed countries have committed to reduce their emissions by 80%), though they have the opportunity to develop cleaner energy development pathways. Middle- and high-income countries, with expanding economies and large industry, are huge and growing energy consumers, especially China, which is now the world's largest energy consumer (World Bank, 2010) although with much smaller per capita consumption than "industrialised countries". The challenges for how countries, primarily the BRICS can reduce their energy intensity and de-carbonise their energy use while their economies grow are immense, and their success in doing so, along with developed countries, will be decisive in terms of world CO2 levels.

Low-carbon energy choices can substantially improve national energy security by reducing price volatility or exposure to disruptions in energy supplies, as well as reducing greenhouse gas emission. There is a huge investment gap and potential gains for energy efficiency improvements, which can reduce energy demand and energy intensity of production particularly from commercial and domestic buildings, appliances, vehicles , industry and power sector but recent progress has been very slow (UNIDO, 2011); (T'Serclaes, Sept 210)

Renewable energy diversifies the energy mix and reduces exposure to fuel price shocks, though its first capital costs are high, just as its operating costs are low. There is great scope to expand hydro power in Africa, for example, but it needs to be carefully integrated with agriculture and other water needs (Bonn 2011 Conference, 2012). Increasing access to electricity services and clean cooking fuels in many low-income developing countries, particularly in South Asia and Sub-Saharan Africa, would add less than 2 per cent to global CO2 emissions (World Bank, 2010).

The UN Sustainable Energy for All Initiative (SE4A) is targeting universal access to basic energy services by 2030. The United Nations Conference on Sustainable Development (Rio+20), provided a timetable for agreement on commitments to specific action to achieve sustainable development, including universal energy access by 2030. It should be noted, though that the SE4A target says little or nothing about promoting productive use of energy, which will be key to its sustainability. The European Commission has already made a commitment to contribute to that goal, initially with a €50 million fund for technical assistance: "In energy, the EU should offer technology and expertise as well as development funding… The EU should support capacity development and technology transfer, including in

climate adaptation and mitigation strategies. The EU is looking for long-term partnerships with developing countries, based on mutual accountability." (European Commission, Oct 2011) Though few of its country programmes in ACP countries as yet feature energy.

The IEA estimates that achieving universal access by 2030 (SE4ALL) would require five times the current level of investment by Official Development Assistance, National public finance of the countries concerned and by the private sector (OECD/IEA, 2011), DFID energy activities will contribute to this ambitious goal, particularly through current and planned programmes such as its contribution to the International Energy and Climate Initiative, Energy+ originated by the government of Norway, which is a partnership aimed at financing renewable energy and energy efficiency through results-based approaches. (David Reed, March 2011).

The EU-Africa Infrastructure Trust fund is providing grants and loans from EU member states including the UK for regional and cross-border energy investments coupled with loans from the European Investment Bank (EIB).
The EU has also launched the Renewable Energy Cooperation Programme (RECP) under the Africa-EU Energy Partnership, which includes support for RE policy; private sector cooperation; project preparation and investment; technology innovation and capacity development. (PDF, 2012)

The investment s in sustainable energy for all include those needed for clean cooking and for electricity connections, together with the associated increase in generation, transmission and distribution capacity. In the case of Africa this would also have to include establishment of regional energy markets taking advantage of least cost energy resources, and including investments in regional interconnections. (See below). Investments in energy supply will only bring significant poverty reduction benefits to the extent that consumers are able to invest in end use appliances, and use energy to improve productivity.

3. Energy, economic growth and poverty reduction

3.1 the contribution of energy to GDP and employment

Energy is a fundamental factor of production and its availability and affordability is essential for any modern economy. Availability at household level of clean energy for cooking, to make staple food edible, is also essential if undue labour is not to be taken up with fuel collection and wasted through ill health.

In Africa, the deficiencies of the region's power sector are a serious drag on long-term growth and competitiveness. If all countries were to catch up with the regional leader, Mauritius, in terms of infrastructure stock and quality, their rate of economic growth per capita would be enhanced on average by 2.2 per cent per year. (Eberhard, Sept 2011)
The supply chains for fuel wood and charcoal (particularly charcoal for cities) make a significant contribution to national GDP (e.g. comparable to that of the tea, coffee or tobacco industries in countries like Malawi, Tanzania and Rwanda) (EUEI-PDF, March 2011). (Matthew Owen, 2009)

3.2 Energy and Gender

Access to energy has a gender dimension that needs to be taken into account, particularly in terms of decision-making at household level. (Danielsen, 2012)

Cooking with biomass (wood, charcoal, waste materials) is still the norm for the large majority in South Asia and Africa and causes 2.7% of global burden of disease. In many countries biomass for cooking and process heating is seen as backward and environmentally damaging. With attention to regulation and promotion of fuel supply and efficient and clean end use appliances (e.g. gasifier cookers) it can be both clean and sustainable. (Roth, Jan 2011). These technology developments, together with the promotion of "improved" cooking stoves and the use of LPG as a cleaner fuel can have a significant impact on the health of women and children. (Wisdom Togobo, 2012) (World Health Organization, 2006). The international initiative Global Alliance for Clean Cookstoves brings together many actors on this topic, but seems to neglect the supply side – the growing of trees and other biomass, which is an agricultural issue that needs attention. (Global Alliance for Clean Cookstoves, Nov 2011)

There is evidence also that adequate household energy, and modern energy for health and education services can provide additional time for improved women's literacy, girls' education leading to greater control and choice of fertility. (Anil Cabraal, 2005)

3.3 Energy poverty and energy for poverty reduction

The focus on universal access through the Sustainable Energy for All initiative, targeting universal access by 2030 provides a focus for global attention to the issue. The IEA has estimated that in the case of electricity, huge investments will be needed with a mix of grid extension and intensification, mini-grids for more isolated communities, and off-grid household systems (mostly solar PV) with financing split more or less evenly between national governments, ODA, and local and international private finance plus consumers. Scaling up very small (e.g. 20W) low cost household PV systems could meet basic rural electricity requirements using modern energy efficient appliances for lighting (LEDs), television, radio, e-books and mobile phone charging, but will not meet the needs for agricultural processing, workshops and other uses that require mechanical power. Work is on-going to define realistic indicators to monitor progress toward universal access. (Practical Action, 2012) (Fatih Birol, April 2012) (OECD/IEA, 2011) demand for electricity by the Urban poor, being normally based on grid intensification is estimated by IEA to be double that of the rural poor. The constraints to access expansion in urban slum areas are more to do with management models and avoiding pilferage or payment defaulting. (Smyser, 2009)

4. Climate change and reduction of carbon emissions

This topic is dealt with in more depth in the Low Carbon Development/Climate Change Mitigation evidence review.

4.1 Adapting to climate change

A draft ESMAP report summarises the vulnerability of energy systems to climate change and proposes a framework for planning, incorporating climate impact risk management methods, and steps that are needed to develop better adaptation methods and to improve climate resilience of energy system design. (Ebinger, 2010)

Targets for renewable energy and energy efficiency have been set at regional and national level in many developing countries. For example ECOWAS has recently adopted targets for renewable energy capacity across the region. (ECREEE, April 2012). This West African centre for regional cooperation on renewable energy (supported by Spain, Austria and UNIDO) may be replicated in Eastern and Southern Africa, though in those regions it may take the form of a network of existing institutions.

In South-East Asia there is regional cooperation in the form of the ASEAN Plan of Action for Energy Cooperation. (ASEAN Centre for Energy, Nov 2010)

5. Polices and approaches

The global need for effective support for investment in energy for poverty reduction requires donors to coordinate their activities. The recent EU green paper on EU development policy contains a reminder that it is a legal obligation – Art 210 of the Lisbon Treaty - for EU member states to coordinate their development policies, and yet there are many unrelated national energy initiatives by Member States. (European Commission, Nov 2010)

5.1 Government Policies and Programmes, including Utility Reform

Given the huge investment required in the electricity sector, and the limits to public sector financing capacity, private finance is going to be of critical importance, though this does not imply that developing countries have to follow the example of industrialised countries, with full privatisation and unbundling of utilities. Corporatisation can be a useful first step. However what private sector investors require above all is stable and coherent policies from government, and in many cases sector reform to allow non-state actors to participate; for example standard Power Purchase Agreements, assurance of payment by off-takers, aided preferably by some sort of financial guarantees against political risk. They also need for exit strategies to attract private capital. That is to say that equity investors need to know how they can eventually recover their investments and profits.

There are nearly 60 medium- to longer-term power sector projects involving the private sector in the African region, excluding leases for emergency power generation (Eberhard, Sept 2011). Almost half of these are Independent Power Producers (IPPs). Involving more than $2 billion of private sector investment; these IPPs have added nearly 3,000 MW of new capacity. A few IPP investments have been particularly well structured and contribute reliable power to the national grid. A review of IPPs in Africa in 2008 found the majority to have been successful, with some notable exceptions, with investment climate and policy environment being closely related to successful outcomes. (Eberhard, Sept 2011)

The other half of the Private Investment transactions in Sub-Saharan Africa have taken the form of concession, lease, or management contracts, typically for the operation of the national power system as a whole. These projects have been characterized by a relatively high rate of disappointment, with around a third of the contracts either currently (2008) in distress or already cancelled, often caused by differences of expectation on each side of the agreements. (Eberhard, Sept 2011)

5.2 Tariffs

Electricity tariffs are a sensitive issue, and in Africa costs of supply are sometimes much higher than in other regions, due to inefficiency in utility management, inadequate bill collection, theft and corruption. And yet tariffs, though sometimes high by international standards do not adequately cover these costs (e.g. most SADC countries). In many countries there is a very low first block of tariff as a “lifeline tariff” to make electricity affordable to poorer consumers. However, as electricity consumers are not generally from the lowest income groups, this operates as a regressive subsidy and in many cases is set at an unnecessarily high level. Even poor consumers have a willingness to pay in the range US$ 0.10 to 0.40 per kWh (especially when using modern energy efficient appliances. There is thus scope for tariff reform (and management reform) to bring utilities to financial viability and investment grade. Very poor consumers may still not be able to afford electricity, but the main problem is normally the initial connection cost, where more could be

done to provide financing mechanisms where the cost is spread over a year or more as an addition to the tariff. This can be an opportunity for donors to encourage utilities to connect poorer consumers through output-based aid incentives. Output-based or results-based approaches can also be effective for mini-grids and off-grid access delivery as well as slum electrification. (Yogita Memssen, 2010)

In principle most countries in Africa governments have established regulators, though they are not in practice as independent as they would be in industrialised countries. Their job of protecting investors (utilities, distributors) and consumers is thus subject to political pressure. Nevertheless donors make it clear that investment from MDBs or commercial investors does require financially viable utilities. (Eberhard, Sept 2011)

5.3 Rural Electrification

National utilities are by their nature centralised and work to master plans (subject often to political whim) to prioritise the most heavily populated centres and energy-intensive industries. Rural areas with their low income, scattered populations are relatively unattractive to investors. This issue is addressed in some 20 countries in Africa by Rural Electrification Agencies (REAs), providing capital subsidies through Rural Electrification Funds(REFs) for grid extension to otherwise ignored areas or to municipalities or privately or community-owned electrification schemes, typically mini-grids. These agencies vary greatly in their approaches, but merit support, and if they prove effective, donor funding complementing government funds or electricity levies as part of the REFs. Other countries (such as Senegal and Mali) have a concession approach, where bids are invited for subsidies to connect rural areas. (Mayer-Tasch, (forthcoming)) . (Rural Electrification Funds: Sample Operational Documents and Resources) In Asia, countries such as China and Vietnam have achieved very high levels of electrification through high levels of government subsidy and strong political commitment. (Niez, March 2010)

There are a number of business models being implemented, supported by loan guarantees and partial capital subsidies to enable sustainable private sector energy supply chains (e.g. www.s3idf.org)

5.4 Cooking – biomass, LPG,

The issue of cooking energy seldom receives much attention from energy ministries, since it is seen more as an agricultural, land use, health or social issue. The issue often falls between energy, environment, forestry or land ministries (and recently in India, Health; and has vested interests (ownership of transport for charcoal for example), which are politically sensitive. However, there is much that can be done through regulation and taxation for a sector which employs large numbers of people in the production, transport and selling of charcoal and other fuels – see section under development agency policy. (World Health Organization, 2006) (EUEI-PDF, March 2011) (Matthew Owen, 2009)

5.5 Urbanisation and Slum Dwellers

In cities such as Nairobi, millions of people live in slums with minimal services, including electricity. Utilities are reluctant to connect consumers whom they know will be difficult to bill, and who are likely to steal electricity. They also have excuses, such as that the dwellings are illegal, not of the right standard, etc. However the impact of electricity services on the poverty of the inhabitants will be high. Various approaches, including Output-Based Aid approaches have been tried with some success around the world,. (Yogita Memssen, 2010) (ESMAP) (Smyser, 2009)

5.6 Biofuels

Biofuels offer a potential substitute for liquid and gas fossil fuels for local production and for export. There is considerable interest and activity in this field, and some regions (e.g. SADC) have already produced guidelines for the sustainable and economic development of these fuels. The potential for local economic benefits is huge, but sustainability issues are challenging and the agricultural and processing technology are still at an early stage (except for ethanol) (Practical Action, 2011). (SADC/PROBEC, August 2010)

5.7 Regional Issues

Some 21 of 48 Sub-Saharan countries have national power systems that fall below the minimum efficient scale of 200 MW for electricity generation. As a result, they pay a heavy penalty; with operating costs double those of the continent's larger power systems. In addition there are great opportunities for economies from exploiting regional resources, such a large hydropower (e.g. Cahora Bassa in Mozambique, and potentially Grand Inga in DRC) to supply neighbouring countries. At present, only 16 per cent of power production is traded (almost all of it between South Africa and its immediate neighbours). It is estimated that some US$500 million per year through 2015 would have to be invested in 28 GW of inter-connectors to make Africa's regional power pools a reality and thus reduce the cost of power across the continent. The returns on these investments are of the order of 20 to 30 per cent, and as high as 160 per cent in the case of southern Africa (Vennemo and Rosnes, 2008). (Infrastructure Consortium for Africa/World Bank, 2010)

Regional power pools are being established, starting with bilateral agreements for cross-border investments leading to government-to-government agreement to the establishment of special purpose vehicles with shared ownership to invest in regional power generation and transmission. There is a growing role for regional power pools, such as that for the Mekong, the Southern Africa Power Pool and those for West, Central and Eastern Africa. Donor support for capacity building for regional regulators to develop the conditions, standards and agreements for effective cross-border trade has proved valuable (e.g. RERA in Southern Africa, ERERA in West Africa), (Armar, 2005)

African regions have also adopted regional energy access strategies, though the regional economic commissions which are supposed to oversee them are rather weak, and the commitment of the member states is not yet well developed. (UNECA, 2006)

5.8 Going to scale

The goal of Universal energy access, scaling up rural electrification, regional integration, clean cooking are firmly on the global agenda, with 2012 set as the UN year of sustainable energy for all and the target of universal access by 2030. The extent to which governments adopt this at a national level is being encouraged with early support for early "Opt-In countries". (UN, 2012)

In China, North Africa, South Africa and in the USA and Spain in particular, large scale concentrating solar electricity generation pilot plants up to two hundred MW are being built. The technology still requires considerable development, but it would seem that in suitable desert regions it will eventually (2020-2030) become competitive with "conventional" renewable sources alongside large hydro, geothermal and wind power (IEA, 2010). Deployment on a large scale will require international agreements to the construction of long high voltage transmission lines. The role of ODA is likely to be limited to multilateral action to facilitate such agreements. (International Energy Agency, 2010)

The SARI – South Africa Renewable Energy Initiative of the S African Government, partnered by the governments of the UK, Germany, Denmark and Norway proposes an

accelerated investment in renewables to provide , subsidising the additional marginal cost of renewables through a variety of concessional loans and guarantees so as to attract private finance to the point of grid parity, where subsidy is no longer necessary (Dept of Industry, Dept of Energy, South Africa, Dec 2011) (Deutsche Bank Climate Change Advisers, April 2010)

5.9 Fragile States

Fragile, particularly post-conflict states are normally in most urgent need of basic rehabilitation of their energy assets, installation of emergency generation, adoption of transitional energy policies and re-establishment of legislation, utility management capacity and service personnel training, prior to the long process of re-building a national network. WB/IFC assess energy shortage as being the major barrier to economic recovery (Benjamin Leo, 2012)

5.10 Procurement and transparency

A lack of transparency is often apparent in procurement of power generation, leading to unnecessarily high costs and economic inefficiency of the utility. Decisions on new generating plant are often not taken until severe under-supply makes the situation urgent, and a properly managed public competitive bidding process is foregone. Better planning and training of specialist procurement staff, sometimes in a specialist agency or unit, can help improve the processes. Specialist units have been set up in for example, Ghana, Nigeria, Malawi with support from the PPIAF, which also publishes a number of manuals and guidelines on the subject.(Anton Eberhard, 2008) At a lower level, billing and bill collection is open to abuse and requires tighter management. (World Bank Energy Transport and Water department, April 2009)

5.11 Financing Strategies for Development Assistance

Leveraging Private Sector Investment

There are many ways in which ODA can help to create an enabling environment to encourage private sector investment in the energy sector. One recent example is the reform of the management of the distribution company UMEME by the CDC-funded Act.is company, where management, billing, bill collection were improved resulting in improved financial performance. (ACT.IS, 2012)

“Private financiers are looking for well-targeted, well-designed and scaled public finance that fits actual gaps on the ground. Areas for attention include: smaller-scale projects; support fordevelopers; accelerated commercial scale-up of key technologies to facilitate cost reduction; and delivery infrastructure. Greater integration between national policy development and availability of well-designed public risk reduction tools for commercial investment (e.g. around PPA payment security) is required. Board level mandates are likely to be required for public institutions in order to provide longer-term, more strategic provision to this sector.” (Hamilton, April 2010)

Mechanisms for providing international ODA financial support to stimulate renewable energy investments in developing countries and providing risk reduction measures have also been proposed in the Deutsche Bank GET FiT green paper. (Deutsche Bank Climate Change Advisers, April 2010), which tackles the issue of the current higher energy costs of renewable-energy based electricity. This approach was used as a model for the South Africa Renewable Energy Initiative programme, to which DFID has contributed. (Dept of Industry, Dept of Energy, South Africa, Dec 2011). (Dept of Industry, Dept of Energy, South Africa, Dec 2011) .

One promising approach for stimulating the renewable energy industry, not considered in the above is offered by the rapid reduction in solar PV prices in 2011 (75% over three years), which was due to the rapid expansion of Chinese PV production capacity as well as production technology improvements. Using net metering (now a legal requirement in the USA), PV (or other renewable) electricity-generating consumers can bank the excess electricity they produce in the network and use it to supply their consumption when that exceeds their production. This would mean that in many countries in Africa where the retail tariff exceeds approximately $0.15 per kWh, grid-connected PV installation by medium to large electricity consumers would be an attractive investment. This would bring in substantial finance to the sector without any complex legislation for feed-in tariffs. (Morgan Bazilian, May 2102) (Naïm Darghouth, April 2010)

DFID is already supporting a number of initiatives to incentivise investments in renewable energy in developing countries through its funding of the EU-Africa Infrastructure Trust Fund, managed by the European Investment Bank (EIB); the Private Infrastructure Development Group (PIDG, highly rated in the Multilateral Aid Review); the Public Private Infrastructure Advisory Facility (PPIAF); the Energy and Environment Partners (EEP) results-based fund managed by the Development Bank of Southern Africa (DBSA),; the Renewable Energy and Adaptation to Climate Technology (REACT) fund for the East Africa Region; the $75 million contribution to the Scaling up Renewable Energy Programme (SREP), specifically targeting low income countries, and in partnership with several multilateral development banks and other bilateral agencies under the Strategic Climate Fund of the Climate Investment Fund. . Other recent initiatives to which DFID could contribute include the AfDB Sustainable Energy Fund for Africa (SEFA), initiated with a $57 million grant from Denmark, which aims to provide early stage funding and overcome the barrier of the high project preparation costs for renewable energy projects in African and to leverage private finance (African Development Bank, November 2011)

Capacity development is needed at all levels from utility management, management of Public Private Partnerships, down to operation and maintenance, local service provision, decentralised energy service provision. For the private sector awareness-raising for entrepreneurs, training of local banks in energy investment criteria, academic capacity for training and research and development through, university twinning etc.

Purpose	Intervention Types	Capacity Development for:	Instruments
Energy Access - Rural electrification: Grid extension/ intensification Mini-grids, inc hybrids Off-grid, Productive use, Urban/Slum electrification Business models	Sector reform Support to REFs Leveraging local finance Micro finance for SMEs & consumers Regulation/tariff setting,	REAs, Regulators, Local government SMEs/Business Dev.Services Local Banks Micro finance insts.	OBA (RBF) for connection financing Technical Assistance Partial loan guarantees Grants and loan finance for Multi-donor funds: ESMAP, SEFA, Africa-EU Infrastructure TF/EIB, PPIAF, Energy+, PIDG, EEP, SEFA, SREP, EAIF, REACT DFIs – CDC etc for investment in sector. Risk Mitigation, Currency and Exchange risk management products, Feed-In Tariff support (e.g. GET FIT) Applied Research: competitive research contracts: effective business models,
Power Sector reform Power sector expansion Regional Interconnections Transmission/distrib ution Generation expansion Plant rehabilitation Utility management Private participation PPP management	Standard PPAs, Off-take agreements PPP management Renewable Energy / Low Carbon policies O&M management Energy Planning Project preparation	Regional Power Pools Utility Management Procurement units Regulators Regional regulator associations Min. of Energy	
Energy Efficiency In power sector, industry, commercial and domestic buildings, vehicles, appliances	Policy, strategy development , Demand-side management, Appliance standards, Vehicle standards	Industry associations Mins. of energy	
Transport fuel	Biofuel policy and strategy, Land use policies, Regional standards	Mins. of Energy Agriculture Mins.	
Cooking	Stoves programmes LPG supply chains Forestry management	Forestry management	
Fragile States	Rehabilitation Utility management Sector reform	Utility management Procurement units	

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Review 12

Information and communications technology (ICT)

By Alex Tyers

1. Introduction

This note summarises the available evidence on the role that ICTs and ICT infrastructure play in providing services and improving outcomes for the poor in developing countries.

2. Background: the role of ICTs in global development

The United Nations Development Programme defines information communication technologies (ICTs) as "information handling tools… goods, applications and services that are used to produce, store, process, distribute and exchange information." [1] Commentators often draw a distinction between digital, newer technologies such as mobile phones, computers, and the Internet, and traditional ICTs such as radio and television.[2]

1Promoting ICT for Human Development in Asia. Regional Human Development Report. United Nations Development Programme. 2005.
2 Gurumurthy, A. Gender and ICTs: overview report. BRIDGE, Institute of Development Studies. 2006

Particularly since the 1990s, a growing body of literature has discussed the potential value of ICTs to poverty reduction, to social and economic development, and to service delivery to the poor. A significant indication of this regard for ICTs as development tools was Kofi Annan's establishment of the UN ICT Taskforce in 2001, which placed "ICT at the centre of development for all." Now, across the world, there is a general acknowledgement from governments, donors and non-governmental organisations of the role that ICTs can play in development and in the achievement of the Millenium Development Goals.

Adequate ICT infrastructure, including electricity and robust telecommunications networks, is continually cited as vital to ensure that ICTs such as mobile phones and broadband Internet can be made universally accessible and affordable.

The majority of uses of ICTs for development can be generally categorised in three broad areas:

- economic and financial services
- service delivery to the poor through government, private sector, and NGOs
- e-learning and sharing of knowledge

Economic and financial services
Examples include e-finance, e-commerce, m-banking, m-commerce, and greater access to other markets and employment through ICTs. In this area is where a wealth of literature points to examples and case studies of farmers in rural areas of Uganda who use mobile phones to find market information from their contacts in urban areas, or SMS services in India that can effectively connect potential employers with people who are searching for low-skilled, short-term jobs.[3]

Recent attention in this area has been given to the introduction of mobile banking and mobile commerce to communities in developing countries. In June 2010, for example, following the devastating earthquake in Haiti, the Bill & Melinda Gates Foundation and the US Agency for International Development launched the Haiti Mobile Money Initiative, a $10 million incentive fund to kickstart mobile phone financial services in a country with less than two bank branches per 100,000 people.[4] These services now allow Haitians to send, receive and store money using their mobile phones, in fact bypassing the lacking financial infrastructure of banks and even e-finance services that have traditionally required the use of computers.

Similar services have been established in Africa, such as CelPay in the Democratic Republic of Congo and Africa, M-Pesa in Kenya, and WIZZIT in South Africa.

Service delivery to the poor through government, private sector, and NGOs
Examples include e-health services and e-government, such as electronic payments of utility bills, electronic services that enable citizens to share concerns and ideas with the government and also hold governments to account, and registration of land, vehicles, and businesses.[5]

3 Mobiles give Africa's farmers the chance to set out their stall. Guardian. 4 January 2009.
4 Haiti Mobile Money. A Point-In-Time Case Study. Bill and Melinda Gates Foundation. 2012.
5 New ICTs for Development. Governance and Social Development Resource Centre. 14 June 2010.

In this area, there is the example of Bangladesh, which, by boosting the soft infrastructure necessary to create an electronic photo voter list with the help of several international agencies in the lead-up to the 2008 government elections, subsequently held what is largely considered to the country's first-ever free and fair election.[6]

E-learning and sharing of knowledge
Examples include e-learning and knowledge sharing, m-learning, and education through mobile phones. In this area, the BBC World Service Trust in Somalia produced Radio Teacher, 30-minute educational programmes broadcast weekly on the BBC Somali service between 2002 and 2003, to provide literacy and writing skills and to promote girls' education.[7] The initiative is considered to have provided basic literacy, numeracy and life skills to roughly 10,000 Somalis.[8]

2.1 ICTs and economic growth

In 2010, the United Nations Conference on Trade and Development (UNCTAD) conducted an empirical evidence review[9] of the ways ICTs can impact development and economic growth. The evidence showed that ICTs can increase productivity and growth on a macroeconomic scale in three ways:

- growth of ICT sector and growth in associated industries
- increased ICT investment across the economy, which leads to a rise in labour productivity
- and the important role of ICTs in innovation and efficiency of firms, which results in multifactor productivity growth across the economy

The research shows that positive macroeconomic impacts of ICT in developing countries were due to the growth of the ICT sector, rather than through individual ICT use. There is some evidence that growth of a strong ICT sector has a positive impact on poverty reduction, although there are few specific studies on this subject. These positive impacts are associated mostly with microenterprises, particularly related to the use of mobile phones, and in the informal sector.

Studies of developing countries from 1990 to 2003 have shown a positive link between ICT investment and GDP growth, although this impact appears to be small compared to contributions from other capital and labour. This may be due in part to low levels of ICT penetration at the time, and so an updated report is needed, as the current evidence base is weak.

At a case study level, the evidence shows that small and microenterprises in developing countries benefit from the use of mobile phones, particularly for business, including improved communication and access to information about markets. Other studies show that providing

6 Country of Origin Information Bulletin – Bangladesh 2009. Home Office, UK Border Agency. 21 January 2009.
7 Abdi, J., Matthews, L. and Yocum, L. Somali Girl's Education (ISPABE Project) Qualitative Research Findings. BBC World Service Trust. June 2009.
8 Radio education to help Somalis. bbc.co.uk. 19 June 2003.
9 Measuring the Impacts of Information and Communication Technologies for Development. United Nations Conference on Trade and Development. 2011.

Internet access alone, though, is not enough to bring economic benefits to individuals. It needs to be provided along with other forms of support, such as training.

The UNCTAD evidence review shows that more advanced ICTs such as broadband can have greater economic impact than simpler technologies, but due to limited access to broadband, more accessible ICTs such as radios or mobile phones have the most potential to contribute to poverty reduction. Mobile phones in particular are referred to as 'leap-frogging' tools that enable people, an idea supported by Richard Heeks[10] and Richard Duncombe[11] from the University of Manchester.

A 2009 World Bank[12] study showed that higher broadband penetration in developing countries has a big impact on economic growth, showing a much larger increase in GDP per capita compared to mobile phone penetration. This is supported by a 2009 report by Richard Heeks[13] from the University of Manchester, which cited evidence that broadband uptake is associated with economic growth at the macro level—in terms of employment and GDP—and with employment and productivity opportunities at the micro level. However, he points out that while digital divides around mobile phone ownership and Internet access are closing, the *broadband* digital divide is growing. Evidence from sub-Saharan Africa shows that this divide can be diminished through involvement of the private sector, discussed in more detail later in this paper in relation to the EASsy cable.

2.2 ICT and employment

The 2010 UNCTAD report points to evidence that growth of the ICT sector is linked to increases in employment, particularly in the telecommunications sector. Nigeria is a good example, where growth in the mobile industry has resulted in skills development and growth in employment in related industries.

In a 2009 study[14] of broadband penetration in Latin America, Katz concluded that broadband penetration can increase employment in three ways:

- direct creation of jobs needed to develop broadband infrastructure
- indirect creation of jobs in goods or service industries related to the development of broadband infrastructure
- creation of jobs in other areas of the economic through induced effects of development of broadband infrastructure

The development of IT service industries—in line with development of the ICT sector—are also linked with increases in employment opportunities, particularly for women. The World Bank study found that women in the Philippines and in India have higher levels of participation in IT services, accounting for 65 percent and 30 percent of all professional and technical workers respectively, much higher than for other service industries. However, because IT service workers tend to be better-educated, this benefit does not directly apply to

[10] Heeks, R. Do Information and Communication Technologies (ICTs) Contribute to International Development? University of Manchester. 2010.
[11] Duncombe, R. Impact Assessment of Mobile Phones on Development: Concepts, Methods and Lessons for Practice. University of Manchester. 2009.
[12] Information and Communication Technologies for Development: Extending Reach and Increasing Impact. World Bank. 2009.
[13] Heeks, R.. The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development? University of Manchester. 2009.
[14] Katz, R. Estimating Broadband Demand and its Economic Impact in Latin America. Colombia School of Business. 2009.

those at the bottom of the pyramid, although it can have indirect effects on employment as countries move towards more service-based economies.

At the individual level, ICTs are associated with increases in employment opportunities through increasing access to microcredit, or encouraging entrepreneurship, particularly through mobile phones. Examples include poor countries in the Middle East and North Africa, discussed later in the paper.

2.3 Impact of ICTs on education

ICTs can bring educational benefits by providing both the tools needed for teaching and learning, and developing necessary related ICT skills for learners. Separate studies by Kozma[15] and OECD[16] both point to evidence that ICTs in education can lead to improved attitudes towards learning, improved ICT skills for teachers and increased access to adult education and adult literacy. Kozma cites controlled empirical studies in India, Uganda and Kenya that have pointed towards links between ICT use and improved educational outcomes, though the positive impacts were only observed in specific use of computers for specific subjects. There was, however, no evidence of a positive correlation between general availability and use of computers at school and improved student learning.

The OECD review of empirical evidence found a complex relationship between ICTs and educational performance, supporting Kozma's finding that there is no demonstrated evidence between ICT use and availability in schools and increased educational outcomes. This is backed up by studies of the one child per laptop project, discussed later in the paper.

A study by GSMA in 2011[17] in Ghana, Uganda, Morocco and India found that there is huge potential for the existing mobile phone infrastructure to be used for informal learning, professional skills development, and employment opportunities to help young people with their aspirations and link them to job opportunities. However, there would need to be collaboration between the private sector and the international development community in order to drive costs down—through advertising, for example—and to develop infrastructure that will allow beneficiaries to access the Internet through their mobile phone.

2.5 ICTs and citizen participation, voice and accountability

The evidence base shows that ICTs contribute to better governance through increased participation in elections, accountability and transparency, all of which are prerequisites for economic growth.

The 2010 UNCTAD report found evidence of a positive impact on the increase in participation by citizens in decision-making and facilitation of democratic processes. However, many of the impacts are intermediate impacts—the impact is on behaviour and activities such as dealing with government, rather than final impacts such as cost savings.

[15] Kozma, R. Monitoring and Evaluation of ICT for Education Impact: A Review. in Wagner DA et al., eds. Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries. infoDev. 2005.
[16] Are the New Millennium Learners Making the Grade? Technology Use and Educational Performance in PISA. OECD. 2010.
[17] Shaping The Future – Realising the Potential of Informal Learning through Mobile. GSMA. 2011.

Case study evidence from a study across countries in the Middle East and North Africa from Economic and Social Commission for Western Asia (ESCWA)[18] showed positive social impacts of ICTs in poor communities through community development projects on the individual level. ICTs helped improve communication, access to information and knowledge-sharing through the building up of knowledge repositories, as well as the delivery of awareness-raising services. The report also found that ICTs helped improve economic impact on the individual level by improving employment opportunities through facilitated access to microcredit, particularly through mobile phones. The use of mobile phones also encouraged entrepreneurship by introducing new and innovative ideas.

A report by Spence and Smith[19] highlight the link between growing connectivity, use of ICTs and growing openness across all parts of society (socially, economically, legally and technologically), increasing communication, giving citizens a voice and making exclusivity and 'closedness' very difficult to sustain. The authors point out that this open communication and possibility of informed public discourse, particularly through mobiles, enables social choice, builds human capabilities and enhances freedoms—a story of human development at the individual level.

2.6 Gender, ICTs and development

Alongside the tangible development benefits of ICTs is growing evidence that ICTs also bring about social, sometimes more qualitative benefits. A 2010 GSMA[20] report cites evidence that owning a mobile phone contributes to women's sense of empowerment. Eighty-five percent of women surveyed felt more independent as result of owning a mobile phone. Evidence from Pakistan showed that girls learning literacy skills through mobile experience an increase in their mobility, as their families appreciated the greater sense of security that being able to contact their daughters or wives by phone provided.[21]

Empowerment often takes the form of ownership. In India, women using mobile phones in a development project took ownership of the mobiles, not their husbands.[22] The women involved felt that they had been given a voice and had moved away from 'powerlessness'. In addition, the GSMA report found that women are using mobile phones for economic opportunities, with more than 50 percent of the women in the study saying that they have used mobile phones as a way of earning income. Forty-one percent reported having increased income and professional opportunities once they owned a mobile phone. The 2009 World Bank report cites evidence of empowerment of women by increasing access to public services through ICTs.

The role that ICTs play in helping women realise capabilities has been demonstrated in studies in Uganda[23], Nigeria[24] and Chile.[25] Where women have used ICTs for their own

[18] ESCWA. Impact of ICT on Community Development in ESCWA Member Countries. 2009.
[19] Spence, R. and Smith, M. ICT, Development and Poverty Reduction: Five Emerging Stories. 2010. Harvard Forum.
[20] GSMA. Women and Mobile: A Global Opportunity. 2010.
[21] GSMA. m-Learning: A Platform for Educational Opportunities at the Base of the Pyramid. 2010.
[22] Balasubramanian, K., Thamizoli, P., Abdurrahman, U., Kanwar, A. Using Mobile Phones to Promote Lifelong Learning among Rural Women in Southern India. Distance Education Vol. 31. 2002.
[23] Kivunike, F., Ekenberg, L., Danielson, M, Tusubira, F. Investigating Perceptions of the Role of IT Towards the Quality of Life of People in Rural Communities in Uganda in Byrne, E., Nicholson, B. and Salem, F. (eds.). Assessing the Contribution of ICT to Development Goals. UAE: Dubai School of Government. 2009.

purposes, they report increased confidence and a sense of self-esteem and well-being, as well as being able to achieve their desired outcome. These benefits go beyond simply learning new skills—they go towards changing social practices and relationships, realising capabilities and negotiating social roles as a form of empowerment.

However, there is a large gender digital divide in ICT access.[26] Clearly, closing this gap would bring social benefits to women and their families, as well as massive increases in revenue for the mobile operators through women's mobile phone subscriptions, for example, which could strengthen the ICT sector and lead to economic growth.

Reasons for this gender digital divide include barriers to access for women such as costs of handset and services, lack of ICT skills and cultural issues. Geographical and mobility conversion factors are an issue in this respect. Public ICT facilities, such as cyber cafés, are often men-only places where women are either not permitted inside or feel uncomfortable frequenting. In addition, due to domestic responsibilities and multiple roles, women often have time constraints and cannot visit public facilities during daylight, whilst public mobility at night is restricted for many women, mainly due to fears of sexual harassment in the public arena.[27]

Where financial resources are concerned, financial control and decision-making can tend to belong to husbands or fathers, with women being less likely to have access to finances and more likely to live in poverty. This may translate to a lack of control over ownership of an ICT and the expenses associated with it. The research shows that when access to ICTs involves cost, women are less likely to have the disposable income to do so. The 2010 GSMA report highlights the need to break down these barriers, particularly cost, through partnership with the private sector, as discussed in detail later in this paper.

2.7 The need for more knowledge and evidence

In 2005, the Organisation for Economic Co-operation and Development (OECD) reported28 that evidence links investment in the ICT sector and ICTs to economic growth, though there are few studies on the links between ICTs and pro-poor growth. Years later, this still seems to be the case. ICTs can contribute to the achievement of the MDGs by improving livelihoods, improving service delivery to the poor and involving local stakeholders by giving them a voice in planning processes.

Despite the obvious benefits of using ICTs, the "growth of ICT availability has not been matched by an equally rapid expansion in knowledge concerning how ICTs impact on development and poverty", according to the UNCTAD *Information Economy Report 2010* report.[29] According to a 2008 report from the OECD,[30] ICT infrastructure growth is only weakly correlated with poverty reduction due to the particular circumstances of the poor: low

[24] Olatokun, W. Analysing Socio-demographic Differences in Access and Use of ICTs in Nigeria Using the Capability Approach. Issues in Informing Science and Information Technology Vol. 6. 2009.
[25] Kleine, D. ICT4What? Using the Choice Framework to Operationalise the Capability Approach to Development. Journal of International Development Vol. 22. 2010.
[26] Women and Mobile: A Global Opportunity. GSMA. 2010.
[27] Hafkin, N. Gender Issues in ICT Policy in Developing Countries: an overview. United Nations. 2002.
[28] Good Practice Paper on ICTs for Economic Growth and Poverty Reduction. OECD. 2005.
29 Information Economy Report 2010. ICTs, Enterprises, and Poverty Alleviation. United Nations Conference on Trade and Development.
[30] ICT in Africa. Boosting Economic Growth and Poverty Reduction. OECD. 2008.

skill levels; little access to financial services; and marginalisation on the basis of rural isolation, language or gender. Low-income countries need effective pro-poor policies in order to improve ICT infrastructure and create access and supportive enabling environments that can make ICT available and affordable to low-income users.

More needs to be understood about the emerging new roles and impacts of ICTs in poor communities. As few empirical studies have looked specifically at this question, the evidence base remains relatively weak.

3. Current coverage and infrastructure in Africa and Asia

3.1 Africa

The story of ICTs in Africa since the 1990s is considered remarkable and one of success in the 2011 *Africa's ICT Infrastructure* World Bank report. In general, the availability and quality of services have risen, markets have been liberalized, and regulatory bodies have been established, resulting in investment and lower prices. Two immediate challenges appear to be continued expansion of mobile networks into rural and underdeveloped areas, and greater use of the Internet, which is still in its early stages.

While ICT progress has indeed been substantial in Africa, other regions of the world are experiencing similar, and in some cases, greater success. Other countries, for example, are now placing higher-speed broadband Internet at the core of their economic development strategies, at a time when Africa's ICT infrastructure is still not yet developed enough to provide mass access to even basic low-speed Internet. Broadband services across Africa are still, as expected, typically very expensive[31], though this is starting to change with the development of underground submarine fibre-optic cables such as the EASsy cable, a cable that went live in 2010 and runs from Sudan to South Africa and provides high-speed Internet to millions of people across 19 countries.

Overall, however, ICT penetration levels in most African countries lag behind global averages. Less than 1 in 20 Africans in 2009 used the Internet, and broadband penetration remains minimal. The reasons cited for these circumstances include inadequate infrastructure, shortage of bandwidth, and still-relatively high prices for goods and services, although this is starting to drop for mobile Internet.[32]

3.2 Asia

As with Africa, Asia's ICT scenario is one of change, significant obstacles to progress in certain regions, and even greater divides in ICT progress between developed and developing economies. Asia is home to some of the world's wealthiest and digitised countries and also some of the poorest and least-connected.[33]

31 Williams, M., Mayer, R., Minges, M. Africa's ICT Infrastructure. Building on the Mobile Revolution. World Bank. 2011.
32 Information Society Statistical Profiles 2009. International Telecommunication Union.
33 Global Information Technology Report. 2012. World Economic Forum.

The 2011 *Measuring the Information Society* report from the International Telecommunication Union points to the stark difference between some of the most world's most connected nations—the Republic of Korea, Hong Kong, Japan, Singapore, and Macao—and countries with very low ICT connectedness, such as Bangladesh and Nepal. These countries of Asia form the world's largest mobile market (Africa is second), with South Asia highlighted as the world's fastest growing market for mobile phones.[34]

The region has the highest global share of fixed telephone lines, mobile subscriptions, Internet users and fixed and mobile broadband subscriptions, according to the 2009 *Information Society Statistical Profiles* report. However, despite this high growth and record numbers, ICT penetration remains below the world average. In t*erms of individual Internet and computer use, there are huge differences. In 2007, 13 out of 20 inhabitants of upper-middle or high-income economies were Internet users, compared to less than 2 out of 20 in low-income economies such as Bangladesh, Cambodia, Nepal and Afghanistan.*

Although the region has the highest share of Internet users globally, the numbers are overwhelmingly skewed towards the high-income economies, a pattern of regional divide echoed in the statistics for fixed-line broadband. Overall, in 2007, the region had less fixed broadband subscribers per 100 inhabitants than the rest of the world. As in Africa, fixed-line broadband is relatively very expensive and tends to marginalize rural users.

4. Emerging trends and future investment

4.1 Mobile

Research, evidence and opinion across the board put mobile phones at the centre of the developing world's ICT development scenario. They are portable, require relatively little to no training or even literacy when compared with computers, can easily become an enhancer of existing personal and business operations, and can even provide a sense of empowerment.

The total number of mobile phone subscriptions is estimated in the 2012 *Mobile Technologies and Empowerment* United Nations Development Programme report at around 5.4 billion, while the actual number of people with subscriptions is estimated at 3.9 billion. Mobile phone penetration rates in low-income countries are around 45 percent, and in lower-middle-income countries, at around 76 percent. Reports by GSMA in 2011 on the mobile communications industries in Asia and Africa put the two regions as the two largest mobile markets in the world.

Asia Pacific accounts for half the total mobile connections in the world[35], and Africa is not far behind. GSMA estimates an increase in the number of mobile connections in Africa of over 30 percent a year since 2001, forecast to reach 735 million by the end of 2012.[36]

An offshoot of this tremendous growth has been the evolution of booming telecommunications industries worldwide that are attracting foreign investment. A multiple-

34 Measuring the Information Society 2011. International Telecommunication Union. 2011.
35 Asia Pacific Mobile Observatory. GSMA. 2011.
36 African Mobile Observatory. GSMA. 2011.

country analysis indicates that mobile phone operators accounted for roughly 26 percent of total tax revenues, making them significant income generators for governments.[37]

Other literature points to the positive effects of mobile penetration on Internet use. While poor ICT infrastructure—including limited fixed-line Internet coverage—has been a reason for low Internet penetration alongside poor PC penetration and the challenges of covering large rural areas, the explosion of mobile phone use has helped to leapfrog this lack of infrastructure. Roughly 70 percent of Internet users in Egypt, 59 percent in India, and 50 percent in Nigeria rely primarily on mobile Internet access rather than access through desktop computers, according to a 2012 report from McKinsey & Company. By comparison, only 25 percent of US Internet users and 22 percent of those in the UK report that they never or infrequently access the Internet via a desktop computer. Mobile Internet connections carry lower device and connectivity costs, and they are enabling countries to cross the urban-rural divide with lower infrastructure costs.[38] Notably, roughly 80 to 90 million people worldwide who have no access to an electrical grid are mobile phone subscribers.

For mobile phones and their related services to reach their potential as development tools, numerous challenges found across the developing world must be overcome. Several reports in the evidence base point to the following evidence:

- **Rural-urban divide in network coverage**

  As the mobile industry is driven by the business sector, areas that are not attractive to operators, such as very remote and poor areas, tend to remain uncovered, resulting in a rural-urban divide. However, many operators in other countries where poor rural access remains a problem did not cite poor levels of rural access as a major impediment.[39] This may be due to ongoing efforts to connect rural communities in those countries, and many operators show confidence about improving rural access in the short- to medium-term, particularly as competition increases penetration.

- **Free markets, liberalisation and market reform**

  State-run monopolies in telecoms markets in parts of Africa and Asia are driving up costs for end users. High pricing in terms of handsets, user costs and taxation were a major challenge in using mobile phones for development, particularly for those at the bottom of the pyramid. However, countries such as Rwanda are good examples of where liberalization of the telecoms market has meant that competition drives costs down which has resulted in an uptake of technology amongst lower income groups.

Where state-run monopolies in telecoms markets are not present, fierce competition across Africa and Asia has driven down prices and increased penetration. GSMA reports that prices across Africa dropped by 18 percent between 2010 and 2011, making mobiles more affordable. Although 96 percent of African subscriptions are still pre-paid voice services, as prices drop, the uptake of data services will rapidly increase.[40] However, the same report calls for more transparent regulation in the mobile sector across Africa.

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37 Mobile Technologies and Empowerment. United Nations Development Programme. 2012.
38 Online and upcoming: The Internet's Impact on Aspiring Countries. McKinsey & Company. 2012.
39 Mobiles for Development. UNICEF. 2010.
40 African Mobile Observatory. GSMA. 2011.

- **Power supply and renewable energy sources**

  Evidence of power supply shortages is supported by findings from an UNCTAD 2010 report.[41] For ICTs that can operate on battery power and be recharged through car batteries, such as radios and mobile phones, this is less of a problem. Indeed, GSMA reports that the mobile industry in Africa is contributing to rural electrical distribution through lower carbon emissions.[42] But access to technology such as computers will remain restricted, particularly for the poor and in rural areas, until stable and affordable electricity is available. Clearly, there is a need for renewable energy strategies to be incorporated into any ICT development projects.

- **Education, skills and training**

  Evidence suggests that problems with mobile content appear to stem from the IT training provided in some countries. *A* 2005 report from the Swedish International Development Cooperation Agency found evidence of a need for developing countries to develop ICT sectors that can enable the support of ICT components in their poverty alleviation programme.[43] More vocational training is needed to develop the use of ICT and related industries. Many educational systems in developing countries do not have ICT skills components in their curriculum, and to incorporate them properly would require an overhaul of those systems. Related to skills, research indicates that one of the major barriers to ICT usage is the language barrier, particularly for Internet usage, as the majority of websites are currently in English, and there is a lack of content and services available in local languages.[44]

4.2 Role of the private sector in the future

The evidence suggests that creating free markets and open competition, driving down user costs and building new networks to reach the underserved cannot be achieved without working with the private sector. The sums of money are huge—private sector investment in the mobile infrastructure in Africa, for example, averages about US$10bn per year.[45]

Evidence from Africa and Latin America shows that the private sector has played a tremendous role in network development and bringing the Internet to marginalized areas. A 2010 World Bank report on network coverage in sub-Saharan Africa[46] suggests that countries with liberalized network markets to allow investment and competition to emerge have tended to focus on the most commercially attractive areas of the country, leaving a stark rural-urban divide and not reaching those at the bottom of the pyramid. Only state-run operators tend to reach those areas, and their networks are generally poor and inconsistent.

There is evidence of success in reaching such areas through partnership with the private sector, through competitive subsidies, shared infrastructure consortium models and incentive-based private sector models, though hybrid models have also been successful. There are few examples of successful use of competitive subsidies model in developing countries, but it has been used successfully in Singapore and France. In Brazil, a public-

41 Information Economy Report 2010: ICTs, Enterprises and Poverty Alleviation. United Nations Conference on Trade and Development. 2010.
[42] African Mobile Observatory. GSMA. 2011.
43 Greenberg, A. ICT for Poverty Alleviation – Basic Tool and Enabling Sector. SIDA. 2005.
44 EFA Global Monitoring Report 2010: Reaching the Marginalised. UNESCO. 2010.
[45] Heeks, R. The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development? University of Manchester. 2009.
[46] Williams, M. Broadband for Africa: Developing Backbone Communications Systems. World Bank. 2010.

private partnership between government ministries, the national telecommunications regulator and four fixed-line operators is an example of an incentive-based model: operators are being offered a reduction in their tax obligations in exchange for investing in broadband services across underserved areas. Because the operators own and run the networks, it is likely that they will be efficiently managed, while the government is able to specify the type of network that it wants and the areas that it wants it. However, because it is privately owned in a competitive market, it is possible that the operators may discriminate against their competitors, meaning that the operating of the network requires strong governmental monitoring.[47]

An example of a successful shared infrastructure consortium model is the EASsy submarine fibre-optic cable, which runs from Sudan to South Africa and allows all countries along the route access to the global submarine cable system.

EASsy was a public-private partnership commercially sponsored and privately financed, developed and owned by a consortium of 25 telecommunications operators across the countries involved, with support from donors such as the African Development Bank and the IFC. The partnership learned from the mistakes of previous SAT cable along the West African coast, where consortium members each had exclusive control over access to the cable in their own country, resulting in a lack of competition and high prices for end users. The model is based on an open-access model of governance, where the EASsy consortium members share access and sell services on a cost-oriented basis with full transparency, thereby competing with other consortium members. This keeps costs down for the end users and creates subsidised high-speed Internet access for millions, reaching those in rural areas who are traditionally excluded.[48]

However, this particular project has been plagued with problems resulting from such a large and complex consortium. There have been disagreements over the funding structure and ownership of the project, and there has been political intervention resulting in disagreement between private investorsand government authorities, whose concern was low-cost bandwidth access, which all led to failure to meet deadlines, meaning that the cable was over four years behind schedule. The EASsy project is an example of how tensions might arise between public and private, the former's concern being low-cost bandwidth access, and the latter's being profits, and the need for cooperation and communication.

There are also examples of successful ICT and development projects that have involved the private sector, particularly mobile operators. Heeks[49] highlights the growing trend of private sector firms investing in ICT and development projects for reasons of both commercial and corporate social responsibility, and cites examples of multinationals like Cisco, Hewlett-Packard, Intel and Microsoft moving hardware into poor communities, as well as commercial operators setting up ICT centres in these communities. Examples include Dhristee in India and Grameenphone in Bangladesh. Other examples include Vodacom in South Africa investing more than R6 million in Cell-Life, developing mobile phone software to manage treatment for HIV positive patients. Dialog in Sri Lanka has worked with Disaster and

[47] Williams, M. Broadband for Africa: Developing Backbone Communications Systems. World Bank. 2010.
[48] Foster, V. and Briceno-Garmendia, C. Africa's Infrastructure: A Time for Transformation. World Bank. 2010.
[49] Heeks, R.The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development? University of Manchester. 2009

Emergency Warning Network (DEWN) to develop an early warning system that works through mobile phones.

5. Successes and failures in ICT projects

Even in the developed world, the successful use of ICTs involves many obstacles. ICT projects are often poorly designed and implemented, and even when successful, it can take decades to reap substantial benefits from them. For a number of years, the developing world's lack of readily accessible digital technology—the Digital Divide—was viewed as a core problem rather than one of the symptoms of overall deprivation. This misunderstanding of the problem resulted in a large number of poorly directed programs.

Much literature points to the tendency of development projects to be technology-driven, rather than purpose-driven, hence the attention often placed on the potential of technologies that are still unexplored fully even in the developed world, such as tablets. This may be because new technology is, by its nature, fresh and exciting, can offer seemingly great potential, and therefore, has the uniqueness to attract funding.[50]

However, the success stories of ICT development projects tend to be the ones that keep traditional and available technology in mind. They make use of existing technology and have considered how that technology will fit into people's existing personal and business operations. In sub-Saharan Africa, the radio—despite being a technology that was first commercially available in the 1920s—is the ICT with the highest level of ownership, access, and usability by the poor. It is cheap, can be powered by batteries, can penetrate remote areas, requires no literacy or education, and can transmit information that can easily be localised.[51]

Projects such as the DFID-funded nine-year English in Action project in Bangladesh, launched in 2008,[52] which aims to provide English language skills to a total of 25 million primary and secondary students and adult learners using low-cost mobile phones, are good examples. English in Action involves uses locally appropriate technology—the tremendous boom in mobile phone use in Bangladesh has made phone more cost-effective and accessible.

It is increasingly clear that ICTs must be subject to the same guidelines as those applied to other development cooperation programs. Heeks provides a good practice summary taken from experience of successes and failures of ICT development initiatives. Initiatives should be affordable, scalable, practically implementable and ultimately self-sustaining; there is a need for participation of local users, and use of locally appropriate, low-cost technology. In order to make it self-sustaining, good practice involves a partnership between public and private.

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[50] Duncombe, R. and Boateng, R. Mobile Phones and Financial Services in Developing Countries: A Review of Concepts, Methods, Issues, Evidence and Future Research Directions. University of Manchester. 2009.

51 Heeks, R. The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development? University of Manchester. 2009.

[52] www.eiabd.com

M-Pesa in Kenya is a good example of another successful project, utilising low-cost, existing technology and involving the participation of local users. M-Pesa (Swahili for 'money') is a mobile financial service public-private joint venture, piloted in 2005 and launched in 2007, between Vodafone and Kenya telecom operator Safaricom, with support from DFID.[53] This project is an example of how a successful private-partnership can work: because it is a public-private partnership, it is self-sustaining and scalable, with the number of Kenyans having access to financial services jumping from 18.9 percent in 2005 to over 70 percent in 2011, bringing millions of previously excluded people into the financial system.

Another example of a successful public-private partnership is a partnership between UNESCO, Mobilink Pakistan and BUNYAD that promoted literacy of 250 adolescent girls in rural areas of the Punjab province in Pakistan through mobile phones. One of its unique features was the use of Urdu as the medium of instruction, using localised content and involving the beneficiaries from the very beginning. This project has potential for sustainability through its involvement with a mobile operator, and is scalable—it has recently scaled up to include another 1250 girls in rural areas of the same province and was cited by GSMA as an example of best practice.[54]

Despite these obvious successes, critics point to failures, unreached potential, and an inaccurate regard for ICTs as cure-alls, rather than enablers. Heeks[55] points specifically to the failure of many projects focused on telecentres—rooms or buildings with Internet-connected PCs—that were rolled out unsustainably across the developing world in the last two decades of the twentieth century. Indeed, other literature in this field mentions the skepticism and doubt that began to surround the links between ICTs and development after the highly-touted telecentre concept proved unsuccessful in many cases. Reasons cited for the failures include the fact that telecentres require ongoing technical support, and its users, who may be computer-illiterate, require ongoing assistance to make use of the telecentres' facilities. The exceptions seem to be telecentres that are constructed in conjunction with some other use, and then are also used as a community telecentre, such as banking or government access kiosks. The other application can then provide ongoing funding and personnel to ensure sustainability.[56]

This lack of ongoing support and training is possibly a reason for the failure of the One Laptop Per Child project in Peru, which aimed to provide a low-cost, low-power connected laptop to each child in the programme. OLPC has had impressive reach, delivering over a million laptops in Peru alone, but has suffered from not meeting the local communities needs by instead providing what donors assumed the beneficiaries needed, rather than involving the beneficiaries in the planning stage. It also suffered from little or no support and training for teachers in how to use the laptops in the classroom, as well as no educational impact assessments until much later. Michael Trucano, senior ICT and education policy specialist for the World Bank, has commented[57] that the problem with many ICT development education projects is that providing blanket access, as in the case of OLPC, does not

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[53] Designing Mobile Money Transfer Services: Lessons from m-Pesa. GSMA. 2009.

54 Turning on Mobile Learning in Asia. UNESCO. 2012.
55 Heeks, R. The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development? University of Manchester. 2010.
56. Greenberg, A. ICT for Poverty Alleviation – Basic Tool and Enabling Sector. SIDA. 2005
57 Michael Trucano. World Bank. 2010.

address issues of the associated teacher training and necessary continuous support, in the way that, for example, the English in Action project in Bangladesh appears to be doing. A recent independent impact assessment report conducted by Cristia concluded that while the OLPC increased access, there was little evidence that the programme increased learning.[58] This appears to be a danger of ICT development projects, particularly in education. Much emphasis is placed on reach and increasing access, and perhaps not enough is placed on educational outcomes. This suggestion is backed up by other studies by Kozma and OECD mentioned earlier in this report.

ICT-based projects can be particularly risky—initial investments can be high, and by its nature, technology changes quickly—so it is important that ICT practitioners be involved in the specification and design of projects in which ICT will be a component.[59] What has emerged in this evidence review is a clear need for proper evaluation methods and impact assessment for ICT development projects: academic commentators such as Heeks and Molla[60], and Duncombe[61] point out the current lack of these.

6. Conclusions

There is growing evidence in developing countries and from past projects that ICTs and ICT infrastructure can have a noticeable effect on economic growth, while use of ICTs have been shown to have postiive impacts in terms of development at the individual level. Clearly, there is a good case for investing in ICTs. However, there are a number of lessons to be learned that should be taken into consideration when designing new ICT4D projects. These include the following:

- Projects should aim to use existing technology rather than introducing new technology—evidence suggests a focus on traditional technologies (radio, television) as well as mobile phones, rather than computers or the Internet
- Projects should take into account current trends in mobile telephony in particular in order to reach those at the bottom of the pyramid
- Projects should aim to be self-sustaining and scalable—the evidence shows that this is more likely if done in partnership with the private sector.
- Particular attention needs to be paid to supporting the development of the relevant skills through education and training, both within the ICT sector and within the education system

Besides ICT development projects that build on mobile phone growth and available technologies, literature in the field also points to other areas in which donor participation could be helpful, involving both public and public-private partnerships. Donors could, for instance, be involved in the encouragement of liberalisation of markets at the policy level, which could help to drive down prices, and also encourage policies of import duty and tax

58 Cristia, J., Cuenta, S., Ibarraran, P., Santiago, A. and Severin, E. Technology and Child Development: Evidence from the One Laptop per Child Programme. Inter-American Development Bank. 2012.
59 Greenberg, A. ICT for Poverty Alleviation – Basic Tool and Enabling Sector. SIDA. 2005.
60 Heeks, R. and Molla, A. Impact Assessment of ICT-for-Development Projects: A Compendium of Approaches. University of Manchester. 2009.

61 Duncombe, R. Impact Assessment of Mobile Phones on Development: Concepts, Methods and Lessons for Practice. University of Manchester. 2009.

exemption of mobile handsets and services to increase uptake, particularly among lower-income groups. Similarly, donors could invest in renewable energy sources (for example, solar power) and encourage governmental strategies in this area.

Donors could also help to strengthen the ICT sector itself through specialist skill training, particularly in the mobile phone sector. Support to policy makers in educational reform appears to be another opportunity area, including the redesign of curriculum to incorporate practical ICT skills, redesign of assessment and teacher training methods, and the development of English language training sectors.

What this evidence review has shown is that there is great potential for ICTs and ICT infrastructure to play a large role in terms of development and the donor community, but as the focus shifts to mobile there needs to be more research into tangible benefit

Review 13

Education and health

By Nigel Wakeham

1. Introduction

This note summarises the available evidence on the role that infrastructure plays in providing services and improving outcomes in education and health for the poor in developing countries.

While common sense suggests that well designed and constructed facilities for both education and health must play a part in improving both education and health outcomes, very little research seems to have been carried out in developing countries to substantiate these assertions. The evidence for the impact that the design and construction of facilities has on education and health outcomes in developing countries is therefore fairly limited. Attachment 1 summarises the main issues to be taken into account when designing education or health infrastructure programmes.

2. Education facilities

2.1 Evidence from developed countries of the impact of the design of facilities on education outcomes

There is evidence from research in developed countries that improvements to the design of educational facilities especially to the lighting, sound control, temperature control and air quality do improve educational outcomes. Similarly, the quality and size of schools were also found to impact on both learning and pupil behaviour.
Research work collated and presented by the National Clearing House for Educational Facilities(NCHEF)[1] provides evidence that: poor air quality increases absenteeism rates and reduces the ability to concentrate; good natural lighting in classrooms has a significant effect on the performance of students in maths and reading tests; temperatures between 20°C and 23.3°C are the best for learning reading and maths (and that the ability to learn these subjects at temperatures above 23.3°C is adversely affected) and poor acoustics and high levels of background noise make listening and learning difficult for children and reduce the effectiveness of teachers.

Their work also suggests that the age and condition of facilities have a major impact on both learning and student behaviour. Facilities that are in good condition seem to improve academic achievement, reduce vandalism and absenteeism and improve teaching and school leadership.

Another significant finding is that small schools seem to perform better in terms of student achievement than very large schools at both primary and secondary levels.
Research collated and presented by the Salford Centre for Research and Innovation in the built and human environment (SCRI)[2] also supports some of the findings presented by NCHEF. They found positive correlations between classrooms with high levels of natural lighting and faster student progress in reading and maths. They show evidence that good acoustics are fundamental to good academic performance and that noise has a negative effect on children's recall. They quote the same evidence as NCHEF for optimum temperatures for learning and they also found evidence that poor air quality reduces students' concentration and leads to absenteeism.

Conclusions

The conclusions to be drawn from the research presented in both papers are that the design and condition of school facilities does affect learning outcomes. Noise, heat, cold, lighting levels and air quality all have an influence on both students' and teachers' ability to perform. What are required in classrooms therefore are clean air and good ventilation, good natural lighting levels and a quiet, safe and comfortable learning and teaching environment.
It can however be very difficult to achieve some or all of these conditions in classrooms in developing countries especially those in the tropics where the prevailing climate can produce high levels of humidity, high temperatures, heavy wind-blown rain and very bright sunshine or glare from clouds or conversely damp and cold conditions.

The best that can be done in these conditions is to ameliorate the climatic conditions through the design of the classrooms: by for instance orienting the buildings to avoid solar gains; by providing them with high, insulated ceilings, good cross-ventilation, protection to windows from direct sunlight and glare from the sky and other *passive* means. It should not be done by using artificial lighting or air-conditioning for cooling as these will increase running costs enormously and also increase carbon emissions.

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[1]Schneider, Mark (2002) Do School Facilities Affect Academic Outcomes. National Clearinghouse for Educational Facilities
[2] Barret, Peter and Zhang, Yufan (2009) Optimal Learning Spaces: Design Implications for Primary Schools. Salford Centre for Research and Innovation in the built and human environment

2.2 Evidence from developing countries of the impact of the design of facilities on education outcomes

As stated above, very little research seems to have been carried out in developing countries on the effect of the design and construction of facilities on educational outcomes and more primary research into this topic is required and recommended.
The existing literature has been reviewed together with a number of relevant project completion reports and project performance assessment reports with a view to drawing conclusions with regard to the impact of the design and provision of educational facilities.

Evidence from the Literature

The following contrasting research evidence and conclusions (taken from '*Scoping Study on the Contribution of Engineering and Planning to Education Stategies*')[3] are worth quoting at this point:

'If students learn as much in inexpensive school buildings as in expensive buildings, we should build less expensive schools. Saved resources can be used to expand access or to improve quality . . . . At most there is only very weak evidence that quality of buildings makes a difference to learning. Although some sort of building is necessary for a school to operate effectively, many studies show little or no relationship between: the type of construction; the amount of ventilation and illumination; physical condition of the roof, walls, or furniture; and student learning (Fuller, 1987).

For example, in Pakistan researchers found no difference between schools with high scores on an external achievement test in mathematics and science, and those with low scores, with respect to the condition of the building and whether children had desks or chairs (Warwick, Reimers, and McGinn, 1990).

Perhaps other factors are much more important in producing student learning. For example, suppose the difference between effective and ineffective teachers is very large, much larger than the effect of buildings. Suppose also that teachers are assigned randomly to buildings. In this case we would only see the effects of teachers.

A few studies do report that quality of the buildings makes a difference (Mwamwenda and Mwamwenda, 1987). It may be that in these studies teachers are assigned according to the quality of the building, and what we are really seeing is the impact of effective teachers.'

However these conclusions can be contrasted with the following:

'There is a growing body of research that links physical facilities to increased educational opportunity and achievement. In the IIEP's research, conducted in 1995/1996, in connection with the Southern African Consortium for Monitoring Educational Quality (SACMEQ), strong links were shown to exist even after controlling for other variables between the extent to which School Heads perceived their school buildings to be in need of major repair or total rebuilding and reading achievement in Grade 6 in all of the countries in the study.

. . .The recent accumulation of solid research data is revealing that physical facilities are a fundamentally important factor in both school attendance and achievement.

. . .Education is a complex process that may be influenced by factors both inside and outside the walls of the classroom (Murimba, et al., 1995). A major concern of educational planners is to identify those factors that have a stronger relationship with school achievement than others. An analysis applying multivariate statistical procedures conduc ted by IIEP with the cooperation of the Ministry of Education and Culture in Zimbabwe revealed that – all things being equal – pupils could not be expected to learn effectively if the classroom did not have

[3] Scoping Study on the Contribution of Engineering and Planning to Education Strategies (2001) DFID

fundamental items such as a blackboard, sitting and writing places for all pupils and basic storage facilities for books and teaching aids.

. . .Other researchers have conducted investigations and have provided empirical evidence to support the theory that in developing countries, low levels of learning among children can be partly attributed to poor and inadequate facilities in school (Heyneman, 1980). An investigation conducted in Nigeria (Urwick and Janaidu, 1983) formed the conclusion that facilities like buildings, separate classrooms, students' desks, etc., determine the very organisation of teaching/learning activities and these factors do influence learner achievement. Research in India indicates that the existence of school desks, and to a lesser degree school buildings, are important if a school is going to be a success (Varghese, 1995).

. . .Fuller, in a review of the international research on environment and learning (1990), concluded that physical facilities are important, though the evidence is less convincing for the UK and the USA than it is for developing countries. Nonetheless Cash (1993) has shown that there are cases in the USA where, in comparable environments, students who attend well-maintained schools which have a good appearance have higher achievement rates than do those who attend poorly maintained buildings.'

. . .The overall conclusion, and which is being reinforced as new research results come in, is that while school buildings and furniture do not teach (parents, teachers, textbooks and supplementary learning materials do) soundly built, well-maintained and adequately furnished and equipped buildings have a profoundly positive effect on both participation and achievement rates.'

There does not seem therefore to be a common view on the extent to which buildings and their design do make a difference to education outcomes. However, as stated previously, commonsense suggests that poor quality facilities or the lack of facilities must impact on both teaching and learning and there is evidence at least from developed countries as shown above that there is a clear link between the two.

Theunynck in *'School Construction Stategies for Universal Primary Education in Africa'*[4] makes some interesting points. He states that the research evidence on the location of schools is unambiguous: the closer to home the school is the more likely children are to enrol at the correct age and then to attend school. In sub-Saharan Africa, the farther children live from school, the lower the enrolment rate. The location of school facilities can therefore be stated to be very important.

(It should be noted that in a paper on infrastructure and the millenium development goals[5]*, Willoughby states that good roads from village to main roads or towns significantly affect school enrolment and attendance, especially that of girls. The lesson seems to be then to either locate schools close to home or provide good transport links from home to school.)* Theunynck also states that teachers show greater motivation and dedication when the infrastructure is more welcoming; ie the quality of the infrastructure does have an impact on teaching. Infrastructure or the lack or poor quality of it was found to have a very strong impact on teacher absenteeism, particularly the lack of toilets.

He also reviews the research into how the condition of school infrastructure impacts on learning outcomes. He quotes from some of the research from developed countries quoted above that found that good quality infrastructure has a positive effect on learning outcomes. He also quotes from a 'Southern and Eastern Africa Consortium for Monitoring Education Quality' (SACMEQ)[6] report that found that the condition of school buildings does have an impact on learning. This found that the change from a school in extremely bad condition to

[4] Theunynck, David (2009) School Construction Strategies for Universal Primary Education in Africa. The World Bank
[5] Willoughby, Christopher (2004) Infrastructure and the Millenium Development Goals. DFID
[6] Michaelowa, Katharina and Wechtler, Anniker (2006) The Cost-Effectiveness of Inputs in Primary Education. SACMEQ

one in good condition resulted in an increase of about 10% of a standard deviation in learning achievement. However it should be noted that this same research found that a lot of resources can be wasted on expensive buildings; simple buildings that satisfy the basic requirements have as much effect as more expensive ones. Theunynck also notes the urgent need for more research into this topic.

An econometric study[7] of the determinants of school enrolment in a large sample of households in rural north India in 1994 showed that enrolment depends on the characteristics of the household, the school and the village. School enrolments were strikingly better in one of the five states studied and the most important single cause was the village infrastructure variable. There were higher enrolments not because the schools were better but because the village infrastructure (electricity, pots office, piped water and telephone) was better.

A recent report '*How the worlds most important school systems keep getting better*'[8] looked at 20 school systems including some in developing countries such as Ghana in order to understand not only how they have improved but how they continue to improve. The report indentifies two types of interventions carried out by continously improving school systems: stage-dependant interventions and cross-stage interventions and it is interesting to note that at the first stage of school system improvement: Poor to Fair (most students achieving basic literacy and numeracy), one of the most important interventions is that of bringing all schools in the system up to a ***minimum*** quality threshold (author's emphasis) including facilities so that they are adequate for attendance and learning. Many if not most school systems in developing countries can probably be described as 'poor' and therefore an important intervention to start them improving to 'fair' must be the improvement of school facilities to a minimum acceptable standard.

Evidence from Projects

Given the large number of education projects that have been implemented by donor agencies over the last 60 years or so that have included the renovation and construction of facilities, it is surprising that little or no research seems to have taken place on the links between educational infrastructure and educational outcomes but this seems to be the case. Most World Bank implementation completion reports and project performance assessment reports comment on whether the proposed facilities have been constructed or not but do not comment on the appropriateness of the design of the facilities or even on the quality of the construction and their relationship to educational outcomes.

Most reports do discuss educational outcomes but not in relation to the effect of the design of the facilities as this is obviously very difficult to separate from other project inputs such as provision of textbooks and furniture, teacher training, etc. It is however worth quoting from a number of project reports in order to see what if any issues have been highlighted and what conclusions have been drawn with regard to the provision of facilities.

Vietnam: the World Bank Primary Education for Disadvantaged Children (PEDC)[9] project in Vietnam set out to bring primary schools in 200 poor districts up to a new minimum standard: Fundamental School Quality Level (FSQL). FSQL indicators include students' and teachers' toilets and classrooms of solid construction with adequate natural lighting. All facilities should also be accessible to children with disabilities. A longitudinal study by the project

[7] Dreze, J and Kingdon G G (1999) LSE Development Economics Discussion Papaer No 18, School Participation in Rural India.
[8] Mourshed, Mona, Chijioke, Chinezi and Barber, Michael (2010) How the world's most improved school systems keep getting better. McKinsey and Company
[9] Attfield, I., Vu, B.T. (2012) A rising tide of primary school standards – The role of data systems in improving equitable access for all to quality education in Vietnam. Int. J. Educ. Dev.

demonstrated better results (a gain of 33%) in both reading and maths of grade 1 students in schools with PEDC interventions than in those without. Other PEDC investments included furniture, textbooks, learning materials, teacher training and community engagement and how much therefore of this improvement can be put down to the physical improvements is open to question.

Ghana: World Bank support to basic education in Ghana[10] over the period 1988 – 2003 financed among other things the construction of 8,000 classroom buildings and the provision of 35 million textbooks. Over that period enrolments increased by over 10% and at the end of the period fewer than 20% of primary school graduates were illiterate compared to two-thirds at the beginning. The Impact Evaluation Report states that gains in educational outputs were directly linked to better school quality manifested in improved infrastruture, more textbooks and better teaching methods. It estimates that improvements in infrastructure quality and *quantity* (see below) increased enrolments by 4% over the period.

However it also states that infrastructure improvements do not appear to have affected learning outcomes; the supply of textbooks was much more effective. The most interesting result highlighted by the report is the importance of school infrastructure on enrolments. Building schools and reducing children's travel time has had a major impact on enrolments. In one area average travel time to the nearest school was cut by 45 minutes with enrolments increasing from 10 to 80%. In two other areas average travel time was reduced by nearly 30 minutes and enrolments increased by over 20%. The report suggests that building a school in a community in which the children had to walk an hour to school will increase enrolments in that community by around 5% and building a new classroom building to replace an unusable one will increase enrolments in the area by 7.5%. Another point made by the report is that classroom overcrowding deters parents from sending their children to school because they doubt that they will receive an education in those circumstances. Increasing the availability and quality of classrooms can therefore be said to contribute greatly to enrolment and educational attainment if not achievement.

The report also states that in 2003 children were significantly more likely to attend school if there was a private school in the vicinity even though the standard of private schools in Ghana was at that time not very good. Support to the private sector could allow government to focus more of its own resources on the poorer parts of the country (see Burkina Faso below).

Burkina Faso: the Post-Primary Education Project in Burkina Faso[11] completed in 2004, constructed and equipped 63 new lower secondary schools many with water wells and teachers' housing. It also provided assistance to the private sector: 54 classrooms were constructed in private schools that had land available and could build additional classrooms on a matching basis. These 108 new private classrooms enrolled an additional 3,780 students in 2003/2004.

Gross enrolment rates increased from 7.2% in 1996 to 12.2% in 2004 and the proportion of private school graduates continuing on to lower secondary school increased from 27% to 42% in the same period.

The construction programme increased access for poorer students and girls. Enrolment in the 10 poorest provinces rose by 85% from 1995 to 2003 and 40.5% of new students were

[10] Books, Buildings and Learning Outcomes: An Impact Evaluation of World Bank Support to Basic Education in Ghana. The World Bank
[11] Project Performance Assessment Report: Burkina Faso: Post-Primary Education Project (2009). The World Bank

girls. The overall proportion of girls enrolled rose to 40.2% meeting the project target of 40%.

The project inputs resulted therefore in substantial enrolment increases overall as well as in lower-income areas and for girls. Overall the number of students who stayed in school and transition to higher secondary education increased. However the project had limited success in imparting to students knowledge that would enable them to pass examinations and meet labour market demands. Repetition rates stagnated and did not drop as expected and low pass rates at the baccalaureat examination meant that most students failed to graduate from secondary school. The report rated the project as satisfactory as all of its targets were met although there must be doubts as to whether educational outcomes improved at all.

There were also significant issues of construction quality in some schools caused it would seem by poor quality supervision.
One other significant finding was that subsidising private secondary education could help to increase access in countries where access to secondary schools is constrained. Increasing the availability of private schools may enable governments to concentrate their resources on lower income and underserved groups.

Malawi: the Malawi Secondary Education Project[12] eventually completed in 2005, constructed 20 new day secondary schools providing 9,600 student places and increasing access to secondary schools by 16.1% over 1998 figures. Most student places were filled and overall the number of boys and girls who stay in school and transition to higher education was increased.

However it seemed that the poorest students could not afford to attend these schools because they could not afford the various fees or the transport costs involved in attending the schools.

There were also problems in continuing the supply of textbooks that were another component of the project and because of this educational quality seems to have deteriorated rather than improved. The lack of books together with a teacher absenteeism rate of around 20% has led to relatively low pass rates in the secondary school leaving certificate and continuing high repetition rates. There were also issues with the quality of some of the new buildings due to poor supervision of the construction.

Tanzania: the World Bank has funded three education projects in Tanzania but only one of them, the Primary Education Development Programme[13] completed in 2005 had a construction component. One of the aims of the project was to expand primary school access as well as improve the quality of education and increase retention.
School fees were abolished in 2001 and there was a subsequent rapid increase in demand. To accommodate this 29,922 new classrooms were constructed (and double shifting was also introduced) and the number of 7 year olds increased from 181,783 in 2000 to 926,305 in 2004 and the enrolment rate of 7 year olds increased from 18% to 84% over the same period. The pupil to textbook ratio also went up from 20:1 in 2000 to 3:1 in 2009 although the pupil to teacher ratio went from 46:1 in 2000 to 54:1 in 2008.

Despite the massive expansion of the system and the increase in numbers of rural poor students attending primary school, primary education managed to maintain if not improve

[12] Project Performance Assessment Report: Malawi: Secondary Education Project (2010). The World Bank
[13] Project Performance Assessment Report: Tanzania: Primary Education Development Program (2010). The World Bank

learning achievement which other African countries have not been able to achieve. It seems likely that this achievement was due to the increase in textbooks rather than the quality of the infrastructure although without the very large school construction programme the huge increase in access to primary education would not have been possible.

East Timor (Timor Leste): there have been two World Bank education projects in East Timor: the Emergency Schools Readiness Project (2000 – 2002) and the Fundamental School Quality Project[14][14] (2002 – 2006). Following the post-referendum destruction in the country in 1999 basice services, including those for education were extremely limited and the main objective of the first project was to provide school age children with opportunities for education at a basic operational level in safe buildings with basic furniture, blackboards and books and teachers with at least a minimal level of training. The project reconstructed to a very basic level 535 schools and 2,780 classrooms. 2 new primary schools and 3 pre-secondary schools were also built, large numbers of classroom furniture were constructed and supplied together with over 2 million textbooks. Although the reconstruction targets were exceeded by approximately 32% school enrolment levels far exceeded expectations and there was therefore a large unmet demand for classrooms.

The second project was designed as a follow-on project to address the unmet needs at both the primary and junior secondary levels. The project sought to maintain existing enrolments at the primary level while seeking to restore junior secondary enrolments and the overall quality of both primary and junior secondary education to pre-1999 levels. Some of the original project targets were found to be overly ambitious and construction costs were much higher than originally estimated and the numbers of schools to be constructed were therefore reduced. Ultimately the project constructed 4 escola basicas (primary/junior secondary schools) and 75 primary schools and renovated 23 primary schools and significantly increased classroom capacity at both primary and junior secondary levels. The report states that the project provided for significant improvements in the classroom learning environment within the project schools. There is no data or comment in the reports however on the impact if any on improvements in educational outcomes by any of the project's components. It should be noted that the original project duration of two years was too short and was extended by 6 months in order to complete the construction programme.
Water and Sanitation in Schools: no discussion about the design and construction of schools in developing countries would be complete without some reference to the role of clean water supplies and appropriate toilets in improving school enrolment and retention rates and possibly educational outcomes. There has been much debate over the role that clean water supplies and particularly improved sanitation facilities play in improving school enrolment and retention rates but again there seems to have been very little research into this although commonsense would suggest that both are important.

Much is made for instance of the role that separate toilets for girls can play in increasing the enrolment of girls in schools but reseach commissioned by DFID into the impact of the provision of separate girls' toilets could find no actual evidence of this[15]. This however would seem to be because of an absence of specific research into the topic. While it would seem reasonable to assume that the provision of separate toilets for girls is important, this paper points out that it is equally important that adequate numbers of good quality toilets for both boys and girls are provided.

[14] Implementation Completion and Results Report: Timor Leste: Fundamental School Quality Project (2007). The World Bank
[15] Birdthistle, Isolde, Dickson, Kelly, Freeman, Matthew, Javidi, Leila (2011) What impact does the provision of separate toilets for girls at schools have on their enrolment, attendance and completion? DFID

A note prepared for the DEW Point Resource Centre[16] points out that the lack of access in many schools in developing countries to water supplies, toilets and hygiene leads to poor children's health (and poor health must reduce educational outcomes), absenteeism from schools, low academic performance and unequal access to education for both girls and the disabled.

A recent study of a school-based water treatment, hygiene and sanitation programme in Kenya[17] has produced some interesting results. Water treatment and hygiene promotion were found to reduce absence among girls but not boys and water treatment, hygiene promotion and the provision of more toilets was found to have a similar effect. None of the interventions were found to a significant impact on test scores or enrolment and improved WASH access was not found to mitigate key reasons for absence for boys. It should be noted that even in schools where additional toilets were constructed the mean ratio of acceptable toilets to pupils was less than 1:50. The results do seem to show that improved hygiene is at least as important as the provision of toilets in reducing the absence of girls.

Smawfield[18] quotes a study carried out in Tanzania that revealed among other things *'high levels of absenteeism and inattentiveness in lessons in those schools with toilet-pupil ratios above 1:30. Girl pupils in primary 5 – 7 were most affected by lack of adequate water and toilet facilities and recorded the highest cases of absenteeism[19]'.* The study endorsed minimum toilet:pupil ratios of 1:20 for girls and 1:25 for boys.

A briefing note prepared by DFID's Resource Centre in Water, Sanitation and Environmental Health[20] states that in rual Pakistan 50% of girls in grades 2-3 drop out of school because the schools do not have latrines and that in Bangladesh, the provision of water and sanitation facilities increased girls' attendance by 15%.

Conclusions

While there seems to be little or no hard evidence from the literature concerning school construction in developing countries or even from past projects that the design of educational facilities has any noticeable effect on educational outcomes, there are a number of lessons to be learned that should be taken into consideration when designing new school construction projects or programmes. These include the following:

- Location of facilities is of prime importance. More smaller schools close to target school populations will greatly increase enrolment levels and therefore overall educational outcomes.

- Better transport infrastructure at the village level will also lead to higher enrolment and attendance levels.

- School facility design and construction should be as simple as possible while providing the necessary basic infrastructure for teaching and learning. Any additional costs incurred through unecessary features will increase costs and reduce the number of

[16] Young, Stephen and Flowers, Cara (date unknown) The Importance of School Water Supply, Sanitation and Hygiene. DEW Point Resource Centre

[17] Freeman, Matthew C, Greene, Leslie E, Dreibelbis, Robert, Saboori, Shadi, Muga, Richard, Brumback, Babette and Rheingans, Richard (2012) Assessing the impact of a school-based water treatment, hygiene and sanitation programme on pupil absence in Nyanza Province, Kenya: a cluster-randomised trial. Tropical Medicine and International Health

[18] Smawfield, David (2006) Understanding and Supporting the Role of Infrastructure in Effective Education Services Delivery. DFID

[19] Mahumbuga, Grace J, Mugogo, Noah E and Lodiaga, John (2005) Effect of Sanitation Facilities on Quality of Education under Crowded Universal Primary Education Conditions

[20] Briefing Note No 2: The Education Millenium Development Goal – What water, sanitation and hygiene can do. WEDC, Loughborough University, UK (2004)

facilities it is possible to construct without providing any additional benefits in the way of educational outcomes.

- All schools within a country should, at the very least be brought up to and retained at a minimum quality threshold so that they are adequate for attendance and learning.

- School facilities should provide maximum comfort for staff and students to maximise learning outcomes at the least cost. In the tropics this will mean ensuring that the buildings are properly oriented; maximising cross-ventilation and maximising natural lighting while minimising solar penetration into rooms.

- School facilities should be well built and inviting in order to maximise retention of staff and pupils and minimise maintenance costs.

- There should be sufficient facilities to house the school's target population without overcrowding as overcrowding reduces enrolment rates.

- A clean drinking water supply must be ensured to maximise enrolment.

- Adequate numbers of functioning and easily maintained and cleaned toilets must be provided for boys girls and staff to maximise enrolment and retention of both students and staff. Girls and female teachers' toilets should be separate from boys and male teachers toilets and have maximum privacy.

3. Health Facilities

3.1 Evidence from developed countries of the impact of the design of facilities on health outcomes

Evidence from the USA links improved health outcomes from evidence-based hospital design.

A study by the Robert Wood Johnson Foundation[21] shows a direct link between patient health and quality of care and the way a hospital is designed. For instance:

- Patient falls declined by 75% at one hospital which spread out nursing stations and placed them near to patients rooms.

- The rate of hospital-acquired infections decreased by 11% at another hospital that now has private rooms for patients and specially located sinks.

- Medical errors at another hospital fell by 30% after more space was allocated for medication rooms and acoustic panels decreased noise levels.

In 1995, around 2 million patients (5% of those admitted) contracted hospital acquired infections that cost US$4.5 million and contributed to more than 88,000 deaths.

The design of hospitals contributes to all of these problems. Poor air quality and ventilation together with 2 or more patients in the same room are major causes of hospital-acquired

[21] Evidence-Based Hospital Design Improves Healthcare outcomes for Patients, Families and Staff (2004). Robert Wood Johnson Foundation

infections. Inadequate lighting is linked to patient depression as well as staff's medical errors. Staff often have to work in crowded busy areas which can lead to errors.

The study states that evidence-based design can improve hospital environments in three key ways by:

- Enhancing patient safety by reducing infection, risk, injuries from falls and medical errors.
- Eliminating environmental stress such as noise that negatively affects outcomes and staff performance.
- Reducing stress amd promoting healing by making hospitals more pleasant, comfortable and supportive for patients and staff.

In one hospital these types of changes showed: an 11% reduction in hospital-acquired infections; a reduction in nursing turnovers to below 7% (national average 20%); 95.7% patient satisfaction and improved staff satisfaction.

An article in the New York Times[22] provides similar evidence for evidence-based design. It states that reseach in the USA shows that single room occupancy reduces infections and patient stress and improves sleep. It also states that natural light can reduce depression and that looking out at scenes of nature can reduce reported levels of pain. A new hospital will therefore have large windows overlooking woods and a river. It will also have a handrail near the bedhead to reduce falls; a sink near the door to allow vistors to wash their hands before entering and thus reduce infection rates; acoustic materials will dampen noise; sight lines will allow nurses to see patients easily and the rooms will be spacious to encourage family visits.

3.2 Evidence from developing countries of the impact of the design of facilities on health outcomes

Evidence from the Literature

Again, as stated above, very little research seems to have been carried out in developing countries on the effect of the design and construction of facilities on health outcomes and more primary research into this topic is required and recommended.

A DFID paper on improving physical infrastructure for maternal mortality reduction[23] states that:

'Experience from many countries (but especially from the DFID/Options Nepal Safe Motherhood Project) shows that buildings themselves are almost never the only barrier to providing services. However, good quality, basic, well maintained buildings remain a necessary if not sufficient condition for the provision of quality services. They can also contribute to attracting and retaining staff and user confidence.'

This paper also points out the importance of the existence of adequate road links and effective, affordable transport connecting users to such facilities 24 hours a day throughout

[22] Cambell, Carol Ann (2009) Health Outcomes Driving New Hospital Design. The New York Times
[23] Vickery, C (from an earlier draft by Wray, A, 2005) Improving Physical Infrastructure for Maternal Mortality Reduction; Annex for the Asia Division Strategy on Maternal Mortality. DFID

the year. An analysis of implementation completion reports of 118 World Bank projects involving health services published in 2006[24] shows that few of these reports evaluated changes in health services (42%) or health status (33%) although nearly all of those that did measure change showed improvements. Of those projects that constructed facilities, only 1.89% reported improvements in health services and only 3.5% reported improvements in health status. It is however impossible to tell from the reports whether these improvements are due to the infrastructure or other project inputs.

Evidence from Projects

East Timor (Timor Leste): the World Bank managed two health sector projects between 2000 – 2008[25] in East Timor which was then a fragile, post-conflict state. The first project constructed a central medical store and around 28 health centres and renovated 36 health posts. The second project renovated a large health centre in Dili, constructed 3 district hospitals and the central medical laboratory and renovated and extended the main referral hospital in Dili.

The first project was instrumental in restoring access to basic services through the construction of the health centres and to essential drugs at least partly through the construction of the central medical stores. The number of outpatient visits increased from 0.75 per capita per year in 2000 to 2.13 in 2004; the number of children under one year increased from 34% in 2001 to 73% in 2004; the percentage of births with skilled attendance increased from 26% in 2001 to 41% in 2004 and the percentage of the population with access to basic health services within 2 hours increased from 75% in 2001 to 86% in 2004.

The second project made a substantial contribution to the rehabilitation and development of the health system that had been largely destroyed in 1999. The design and construction of the hospitals contributed to a cost-effective use of resources and are expected to to generate substantial benefits for the population in coming years. Delivery of health services in general has improved significantly and the data show an improving trend for immunisation coverage and deliveries attended by health personnel.

The construction of the heath centres, the renovation of the health posts and the construction and renovation of the hospitals obviously contributed greatly to the increase in access to services but their contribution to outcomes is not known. They were however all simply designed and constructed on one-storey with the maximum use of natural light and ventilation.

Tonga: the World Bank Health Sector Support Project[26] in the Kingdom of Tonga which was completed in 2009 had 4 components one of which focused on improving the quality of Vaiola Hospital which serves as the national outpatient referral centre and tertiary hospital by investing in infrastructure redevelopment and management strengthening. The physical layout of the hospital was poor and several of its wards and departments were cramped which impeded their operations.

[24] Subramanian, Savitha, Peters, David and Willis, Jeffrey (2006) How are Health Services, Financing and Status Evaluated? The World Bank
[25] Implementation Completion and Results Report (2009) Timor Leste: Second Health Sector Rehabilitation and Development Project. The World Bank
[26] Implementation Completion and Results Report (2010) The Kingdom of Tonga: Health Sector Support Project. The World Bank

The redevelopment of Vaiola Hospital was successful in that it helped improve the quality of healthcare. Bed occupancy rates were increased to 70% from 40%; the rate of patient changeover increased significantly from 5,592 discharged patients when the project started to 8,312 by the end of the project. The rehabilitation of the hospital also had a positive impact on the health workforce by increasing staff motivation.

Eritrea: the World Bank Health Project[27]2 which was completed in 2005 aimed to improve the health status of the Eritrean population through among other things, the construction of 2 hospitals and the refurbishment of 30 clinics.

The project had mixed results: there were significant improvements in health indicators and many of these could be linked to project-financed out-puts such as clinic refurbishment and the provision of drugs and medical supplies. The hospital investment expanded the sector's infrastructure through the construction of two hospitals but the returns on investment had not been fully realised because the two hospitals (in 2007, a year after their opening) had the lowest bed occupancy ratios in the country.

Conclusions

Again there seems to be little or no hard evidence from developing countries that the design of health facilities has any noticeable effect on health outcomes, there are a number of lessons to be learned that should be taken into consideration when designing new health facility construction projects or programmes. These include the following:

- Location of facilities is of prime importance especially of health facilities at the primary health care level to increase access to health services especially in rural areas.
- The existence of adequate road links and effective, affordable transport connecting users to health facilities 24 hours a day throughout the year are of paramount importance.
- Health facility design and construction should be as simple and economic as possible especially at the primary health care level.
- Health facilities should provide maximum comfort for staff and patients to maximise health outcomes at the least cost. In the tropics this will mean ensuring that the buildings are properly oriented; maximising cross-ventilation and maximising natural lighting while minimising solar penetration into rooms.
- Health facilities should be well built and inviting in order to maximise retention of staff.
- Health facilities should be designed to be easily cleaned and maintained.
- A clean drinking water supply must be ensured.
- Adequate numbers of functioning and easily maintained and cleaned toilets must be provided for males, females and staff. Female toilets should be separate from male toilets and should have have maximum privacy.

[27] Project Performance Assessment Report (2009) Eritrea: Health Project. The World Bank

Annex 1: Infrastructure issues that impinge on health and education services

ACCESS:

Facilities should be close to the communities that they are serving and easily accessed. This increases enrolment and reduces carbon emissions from transport.

The size of any new facility should be appropriate to the size of the community that it is serving (and small schools are usually better than large schools).

The location of existing facilities should be mapped (location, size, condition, community served, etc) before any new construction programme starts.

Any existing facilities should be renovated to the same standard before any new ones are constructed.

New facilities should only be constructed as a last report and as part of an overall health or education programme. There is no point in constructing new health centres of schools if staff or equipment is not available.

Access to new facilities might require the construction of new bridges, roads, culverts, etc.

There should be access for all groups including women and the physically disabled.

A good water supply and separate toilets can increase access for girls and women.

DESIGN

Experienced construction consultants should be involved in the identification and design stages of any project that will include the construction of facilities for health and education.

Designs should support social inclusion and provision of equal opportunities.

Designs should be appropriate to the services offered and the community served.

Designs should take into account the climatic conditions in order that the facilities are comfortable to use.

Buildings should be correctly oriented to avoid solar gains and over-heating.

Designs should make the maximum use of natural light and ventilation and not rely on artificial lighting or cooling.

Designs should take account of other physical factors such as the likelihood of earthquakes, hurricanes or cyclones or tsunamis.

Designs should offer as much flexibility in use as possible so that for instance in the case of schools, communities can make use of some or all of the facilities to increase local ownership.

Adequate numbers of toilets for both sexes and a drinking water supply must be provided.

Female toilets should be separate from male toilets.

CONSTRUCTION

The construction should make as much use of locally available materials as possible (resource mapping is very important before project starts) to reduce transport, carbon emissions, etc.

Construction should be as energy efficient as possible. The use of materials such as cement and concrete that require large amounts of energy to produce should be reduced as much as possible and replaced with more energy-efficient materials such as stabilised soil blocks. Concrete columns and beams should be omitted as far as possible.

Maximum use should be made of solar power for the provision of hot water for health facilities and electricity for health facilities and schools.

The construction should use easily understood techniques and local labour as much as possible to provide employment possibilities.

The construction should be simple and robust to ensure long life and cost-effective in order that more facilities can be constructed.

The construction should take into account ‘cost-in-use’ and buildings should be designed with the aim of reducing maintenance as much as possible.

Professional and competent supervision and management is required for any construction programme if good quality buildings are to be produced. This is especially important if communities are to be involved in the management of a project.

COMMUNITY-BASED CONSTRUCTION

The use of communities to provide land, materials, labour and some elements of management in construction programmes can reinforce community ownership of facilities and willingness to assist with maintenance.

The use of communities in the implementation and management of projects can develop skills and the ability to manage future projects.

The use of community labour can provide employment and with training, upgrading of skills and capacities.

CORRUPTION

Independent, professional supervision, transparent bidding, funding and payment procedures can all help to reduce corruption.

The use of communities to monitor the implementation of projects can also help reduce the opportunities for corruption.

ASSET MANAGEMENT

Asset management is a way of ensuring the maximum economic use of built resources and this will include a maintenance plan for existing and new facilities to ensure that they have a long useful life at lowest cost.

Review 14

Jobs and skills

By Kevin Blanchard and Kate Conroy

1. Introduction

This paper provides inputs related to infrastructure created jobs and skills in the form of an Evidence Review in order to assist in the drafting of an Infrastructure position paper (IPP) which is intended to address the role of DfID in promoting economic and social development.

This IPP will examine the contribution infrastructure can play in job creation and developing skills in a developing country context. Within those broad subject areas, this paper will also investigate how infrastructure can assist with gender equality, reintegrating ex-combatants into society and those looking to diversify from agricultural based labour.

2. Infrastructure, Growth and Poverty Reduction

"In order to contribute to development within poor countries, it is vital that infrastructure projects bring local benefits such as employment… "

International Development Committee - Ninth Report DFID's Role in Building Infrastructure in Developing Countries 13th September 2011[1]

To achieve a sustainable impact on poverty reduction, the poor in developing countries require access to waged employment, skills training and basic goods and services such as healthcare, education, markets, water/ sanitation, and housing. Investment in infrastructure projects has been shown to provide jobs, increase skills creation and build on basic services for the poorest in society. The 2010 UN Summit on the Millennium Development Goals highlighted the importance of infrastructure/ capital projects in both economic and social terms for increasing employment and income opportunities (UN, 2010)[2].

Labour based methods of developing infrastructure have often been used in a developing nation context due to the availability of comparatively cheap and readily available labour. These circumstances are an outcome of high levels of unemployment and low wage levels associated with those countries. Attempts have been made to replicate the scheme within a capitalised economy, with varying levels of success as the Northern Provence Labour Intensive Rural Roads Maintenance scheme in South Africa highlighted[3]

Northern Province Labour Intensive Rural Road Maintenance Programme – 2000/1

This programme aimed to use labour intensive methods to build and maintain roads within the Limpopo region of South Africa. It was envisaged that developing a high intensity labour focused programme would increase employment levels in rural areas and increase wealth. Whilst the overall outcomes of the programme were met and were largely successful, the donor and organisers found it difficult to engage with rural communities in this industrialised nation due to the low levels of literacy and numeracy skills.

Overall the project found similar issues to those found in a developing nation context; however a key difference was the speed in which the budget was exhausted. This was thought to be largely due to the project being within an upper-middle-income economy and as such encountering a higher wage expectation.

Using local resources to improve infrastructure is essential for developing a strong economic foundation by increasing incomes and consumption, facilitating access to markets and providing social services. As such, the significance of infrastructure when providing access to basic services, promoting development through social protection and building infrastructure affiliated social safety nets is significant. To highlight this potential, a report by the International Labour Organisation (ILO) found that over half of public investments in some developing countries are infrastructure based, and in many cases, over 50% of these investments (rising to as much as 80 or 90% in the least developed countries) are funded by external donors (ILO, 2005) [4]. The multiplier effects of these infrastructure related employment, skills and asset increases are significant.

Additionally, an infrastructure project not only allows building and protecting of human capital and skills creation for unskilled/ semi-skilled workers but also provides opportunities (both in training and employability) to those at a graduate level through technical and vocational education and training. This is important as unemployment, particularly in a South Asian

[1] *DFID's Role in Building Infrastructure in Developing Countries* International Development Parliamentary Committee, 2011 - http://bit.ly/LpsLOI
[2] UN General Assembly, 2010 - http://bit.ly/L9DZZr
[3] Taylor et al, 2003 - http://bit.ly/LcyZAT
[4] International Labor Organisation, 2005 - www.ilo.org/public/english/employment/recon/eiip/about/lbt.htm

context amongst youth and recent graduates, is three to four times higher than wider adult unemployment rates (World Bank, 2007)[5].

Significantly, experience has shown that for the same level of investment in local infrastructure, the use of labour-based technologies can create between two and four times more employment (mostly unskilled), a drop foreign exchange requirements by 50% to 60%, decrease overall cost by 10 to 30%, and reduce environmental impacts (ILO, 2005).[6]

3. Infrastructure in fragile or post-conflict states

When considering infrastructure's impact on poverty reduction and growth rates in fragile or post-conflict states, large infrastructure projects have been shown to help another sector of the unemployed, jobless ex-combatants. These schemes have also been shown to have knock-on effects related to reducing poverty, unemployment levels, malnutrition and food poverty[7]

A World Bank report into funding assistance given in Cote d'Ivoire concludes that infrastructure projects have helped ex-combatants during the transition from a combat to civilian life (World Bank, 2006)[8]. In addition to the benefits of infrastructure projects on getting ex-combatants into work, a separate World Bank funded report into world development in 2013 has also highlighted the beneficial impacts of job creation in promoting social cohesion which is of key importance to those returning to a civilian life after military service (World Bank, 2011)[9].

Ex-Combatants building Infrastructure – Sudan, 2004

Looking at the impacts on infrastructure on ex-combatants, the USAID Office of Foreign Disaster Assistance (OFDA) funded a project within Sudan after the conflict aimed at improving road systems damaged by the war and improving economic and social capacity within the country.

The project highlighted the plight of 1000's of young men who having been in armed conflict since childhood, had no skills or knowledge in order to get a job and earn money to feed families etc. The project trains the men in basic construction, literacy and numeracy skills through on the job training. The ex-combatants are paid with a combination of food-for-work and cash-for-work incentives and are also provided with accommodation for the period of work and the tools and equipment.

In addition to allowing ex-combatants to learn a new skill or trade, the project has also highlighted the additional effects of reducing food poverty through increasing income and has subsequently reduced malnutrition of the children within the soldier's family.

ReliefWeb 'Sudan Project Report' – Found at http://reliefweb.int/node/201784

[5] The World Bank, 2007 - http://bit.ly/KFmJqm
[6] ILO (undated), www.ilo.org/public/english/employment/recon/eiip/about/lbt.htm
[7] ReliefWeb 'Sudan Project Report' - http://reliefweb.int/node/201784
[8] Cote d'Ivoire Technical Annex for Grant, World Bank (2006) - http://bit.ly/NsKnMI
[9] World Development Report 2013, World Bank (2011) - http://bit.ly/w0utY7

4. Infrastructure and Employment

In developing countries, limited economic diversification often means that there are few local formal or informal employment opportunities outside of agriculture. Further, workers within the agricultural sector are often dependent on working seasons and therefore often experience periods of low income, periods of increased poverty and food scarcity (SIDA, 2004)[10].

The seasonality of agricultural labour has also been shown to increase long term poverty through sustained loss of assets, income and consumption through the use of damaging household coping strategies; such as the distress sale of assets, high interest usury and reduced household consumption (SIDA, 2004)[11].

Those working in the agricultural sector also large rely on seasonal labour related migration in the search both for jobs and higher wages. While these coping strategies enable households to survive in the short-term, the longer term impacts can result in households moving much deeper into poverty (Kabeer, 2002, Conroy and Marks, 2008, CPRC, 2010).[12] To address this issue, and given the significant infrastructure deficit in many DFID countries, there is significant scope to undertake productive social protection programmes (public works / cash for work schemes) supported by social safety net programmes to support both the prevent asset and reductions in consumption expenditure at the household level and create assets at the community, regional and national level.

The International Development Parliamentary Committee has therefore suggested that international aid organisations (DfID included) build programmes that allow for the training and capacity building of the local workforce not only to assist in the construction of infrastructure but also in its maintenance and repair (DfID, 2011)[13]. Donors too are showing a significant interest in pursuing social protection and labour programmes, from the ILO's Employment Intensive Investment Programme (EIIP) to the more recent new World Bank Social Protection and Labour Strategy 2012 – 2022 (World Bank, 2012)[14].

Public works schemes (often known as cash-for-work or food-for-work programmes), have long been used to assist the poor and vulnerable in times of distress, from colonial famine response programmes in India, the Poor Employment Act in Victorian England, the US's New Deal programme in the 1930s, to more recent Public Works initiatives delivered as part of wider national Social Safety Net programmes; such as the Argentinian *Jefes y Jefes de Hogar* workfare programme, the Bangladesh Rural Maintenance Programme and the Indian Employment Guarantee Scheme of Maharashtra (ILO, 2005)[15].

The *Jefes y Jefes de Hogar workfare programme* in Argentina was initially created as a response by the Argentinian Government to the economic crisis that gripped the country in the late 1990s. As a result most other safety net programmes were stopped or their resources transferred to the *Jefes* programmes. The *Jefes* programme is similar to other guaranteed employment programmes, providing a monthly income to households for a minimum of 4 hours of work per day. Participants work on community services and small

[10] The Informal Economy, SIDA (2004) - http://rru.worldbank.org/Documents/PapersLinks/Sida.pdf
[11] The Informal Economy, SIDA (2004) - http://rru.worldbank.org/Documents/PapersLinks/Sida.pdf
[12] CRPC (2010), 'The Chronic Poverty Report 2008-09: Escaping Poverty Traps' www.chronicpoverty.org accessed 5 April 2010, Kabeer (2002), Safety Nets & Opportunity Ladders: Addressing Vulnerability and Enhancing Productivity in South Asia www.odi.org.uk/resources accessed 6 June 2012, and Conroy, K. and Marks, M. (2008), The use of coping strategies by extreme poor households on the Jamuna chars during monga, www.clp-bangladesh.org accessed 6 June 2012 .
[13] *DFID's Role in Building Infrastructure in Developing Countries* International Development Parliamentary Committee, 2011 - http://bit.ly/LpsLOI
[14] Productive role of Safety Nets, World Bank (2012) - http://bit.ly/ND1trq
[15] Labour Based Technologies, ILO (2005) - www.ilo.org/public/english/employment/recon/eiip/about/lbt.htm

construction or maintenance activities, or undertake skills training programs. Specific targeting requires that for households to be eligible for the scheme they must have children under age 18, individuals that are pregnant or people with disabilities and here is normally a limit applied that means only one person per household is eligible under the *Jefes* programme (World Bank, 2002)[16].

The Argentinian Ministry of Labor also operates another employment programme, *Programa de Emergencia Laboral* (PEL) with a design very similar to that of *Jefes*—monthly benefits are the same, but it includes some beneficiaries that do not qualify for *Jefes (*Tcherneva and Randall Wray, 2005*)*[17].

The Argentinian Government's total spending on *Jefes* and PEL is currently equal to about 1% of GDP, with nearly 2 million participants (about 1.6 million in *Jefes* and 300,000 in PEL) or about 5% of the population. According to the World Bank's reviews (World Bank, 2002)[18], the programme was successful in a number of areas: participant targeting, the provision of small scale infrastructure and increased household income and improved food security. Women also accounted for over 60% of programme participants. Nearly 90% of *Jefes* beneficiaries work in community projects, which include agricultural micro-enterprises and various social and community services and involved the building or repair of many small-scale community infrastructure assets[19]. Large-scale infrastructure projects, primarily under the jurisdiction of the Ministry of Infrastructure, also hire *Jefes* workers for the repair of Argentina's roads and bridges.

The Argentine Ministry of Labor estimates that the effect of *Jefes* on growth is positive. It is reported that the multiplier effect of the increase in income due to the *Jefes* is 2.57. With a multiplier of 2.57, the impact of 150 pesos per person per month for 1.8 million people (the number of beneficiaries at the time of these calculations), the annual addition to GDP is calculated to be 8.327 billion pesos, which represents 2.49% of GDP (Tcherneva and Randall Wray, 2005*)*.[20]

Other key elements of public works schemes, whether implemented by National governments or donor funded agencies include (IPC-UNDP, 2010)[21]:

- accurate participant targeting
- provision of a safety net scheme
- transfers for those unable to participate in the works programme and;
- complementary interventions designed to inflate the short term effects of the scheme.

Despite the historical and largely emergency-based context of public works schemes, more recently they have been associated with one of the most widely implemented development policies, conditional cash transfers. Implemented in approximately 35 countries over the last 20 years, conditional cash transfers are specifically targeted towards the poor, and are largely designed to distribute cash payments to participants if the participants meet improved human capital conditions, such as improving education levels etc (World Bank, 2009)[22]. Public works schemes also have a non-human capital conditionality which requires at least one household member to be in work to benefit from the scheme. This condition is

[16] World Bank Project Appraisal for Jefes y Jefes de Hogar programme (2002) http://bit.ly/M5513C
[17] Tcherneva and Randall Wray (2005), Is Argentina's job creation project *Jefes de Hogar* a true Employer of Last Resort Program? www.cfeps.org/pubs/wp-pdf/WP43-Tcherneva-Wray.pdf accessed 10 June 2012
[18] World Bank Project Appraisal for Jefes y Jefes de Hogar programme (2002) http://bit.ly/M5513C
[19] World Bank Project Appraisal for Jefes y Jefes de Hogar programme (2002) http://bit.ly/M5513C
[20] Tcherneva and Randall Wray (2005), Is Argentina's job creation project *Jefes de Hogar* a true Employer of Last Resort Program? www.cfeps.org/pubs/wp-pdf/WP43-Tcherneva-Wray.pdf accessed 10 June 2012
[21] Towards a Long Term Development Approach, IPC UNDP (2010) - http://bit.ly/LfqvN4
[22] Conditional Cash Transfers, World Bank (2009) - http://bit.ly/bAAMol

considered as a step moving away from simply giving aid (cash or other forms) to recipients which could be argued creates a culture of dependency. Critically these schemes have a dual function: providing vulnerable households with employment, income and consumption support whilst also helping to build local infrastructure which benefits the wider community, often in the form of low quality rural roads, drainage and low cost housing (World Bank, 2009)[23].

Applied in the short term, this approach is one response to support households through shocks and labour market crises and when guaranteed annually (as shown in the Indian Maharastra Public Works Scheme or Ethiopian PSNP models), can provide longer term regularised household stability and through appropriate targeting, labour-intensive public works programmes can support a wider national social safety net. Additionally, appropriate labour-intensive public works programmes can provide short-term food security by creating employment and therefore enabling a higher level of household income to be spent on food (Mascie-Taylor et al 2010, World Bank 2011)[24].

If timed to coincide with seasonal depressions in the rural labour market, these works schemes can provide economic respite to those who would normally suffer during the agricultural 'off-seasons' and as such mitigate the need for distress sales and reducing household expenditure.[25]

Detailed econometric analysis of the ICRISAT panel survey found that, despite some unevenness in the results, EGS participation generally decreases the variability of labour earnings (ODI, 2006)[26].

4.1 Women and Growth

Vivid Economics have shown during research on gender equality and economic growth that increasing human capital, specifically for women and girls, has direct impacts on the economic performance of a country. Vivid also state that a country is rarely wealthy if there are high levels of disparity between men and women's education rates and subsequent employability (Vivid Economics, 2010)[1].

Studies have also shown that improving gender equality increases the competitiveness of labour markets and as such has a positive effect on growth[1]. Indeed, there is a growing literature that demonstrates that female employment not only improves the social capital within the country but increased earnings can also increase a woman's bargaining power in the home (Amartya Sen 1999; Lawrence Haddad *et al* 1997; Stephan Klasen and Claudia Wink 2003)[1]. Other benefits of gender equality include higher savings, more productive investments, use and repayment of credit, and higher investments in the health and education of their children, thus promoting human capital of the next generation and economic growth (World Bank 2001).

An example of infrastructure projects increasing women's employability can be found in the Chars Livelihoods Programme (CLP) Phase 1 and 2 (2004 – 2015). The CLP is a large integrated DFID funded programme operating in Bangladesh. In addition to its significant asset transfer programme, the CLP provides seasonally timed employment opportunities and basic infrastructure through two major cash-for-work programmes each year:

[23] Conditional Cash Transfers, World Bank (2009) - http://bit.ly/bAAMol
[24] Mascie-Taylor & Goto (2009), World Bank (2011), Evidence and Lessons Learned from Impact Evaluation on Social Safety Nets, www.worldbank.org
[25] The Maharastra Employment Guarantee Scheme, ODI (2006) - www.odi.org.uk/resources/docs/1698.pdf
[26] The Maharastra Employment Guarantee Scheme, ODI (2006) - http://bit.ly/NqmdUt

- Dry Season Cash for Work scheme and;
- Infrastructure and Employment Programme (IEP)

Both schemes have been planned to take place between January to May and October to December each year which are the periods coinciding with the *boro* and *monga* hunger seasons. IEP, in particular, was adapted over time to respond to the varying needs of households during *monga*. Wages are based on local private sector activities, with a 20% premium added to account for the wet working conditions. Participation on IEP was voluntary but due to limited work opportunities available to female char dwellers it was decided that CLP would also set aside a guaranteed and non-transferable 30% of IEP jobs for women. In addition a set five-day working week was introduced to allow for domestic activities traditionally associated with female employees. In a robust panel study, participation on CLP IEP was shown to be associated with significant reductions in household loan taking, distress sales and work-related migration. Another benefit was a noted improvement in women and children's nutritional status (Conroy and Marks, 2008; Mascie-Taylor & Goto, 2009)[27].

Another example of the work being carried out to ensure gender equality in infrastructure development projects is the IMC Worldwide run Rural Access Programme (RAP) in Nepal. DfID funded projects have sought to boost the employment levels of women within the country. Since its design phase in 2000 to its expected end date in 2012 the project has developed a workforce comprising of 40% women. In addition to increasing employment rates amongst Nepalese women, the project has also connected over 1 million people through access to the roads being built and as such has increased levels of human capital in the region[28].

4.2 Infrastructure, Jobs, Skills Creation and Security

As DFID and other donors refocuses their attention to fragile and post-conflict states, the imperative for developing skills and employment opportunities becomes as much an issue of maintaining security itself as increasing income and household consumption. As an example returning ex-combatants pose a significant threat to a country's economic stability and as such specific donor funded programmes are evolving to work with this specific group. A joint submission to the International Development Committee's Ninth Report, '*DFID's Role in Building Infrastructure in Developing Countries*' by Engineers Against Poverty (DCEAP), Institution of Civil Engineers (ICE) and The Royal Academy of Engineering (2011) highlighted the importance of providing young men with alternatives to joining and re-joining armed groups[29].

The development of a skilled labour force needs to be relevant to what is needed and available and therefore skills development should be integrated with employment promotion at both formal and informal levels. In particular, international co-operation in developing an enabling environment for micro and small-enterprises is of critical importance and there is evidence that training for workers in the informal economy on basic skills (such as literacy and numeracy) as well as entrepreneurial skills (such as risk management, opportunity analysis) facilitate the transition from self-employment in the informal economy to micro-enterprise development in the formal economy.

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[27] See Conroy, K. and Marks, M. (2008), 'The use of coping strategies by extreme poor households on the Jamuna chars during monga' and Mascie-Taylor, N. C. G., and Goto, R. (2009), 'A cash for work programme improved nutritional status, food expenditure and consumption of poor rural Bangladeshi women and children in the hungry season' www.clp-bangladesh.org accessed 1 April 2010 both www.clp-bangladesh.org.

[28] *DFID's Role in Building Infrastructure in Developing Countries* International Development Parliamentary Committee, 2011 - http://bit.ly/MbzOrE

[29] *DFID's Role in Building Infrastructure in Developing Countries* International Development Parliamentary Committee, 2011 - http://bit.ly/LpsLOI

A good example of infrastructure creating jobs and skills creation can be found in the Mahatma Ghandi Rural Employment Guarantee Scheme (NREGS) in India. Starting in 2006, NREGS is the world's largest employment guarantee programme (EGS) providing 100 days a year of guaranteed work to poor, rural households. The scheme acted as a significant safety net for the rural poor and as with other work schemes of this nature, its aim was to reduce rural poverty through the creation of sustainable rural infrastructure which was expected to foster rural economic growth[30]. Whilst the scheme's impact has been questioned by some, arguing that it is no more effective at reducing poverty than more traditional schemes[31] others have highlighted its wide ranging benefits for the poorest in society with one study showing a positive impact in poverty levels through the implementation of selected employment guarantee schemes (ODI, 2011)[32].

When examining the impact of NREGS, studies have highlighted the difficulty of drawing conclusions on the benefits since the diversity of schemes (design of scheme, populations, various methodology used etc.) in operations have meant comparison of data is difficult. Studies that have attempted to examine impacts related to employment guarantee schemes; have shown due to the increase of job security and subsequent financial security overall mental wellbeing has improved as a result (ODI, 2011)[33].

Another good example detailing the benefits of infrastructure assisting in creating jobs, skills and security related to a Production Safety Net Programme (PSNP) in Ethiopia. The Government of Ethiopia with the assistance of donor organisations implemented a plan to improve household and community resilience to food shocks and break the cycle of dependence on food aid. Like other national Social Safety Net Programmes, the PSNP had two main components: a Public Works scheme, which provided counter-cyclical employment on rural infrastructure projects such as road construction and maintenance, small-scale irrigation and reforestation; and direct support, which provided direct unconditional transfers of cash or food to vulnerable households with no able-bodied members who could participate in the public works projects (World Bank, 2012)[34].

The PSNP delivers cash and/or food transfers to 7-8 million rural Ethiopians for six months every year, either through Public Works (85%) or for free as direct support amounting to 15% (IDS Knowledge Services, 2008)[35].

When examining impacts related to the PSNP within Ethiopia the International Food Policy Research Institute found limited evidence of households covered under the initiative received any increases in assets or reduction of long term poverty reduction (IFPRI, 2008)[36]. The report also highlighted that when used in conjunction with other methods of social safety net programmes, the benefits of PSNP increased and found a willingness of the participants to invest for productive purposes, use improved technology for farming and in some cases diversify business away from agriculture (IFPRI, 2008)[37].

4.3 Negative Impacts

[30] Dey (2010), Evaluating India's National Rural Employment Guarantee Scheme: The Case of Birbhum District, West Bengal, ISS Working Papers 490
[31] India's Boom Bypasses Rural Poor, WSJ.com (2011) - http://on.wsj.com/lHC92N
[32] Systematic Review of the Impact of Employment Guarantee Schemes and Cash Transfers on the Poor, ODI (2011) - http://www.odi.org.uk/resources/docs/7161.pdf
[33] Systematic Review of the Impact of Employment Guarantee Schemes and Cash Transfers on the Poor, ODI (2011) - http://www.odi.org.uk/resources/docs/7161.pdf

[34] Proposed Additional Credit for PSNP In Ethiopia, World Bank (2012) - http://bit.ly/LZeE1J
[35] Ethiopia Productive Safety Net Programme (2008) - http://bit.ly/OPJ7l4
[36] The Impact of Ethiopia's Productive Safety Net, IFPRI (2008) - http://bit.ly/L9MAvb
[37] The Impact of Ethiopia's Productive Safety Net, IFPRI (2008) - http://bit.ly/L9MAvb

Whilst examples used in the above text highlight the positives and benefits of using infrastructure for jobs and skills creation, there are of course negative impacts to such methods.

- **Environmental risks**
  Past projects using these methods have been criticised on the negative environmental impact they have been shown to have[38]. Increased deforestation leading to landslides, pollutants leaching into water supplies, decreased biodiversity levels have all been recorded in the aftermath of labour intensive infrastructure projects.

- **Health risks**
  Increased levels of HIV/ AIDS transmission rates are often associated with labour intensive work within a developing nation context. The migratory nature of infrastructure labour in developing countries (where individuals will often leave their home towns and families to find work) can sometimes lead to an increase of HIV transmission rates through the use of sex workers or multiple sexual partners[39]

- **Health and safety** has also been shown to be a significant issue when considering labour intensive infrastructure projects. The non-static nature of these developments often lead to health and safety regulations being ignored or corners being cut which can result in injury or death for workers. This can have significant impacts on the families of those injured or killed where compensation is either too low or not offered[40].

- **Gender issues**
  Whilst this paper has identified positives in gender relations during labour intensive infrastructure projects, it is also common to find gender inequalities including lack of crèches for children of working mothers, lack of flexibility when considering women's other role outside of the work place etc.

- **Human rights**
  Whilst the issue of human rights of workers is normally monitored by the donors or organisation funding the project, some issues remain. Not adopting means amounting to forced labour, ensuring fair pay for workers, breaks and reasonable working hours, access to food and water during the working day are all issues that have been found in studies looking at labour intensive infrastructure[41].

[38] http://www2.adb.org/Documents/RRPs/tim/rrp-tim-38618.pdf
[39] http://www.policyproject.com/pubs/SEImpact/botswana.pdf
[40] http://www.oecd.org/dataoecd/18/1/47466934.pdf
[41] http://bit.ly/LeMHrA

Review 15

Urbanisation and growth

By Ivan Turok and Gordon McGranahan

1. Introduction

The relationship between urbanisation and socio-economic development is one of the key questions of our time.[1] The contribution of cities to growth has become an important concern of mainstream economists in the global North, illustrated by the award of the Nobel prize to Paul Krugman in 2008. Yet the biggest practical challenges lies in Africa and Asia, where the issue is how (and whether) rapid urbanisation can strengthen economic development and reduce poverty. The impact of urbanisation on environmental sustainability is a related concern.

Over the last decade, a growing number of influential international organisations have come to the conclusion that urbanisation can assist development (OECD, 2006; UNFPA, 2007;

[1] Urbanisation normally refers to the increasing share of the population (and economic activity) located in urban areas. This is distinct from urban population growth, which can reflect natural growth (i.e. births exceeding deaths) as well as urbanisation. It is also distinct from the physical expansion of urban areas, which can reflect declining population density as well as urbanisation and natural growth. Globally, the contribution of each of these three factors to the expansion of urban land areas is similar in magnitude, judging from United Nations statistics on urbanisation and urban growth (United Nations Population Division, 2010) and recent research on declining urban density (Angel et al, 2010).

UN-Habitat, 2008, 2010; World Bank, 2009). For example, “The prosperity of nations is intimately linked to the prosperity of their cities. No country has ever achieved sustained economic growth or rapid social development without urbanising” (UN Habitat, 2010, p.x). Similarly, “No country has grown to middle income without industrializing and urbanizing. None has grown to high income without vibrant cities. The rush to cities in developing countries seems chaotic, but it is necessary” (World Bank, 2009, p.24).

The arguments put forward for cities as ‘engines of growth’ are generally broad-brush and the supporting evidence is often thin. The connection between urbanisation and growth is often portrayed as automatic, immutable and inevitable - a kind of universal law. Insufficient attention has been given to the different ways in which cities can support economic growth, the varied forms or composition of that growth, the extent to which it is inclusive of poor communities, and the implications of urban growth for ecological systems and the use of natural resources.

China is widely regarded as an example of how urbanisation can fuel industrialisation and transform living standards (World Bank, 2009; Ravallion, 2009). China passed the historic milestone of 50% of its population living in cities in 2011, up from only 20% in 1980. The speed of urbanisation has reflected the strength of jobs growth in cities. Average household incomes in Chinese cities are now almost three times higher than in rural areas because of higher productivity. The government’s commitment to invest heavily in urban infrastructure differs from India and most other developing countries, where congestion, water shortages and public health problems are rife: “For every pound Indian authorities invest in urban infrastructure, their Chinese counterparts spend seven” (Observer, 22nd January 2012).

2. The theory of agglomeration economies

The basic insights into the benefits of economic concentration can be traced back to the founding fathers of economics. Two basic concepts underpin the economic advantages of cities - the *division of labour* and *economies of scale*. Adam Smith introduced the former to explain the benefits for productivity and therefore growth from specialisation among producers. Specialisation means firms concentrate on particular products or tasks, which yields efficiencies and skills. This explained the leap forward from craft to factory production associated with the industrial revolution. Specialisation also applies at the city level, meaning the benefits of focusing on a function for which places have a distinct advantage. Local specialisation becomes more important under conditions of globalisation and intensified competition.

Economies of scale has two aspects. *Internal economies of scale* are internal to the firm and relate to the lower unit costs or efficiencies that result from larger scale production. *External economies of scale* (or *‘agglomeration economies’*) relate to the benefits firms derive from locating near to other firms in order to reduce transport and communication costs, and to gain from network effects, such as shared information. The more firms there are in the network, the more knowledge and intelligence potentially available to learn from. Agglomeration economies also include proximity to a large labour pool, suppliers, customers and competitors within the same industry (*localisation economies*), and firms in other industries (*urbanisation economies*).

These economic gains from spatial concentration can be summarised as three broad functions: matching, sharing, and learning (Duranton and Puga, 2004; Storper, 2010). First, cities enable firms to *match* their distinctive requirements for labour, premises, suppliers and business services better than smaller towns, simply because markets are larger and there is a bigger choice available. A bigger pool of providers also tends to reduce costs and improve variety as a result of competition and specialisation. In a volatile economic environment

there is a premium on adaptability to shifts in markets, especially as companies tend to be leaner, more focused on core competences, and more reliant on buying-in goods and services rather than in-house production (Buck et al, 2005; Scott, 2006). Agglomerations enable firms to 'mix and match' their resources more easily in this context. Labour market matching can benefit workers as well as firms by ensuring a better fit with their skills and aspirations, and higher earnings because of the resulting productivity gains.

Second, cities give firms access to a bigger and better range of *shared services* and infrastructure because of the larger overall scale of activity. Cities offer better external connectivity to national and global customers and suppliers through more frequent transport connections to more destinations, and more efficient logistics systems to handle imports and exports. They tend to have higher capacity broadband and telecommunications systems for electronic communication and marketing. They have a better choice of specialised technical support, professional expertise, financial know-how, or research organisations to assist with product design, and to assist companies to stay up-to-date with changes in technology. Cities also have a wider range of education and training organisations to help with staff development and the acquisition of specialised skills and capabilities.

Third, firms stand to benefit from the superior flows of information and ideas in cities, which promote more learning, creativity and innovation, and results in new and more valuable products and processes (Jacobs, 1969, 1984; Hall, 1998; Storper and Venables, 2004). Proximity facilitates communication and sharing of complex ideas between companies, research centres and related organisations (Cooke and Morgan, 1998; Storper and Manville, 2006; Scott, 2006). It enables people and firms to compare, compete and collaborate, which may establish a self-reinforcing dynamic that spurs creativity, attracts mobile capital and talent, and generates growth from within. These 'dynamic' advantages become increasingly significant over time because they are cumulative, compared with the one-off or 'static' advantages gained from lower production and transactions costs.

Economies of scale can also apply to public infrastructure. It is obviously cheaper to provide and operate public services such as hospitals, water supply, sewage treatment facilities, electricity generation and refuse collection in large cities than in dispersed settlements where population densities are low and distances are large (UNFPA, 2007; Martine et al, 2008). The network effects of public goods can also be maximised where there are large numbers of service users (Overman and Venables, 2010). There is a related argument that urban shelter and infrastructure projects generate greater positive externalities in cities than in towns and rural areas because they both (i) increase the productive capacity of households (particularly through improved health and life expectancy) and (ii) increase the effective labour supply, which enable higher rates of city-wide economic growth. Kalarickal (2007) provides examples of how public investment in low cost housing, sanitation, drinking water, electricity and access roads in informal settlements in Africa helped to reduce public health problems and mortality associated with overcrowding, and facilitate in-migration, which assisted in addressing some of the binding constraints to economic growth. He makes the point that governments and international donors must look beyond the individual project when assessing their costs and benefits because of the significant externalities associated with investments in cities.

The benefits of agglomeration can be offset by rising congestion, overcrowding, overloaded infrastructure, pressure on natural resources and ecosystems (such as water courses and air quality), and higher labour and property costs in cities. These 'agglomeration diseconomies' increase as cities expand, especially if urbanisation is poorly managed and cities are deprived of essential public investment to maintain and expand their infrastructure. The immediate effects of dysfunctional systems, gridlock, power cuts, water scarcity and physical deterioration may be to increase business costs, reduce productivity, dampen private investment and hold back economic growth. The balance between the agglomeration

economies and diseconomies plays a big part in determining whether city economies and populations continue to grow, stagnate or begin to decline.

3. Measuring the relationship between urbanisation and growth

It is difficult to disentangle and measure the effects of agglomeration because of their complexity and feedback effects. The benefits of economic concentration are partly absorbed by higher land and labour costs, and offset by increased congestion. Consequently, the effects may not be apparent in aggregate economic indicators, such as output, employment or average earnings. These variables are affected by a range of other factors as well, such as the city's industrial or occupational composition. The effects of agglomeration may not be apparent at the level of city administrative units, for which spatial data is conventionally available, because the openness of city economies means there is considerable leakage of resources across administrative boundaries. Government financial transfers between localities and regions also tend to mask the underlying economic processes, because they are often specifically designed to compensate for economic weakness.

The key outcome of agglomeration that should be measured is productivity. This is the single most important determinant of growth in economic output and income. It reflects the value of local goods and services and the efficiency with they are produced. Unfortunately statistics on productivity are notoriously unreliable at the local level. Instead researchers employ all sorts of other devices and indicators to assess the economic advantages of agglomeration.

One of the simplest is to compare the urbanisation levels of individual countries with some measure of national economic output, average income or social development in order to test for a statistical association between urbanisation and development. Many results suggest that there is a broad empirical regularity – urbanised countries tend to be more prosperous (e.g. UN-Habitat, 2010). However, the spread of observations is always very wide around the trend line, indicating that other factors are also at play. In addition, the discovery of a statistical association does not constitute evidence of a causal connection, i.e. that cities are actually driving growth and development. Urbanisation may be as much a consequence of economic development as a cause.

There may be some other process contributing to both urbanisation and higher levels of development in cities. The concentration of political power in cities is an obvious candidate, resulting in 'rent-seeking' rather than productive activity, as people and firms seek preferential access to political elites. The outcomes could include more public sector jobs and higher wages in cities, plus higher levels of professional services, construction, embassies, media and consultants seeking access to government contracts and lobbying over legislation. Bekker and Therborn argue that this has been the dominant factor in the growth of many capital cities in Africa: "Proximity to the centre of patronage and redistribution, rather than economic development, has driven the explosive growth of African capitals since independence" (2012, p.193). Glaeser adds a point about the concentration of political power: "The more centralised a nation's government, the larger its capital city, because people are attracted to power as ants are to picnics" (2011, p.225; see also Overman and Venables, 2010).[2]

A series of other studies involving simple correlations between some measure of agglomeration (such as city size or variation in density levels between regions) and some

[2] For a critical interpretation of this view and a restatement of the economic logic of urbanisation, see Satterthwaite (2010)

measure of economic development (such as average incomes or growth in output) have found that no relationship exists, or even an inverse relationship (e.g. studies summarised in Martin, 2008). Leading academics acknowledge that the present understanding of the dynamics of agglomeration and the strength of the cause-effect mechanisms remains quite limited, despite considerable theoretical development. According to Storper, for example:

“All in all, work on agglomeration has progressed considerably in the NEG, urban economics and regional science. But it remains far from an adequate causal account of the dynamics of agglomeration and de-agglomeration. … Deciphering the causes of agglomeration will ultimately require a much better understanding of the complex interdependencies between agents that lead them to congregate together” (2010, p.322).

According to Garretson and Martin, serious weaknesses in the main theories of agglomeration arise because they “embody crude conceptions of geography and history” (2010, p.130). One of the consequences is that they are unable to explain differences in the strength and nature of agglomeration effects in different places and at different points in time. Despite being one of leading proponents of formal economic models based on artificial assumptions, Glaeser recognises that: “Not only is there no one formula toward urban eminence, but also the sources of success are often highly nation specific” (2011, p.225).

With the focus of economic research on the relationship between cities/urbanisation and productivity/growth, there has been little systematic analysis of the varied forms or composition of urban economic growth. In particular, the problems of narrow, unequal and exclusive urban growth have not been examined closely. This gap in knowledge is a particular concern in Africa given the recent revival of many national economies based on booming commodity exports. The imperative to stimulate growth of any kind has been replaced to some extent by the need to diversify and broaden the growth trajectory in order to maximise the impact on jobs and incomes. More robust and inclusive economic growth requires adding value to raw materials, minerals and other natural resources. Global experience suggests that cities can help to transform productive activity, diversify from primary commodities and build more integrated economies with stronger backward and forward linkages. Such cities can be expected to attract labour from rural areas, thereby contributing to urbanisation.

Another area of neglect has been the implications of urbanisation for ecological systems and the use of natural resources. In the context of climate change, rising energy prices and global pressures to cut carbon emissions, it is vital to improve understanding of the environmental consequences of fast-growing cities. At face value, these concerns should reinforce the case for concentrated rather than dispersed development, including localised production of energy, food, water, building materials and many other goods and resources. As with economic growth, however, there is some debate about the environmental costs and benefits of urbanisation.

4. Empirical evidence of agglomeration economies from the global North

A variety of sophisticated econometric studies in the United States and Europe have been carried out in recent years in order to estimate the effects of agglomeration. They use different statistical variables, units of analysis and measurement techniques, and their findings are quite diverse. Many of them conclude that cities do offer measurable economic advantages (Eberts and McMillen, 1999; Ciccone, 2002; Duranton and Puga, 2004), although they are not as substantial or widespread as often suggested. A useful summary of the evidence concluded that the elasticity of city productivity with respect to city size is

somewhere in the range 0.04-0.11 (Rosenthal and Strange, 2004). This means that doubling city size increases productivity by between 4% and 11%. Alternatively, for an increase of 25% in a city's population, the output per worker (and consequently income) rises by between 1% and 2%. Studies based on individual earnings data find somewhat smaller, although still significant, impacts of agglomeration in big cities (summarised in Rice et al, 2006). Some evidence suggests that the impacts are larger for cities that specialise in particular industries. This indicates that localisation economies may be stronger than urbanisation economies. This finding is supported by several studies summarised in Graham (2007, 2009). These found that the elasticity of productivity ranged widely between 0.01 and 0.20, although most were under 0.10, which is modest rather than substantial (see table 1).

Table 1: Estimates of agglomeration economies in the 'North'

Author	Unit of analysis	Independent variable	Elasticity
Aaaberg (1973)	Swedish cities	City size (population)	0.02
Shefer (1973)	US MSAs	City size (population)	0.20
Sveikauskas (1975)	US MSAs	City size (population)	0.06
Kawashima (1975)	US MSAs	City size (population)	0.20
Fogarty & Garofalo (1978)	US MSAs	City size (population)	0.10
Moomaw (1981)	US MSAs	City size (population)	0.03
Moomaw (1983)	US MSAs	City size (population)	0.05
Moomaw (1985)	US MSAs	City size (population)	0.07
Nakamura (1985)	Japanese Cities	City size (population)	0.03
Tabuchi (1986)	Japanese Cities	City size (population)	0.04
Louri (1988)	Greek Regions	City size (population)	0.05
Sveikauskas et al (1988)	US MSAs	City size (population)	0.01
Nakamura (1985)	Japanese Cities	Industry size (employment)	0.05
Henderson (1986)	Brazilian Cities	Industry size (employment)	0.11
Henderson (1986)	US MSAs	Industry size (employment)	0.19
Henderson (2003)	US MSAs	Industry size (no. of plants)	0.03
Ciccone & Hall (1996)	US States	Employment density	0.06
Ciccone (2002)	EU regions	Employment density	0.05
Rice et al (2006)	Britain sub-regions	Economically active population	0.05
Fingleton (2003)	British cities	Employment density	0.02

Source: Based on Graham, 2007, which includes references. Note: MSA = Metropolitan Statistical Area

A novel feature of the Rice et al (2006) study is that it also sought to measure the rate at which the economic advantages of proximity diminish with distance from the core city. They found that the benefits are greatest within 40 minutes driving time of the city core, tapering off quite sharply thereafter and having little or no effect beyond about 80 minutes. The effects of agglomeration are four times stronger 30 minutes driving-time away than 60 minutes away, and 17 times stronger than 90 minutes away. One of the implications is that urban sprawl and residential decentralisation can undermine productivity and growth by lengthening travel-to-work times. Another is that transport improvements to reduce travel times and traffic congestion in the largest cities can yield valuable productivity gains for the economy. This was the main reason that a major UK government report concluded that the top priority for national transport investment should be to invest in Greater London, rather than to connect different cities across the country through high speed rail or other infrastructure (Eddington, 2006).

Another recent UK study disaggregated the effects of agglomeration for different industries and found even larger effects, with the elasticity of productivity varying between 0.07 for manufacturing and 0.19 for services (Graham, 2009). The effects were small or insignificant for non-tradable services such as retailing, real estate, postal services and public services, which tend to locate close to consumers. The biggest effects of all were for financial services and professional services such as management consultants. This chimes with recent qualitative research on high order business services (lawyers, accountants, marketing, insurance companies, engineering consultants, designers, etc) (Hall and Pain, 2006). The latter study across eight European countries found strong tendencies for these top-of-the-food-chain functions to concentrate their activities within each country's largest city.

In summary, econometric studies have produced contrasting evidence for the strength of agglomeration economies. Some of the variation may be attributable to methodological differences. Differing national circumstances are also bound to be important. Whatever the reasons, it is clear that this body of evidence is not strong enough to justify popular claims that cities are 'engines of growth'. According to Martin: "We simply do not know enough … to justify yet further concentration of economic activity in already congested and over-heated regions and agglomerations" (2008, p.10). A particular concern is the level of aggregation. Most previous studies are based on city-level data which may be too highly aggregated to detect the way agglomeration economies operate. These are essentially about the interactions between individual firms, workers and institutions. More disaggregated analysis, based on data at the level of industries, firms and small areas might reflect the underlying processes more clearly, and to identify the industrial and geographical scope of agglomeration economies more accurately. Agglomeration effects should also not be examined in isolation of other factors affecting productivity and development, such as the industrial and occupational structure, level of technology and skills, available land supply, and internal and external connectivity. Some of these forces may reinforce each other, with successful cities emerging as the sum of the parts.

5. Empirical evidence from Asia

A smaller body of econometric research exists on agglomeration in developing countries of the 'global South', particularly Asia. This has been usefully summarised by Overman and Venables, who note that "the developing country literature remains thin" (2010, p.104). Unfortunately there have been no econometric studies of this kind in Africa. The main findings are shown in table 2. They draw particular attention to the question of whether localisation economies or urbanisation economies are more significant, rather than the precise findings for the elasticity of productivity.

Table 2: Analyses of agglomeration economies in the 'South'

Country	Author (date)	Main conclusions
China	Chen (1996)	Localisation economies
India	Shukla (1996)	Urbanisation stronger than localisation economies
	Mitra (2000)	Urbanisation economies in 11 out of 17 industries
	Lall et al (2003)	Urbanisation economies in 8 industries. Localisation diseconomies
	Lall et al (2004)	No localisation or urbanisation economies
Indonesia	Henderson (1996)	Localisation economies in 3 industries. Urbanisation economies in 3 industries.
Korea	Lee & Zang (1998)	Localisation not urbanisation economies

	Henderson (2001)	Localisation economies in 3 industries. Urbanisation economies in 1 industry.

Source: Overman and Venables (2010)

The general message is that localisation economies seem to be more important than urbanisation economies. In other words, sector-specific externalities appear to be more significant than cross-cutting externalities. Moreover, these benefits are not apparent in all manufacturing industries, and few of the studies examined service sectors. Case studies of particular industries confirmed that localised concentrations of specific types of firms offered substantial advantages, and that firms exchanged goods, information and people. Another finding was that informal enterprises can perform complementary functions to formal companies – they do not simply add to local congestion and drive up urban costs. Overman and Venables' overall conclusion is that: "There are substantial productivity advantages to urban centres and, as such, the development of these centres is a key part of countries' economic growth" (2010, p.114).

6. Empirical evidence from Africa

Although there have been no equivalent econometric studies of agglomeration in Africa, there have been several other quantitative studies exploring the relationship between urbanisation and development in Africa, or comparisons of Africa with other parts of the world. Their findings have been very mixed. At least four international comparative studies have found no connection between urbanisation and development in Africa.

A major study of 90 developing countries around the world found a positive relationship between urbanisation and poverty reduction, except in sub-Saharan Africa (Ravallion et al, 2007). Another international study concluded that "There is generally an unequivocal (positive) correlation between urbanisation and economic development and growth, but in Africa this appears not to apply" (Kamete, 2001, quoted in Njoh, 2003). A third study examined the relationship between average income and level of urbanisation for some 80 countries at two points in time – 1960 and 2004 (Bloom and Khanna, 2007). It found that there was an association between urbanisation and income, particularly at higher levels of urbanisation, but the relationship was not simple or linear. This link had also strengthened between 1960 and 2004. A key conclusion was that "the links between urbanisation and income are relatively weak at low levels of development" (Bloom and Khanna, 2007, p.11). The study specifically compared the impact of urbanisation on average incomes in Asia and Africa, and concluded that:

"while urbanisation in Africa over the past 45 years has been accompanied by sluggish economic growth, in Asia, where urbanisation has occurred to a nearly identical extent, economic growth has been rapid" (Bloom and Khanna, 2007, p.11).

Another study focused only on Africa found that nearly three-quarters (71%) of the 32 countries analysed actually had a negative correlation between urbanisation and GDP over the 1985-2000 period (Bouare, 2006, quoted in White et al, 2008). This could be because people left rural areas as a result of poverty and crises, and that migration to urban areas undermined economic performance, possibly by contributing to undue congestion and diverting scarce public resources to fund social infrastructure. Similarly, the World Development Report for 1999/2000 argued that African cities are exceptional in failing to serve as drivers of growth: "Instead they are part of the cause and a major symptom of the economic and social crises that have enveloped the continent" (World Bank, 2000, p.130).

Various observers have suggested that Africa may have urbanised prematurely in response to push factors (rural droughts, falling agricultural prices and ethnic conflicts) rather than the pull of economic opportunities (e.g. Commission for Africa, 2005). This view implies that Africa is over-urbanised and that urbanisation on the continent lacks an economic logic (Beall et al, 2010; Satterthwaite, 2010). Indeed, three-quarters of African governments believe that urbanisation is excessive and have policies to reduce rural-urban migration (United Nations, 2008). These governments have strong anti-urban sentiments because of the social tensions, overcrowding and physical squalor created in cities, combined with the breakdown of traditional family structures, and the spread of crime and disease (McGranahan et al, 2009). There is little doubt that cities are more commonly seen as environmental problems and threats to social order, rather than potential mechanisms for expanding economic opportunities and reducing poverty.

The notion that urbanisation in Africa has no economic benefits is contradicted by at least two other systematic studies which show a positive link between urbanisation and development (Njoh, 2003; Kessides, 2007). Njoh (2003) examined data for 40 sub-Saharan African countries and found a strong positive correlation between urbanisation and human development. In a wider-ranging study, Kessides (2007) confirmed a connection between urbanisation and growth over the period 1990-2003 in 15 of the 24 African countries she examined. She also showed that national economic growth during this period was derived from urban industries, supporting the idea of cities as generators of growth. In a related World Bank report she concluded that:

“Africa cannot simply be characterised as ‘urbanisation without growth’, and the term does not even fit many of the countries. The economic growth that has taken place in the past decade derives mainly from urban-based sectors (industry and services), and this is especially true of the better-performing economies. But cities have clearly not lived up to their productive potential because of widespread neglect and bad management” (Kessides, 2006, p.xxii).

Furthermore, she recognised that the advantages of agglomeration may not emerge automatically, especially if serious shortcomings in basic urban services, land, housing, transport and local government mean that the diseconomies of scale outweigh the economies:

“the simple concentration of firms and people does not guarantee that agglomeration economies will be realised. Many African firms are not experiencing the market efficiencies, ease of mobility and low transactions costs that better-managed cities could deliver, much to the detriment of the economy and competitiveness” (2005, p.ii).

After its sceptical position a decade ago when urbanisation was seen as one of the causes of economic failure, the World Bank has become one of the strongest advocates of giving urbanisation a higher profile in African development policy. The 2009 World Development Report (WDR) made a strong case for the role of cities in promoting economic development:

“Growing cities, mobile people, and vigorous trade have been the catalysts for progress in the developed world over the last two centuries. Now these forces are powering the developing world’s most dynamic places” (World Bank, 2009, p.13)

Africa was singled out for special attention since it has the most dispersed and least urbanised population in the world, the highest transport costs, and the greatest institutional fragmentation and proliferation of national borders because of its colonial legacy. Consequently, the continent has to promote higher densities, shorten distances and lower divisions between nations to stimulate economic growth. Anti-urban sentiments also need to change: “urbanisation, done right, can help development *more* in Africa than elsewhere”

(World Bank, 2009, p.285). Inefficient urban land markets with informal tenure systems and poor basic services obstruct functional urban systems and development: “Informality is a brake on land development, constraining an efficient spatial transformation” (World Bank, 2009, p.241). Deficient rural facilities prompt unskilled rural-urban migration, which concentrates poverty in cities and creates squalor, social tensions and instability. And poor transport infrastructure impedes urban-rural interactions and international trade.

To summarise, there is contradictory evidence about the link between urbanisation and economic growth in Africa. The interpretation of this situation is controversial, with some observers attributing the finding to premature and excessive urbanisation, while others blame poor urban planning and management, and lack of investment in urban infrastructure.[3] Cities in the developed ‘North’ have benefited from a long history of government regulation and active investment, which cities in the global ‘South’ cannot suddenly match. The main conclusion must be that the relationship between urbanisation and economic development is not automatic or straightforward, and that a range of other factors and forces can disrupt the process. Further research is clearly required.

The experience of stagnation and deindustrialisation in many African economies during the 1980s and 1990s is also relevant. It is difficult for cities to perform well in an adverse macro-economic context. Economic decline and structural adjustment policies imposed by bodies such as the IMF and World Bank also left a legacy of weak state institutions and growing informality in the economy and land market. During the last decade there has been a significant economic revival in many African countries, driven by the extraction and exporting of primary commodities (especially oil, gas, metals and minerals such as diamonds and coal) and agricultural products. This form of growth (resource-based) is not naturally urban-oriented. Hence, there is a danger that Africa’s current economic trajectory will also fail to build a connection between urbanisation and development. There is a strong case to be made for government policies to align economic growth and urbanisation agendas through more vigorous pursuit of diversification and industrialisation. This growth path could be more inclusive and more sustainable, especially if combined with a green economy strategy to support renewable energy, restore ecosystems and localise production of food, water, building materials and other goods and resources.

7. Setting the relationship between urbanisation and growth in a broader policy context

The question of whether and how urbanisation should be encouraged cannot be reduced to whether urbanisation enhances economic growth. First, policy aspirations extend beyond growth to include equity and environmental health and sustainability, which are themselves bound up with both urbanisation and growth. Hence a more holistic perspective is important. Second, these economic, social and environmental goals are all influenced by the ‘quality’ of urbanisation, and not just by its level (the percentage of the population living in urban areas) and rate (the annual percentage increase in the level of urbanisation). The quality of urbanisation includes the way in which people and firms find their way into cities – the position people occupy in urban labour and housing markets and social networks, and the niche product markets, supply chains and collaborative networks occupied by firms. Third, different policy measures to encourage or discourage urbanisation can also affect its quality in various ways. Policies towards informal settlements are particularly important since these areas tend to function as gateways to urban labour markets, housing systems and amenities.

[3] The statistics on urbanisation in Africa used to argue that there has been rapid urbanization without economic growth have also been called into question (Potts, 2012)

Given the current state of knowledge about the relationship between urbanisation and economic growth, it makes more sense to seek out ways of facilitating forms of urbanisation that clearly contribute to economic growth, equity and environmental improvement, than to encourage (or discourage) urbanisation per se. Even strong economic proponents of urbanisation, such as the authors of the 2009 *World Development Report* on *Reshaping Economic Geography* (World Bank, 2009) hold back from advocating that preference be given to urban development projects. Nor, however, should rural development projects be justified on the grounds that they reduce rural-urban migration.

Similar considerations apply in relation to equity and the environment – we need to get away from the notion that influencing the rate of urbanization should be a policy goal in and of itself. The potential social benefits of urbanisation are no excuse for allowing rural people to be unfairly deprived of their lands, leading them to move city-ward. But they are sufficient justification for removing the institutional barriers that prevent migrants and the urban poor generally from gaining a foothold in the city (McGranahan et al, 2008; Feler and Henderson, 2011). Promoting urbanisation cannot in itself be justified on environmental grounds, and there are doubts about the environmental implications of very dense settlements generally (Neuman, 2005). But in the right circumstances density can be used to improve the environmental performance of human settlements (Davoudi et al, 2009; Jabareen, 2006; Vella and Morad, 2011). For example, it can facilitate public transport, reduce the cost of bulk infrastructure provision, and reduce encroachment on fragile ecosystems. It can also support a vital public realm in which people from different backgrounds mix and mingle.

8. Knowledge gaps

The sheer lack of aggregate studies of the relationship between urbanisation and economic growth in Africa is striking. Such research is all the more important in the light of the recent revival of African economies. The pattern of resource-based growth could potentially further undermine the connection between urbanisation and development by focusing investment in resource-rich regions outside cities, and in export corridors linking them to coastal ports.
Further research is required into the reasons for the apparently weak relationship between urbanisation and economic growth in Africa. Is this in large part a statistical anomaly, or alternatively too what extent is it attributable to (i) premature and excessive urban population growth, (ii) deindustrialisation associated with structural adjustment policies, (iii) poor current international competitiveness in manufacturing, (iv) poor urban planning and management, (v) lack of investment in urban infrastructure, and (vi) the predominantly informal nature of urban economies and land markets? Past research on this topic is quickly becoming outdated, and a fresh look is needed.
Disaggregated studies of the spatial implications of particular industries would help to understand the strength and nature of agglomeration economies better. They would also help to assess whether added value activities such as minerals processing and particular branches of manufacturing (such as food processing, petrochemicals and consumer goods) can support urban jobs and incomes. The analysis of local industries would need to be located in the context of global value chains and wider economic networks which condition their growth prospects.
Additional research is needed on the comparative cost-effectiveness and impact of public infrastructure and services in large cities, small cities, towns and rural areas. How much more expensive is it to install and maintain power stations, water treatment works, hospitals and waste recycling facilities in different spatial contexts? What does this imply about the economic costs and benefits of urbanisation, and the challenges of equitable service provision?
Policy research on ways of improving the quality of urbanisation, taking into account the consequences for rural as well as urban areas, also needs to engage with current policy

debates in the corridors of power, rather than in the pages of research papers. Policies towards rural-urban migrants, and towards low-income residents generally, deserve particular attention. Some decision-makers believe that policies which favour poor urban communities encourage excessive migration and undermine urban competitiveness and economic growth, without ultimately improving urban living conditions (because of congestion and overcrowding). Others argue that such concerns reflect prejudices against poor people, and that, on the contrary, urban poverty largely reflects unfavourable policies and neglect of public investment in informal urban settlements. Indeed some decision-makers believe that such areas are out of place and shouldn't be tolerated in a contemporary, 'modern' urban setting, where environmental standards should be higher. Rigorous and balanced research is needed to interrogate the underlying assumptions of both sides of such polarised debates, and to better inform both domestic policies and international development assistance.

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