How effective are interventions which seek to improve access and quality of civic infrastructure and amenities? What are the key characteristics of successful interventions in urban areas?: An Evidence Summary

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None of the authors has any financial interest in this review topic.

Use of maps

Maps used in this report serve a purely descriptive purpose. The representation of political boundaries in the maps do not necessarily reflect the position of the Government of UK.

Contribution

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Executive Summary

Research Question

How effective are interventions which seek to improve access and quality of civic infrastructure and services? What are the key characteristics of successful interventions?

Outputs from the present evidence summary

- Evidence map that summarised the systematic reviews on two set of parameters:
    - ***Background context***: Regional coverage, sectoral coverage, outcomes synthesised, years of publication, quality assessment, analysis method, social and lifecycle segments analysed, nature of impact reported and interventions covered
    - ***Effectiveness:*** Outcomes and impacts for different types of interventions
- Key characteristics of successful interventions
- Contextualisation of findings to Nepal, which can also be relevant for South Asian Countries in general

Background

With the rapid pace of urbanisation, provision of civic infrastructure services has become quite important. The importance of civic infrastructure in health and well-being of urban population and the adverse impacts of poor infrastructure on economic development was identified and thus given special attention in the Millennium Development Goals (MDGs) in 2000 and further Sustainable Development Goals (SDGs) in 2015. Under the guidelines laid out by MDGs and SDGs laid by the United Nations, governments have implemented various interventions that seek to improve the provision of civic services. A number of systematic reviews have also been commissioned during this period (2000-2016) to understand the effectiveness of interventions carried out in different civic infrastructure sectors. It is crucial for the policy makers to understand the findings of such studies in a holistic manner to effectively design interventions in civic infrastructure sectors. The present evidence summary analyses the systematic reviews in different infrastructure sectors during the period 2000-2016 focussing on low and middle income countries (LMIC). The study focuses on the systematic reviews in water supply, sanitation, electricity, telecom and road & public transportation sectors. To summarise the evidence that exists in the systematic reviews, the present study employs a conceptual framework to understand under what *contexts* was evidence present on how effective were *interventions* in specific *sectors* leading to *outcomes* and materialising as immediate and long term *impacts* on the population. Six interventions were considered namely public private partnerships, physical infrastructure investments, institutional and regulatory reforms, urban planning interventions, developmental & multi-lateral agencies participation and community & non-governmental organisation based interventions. The outcomes of access and quality are considered for the above interventions. Finally, immediate impact in terms of reduction in effort and time and long term impacts on health, economy, quality of life and social impacts were studied. The study aims at providing the evidence about the effectiveness of various interventions and contextualise the findings with respect to South Asia particularly Nepal. Thus, the present evidence summary aims at providing future direction for policy making particularly in the above contexts.

Method

The rapid evidence summary elucidates methodological rigor adopted in the systematic reviews. The methodology used in this rapid evidence summary consists of following steps: sourcing, search strategy and management, screening and selection, data extraction and synthesis.

- *Sourcing and search strategy:* Systematic reviews were sourced from repositories of systematic reviews, websites of funding agencies and journals publishing systematic reviews.
- *Search management:* This involved management of search results with EPPI review software for title screening, sector based keyword searching and removal of duplicate studies.
- *Screening and selection:* Appropriate inclusion and exclusion criteria was formulated to identify systematic reviews for this summary. A total of 27 systematic reviews were shortlisted for further steps of data extraction and synthesis.
- *Data extraction and synthesis:* A data extraction tool was used to extract data pertaining to study characteristics and findings on the systematic review. Numerical summary and cause & effect analysis were used for synthesising the data so extracted.

Results

Details of systematic reviews studied:

- The water supply (19 SRs) sector has been the prominent focus sector of systematic reviews, followed by sanitation (8 SRs) and electricity (6 SRs). The public transportation has received very less attention (1 SR). Both – access (35 mentions in 27 SRs) and quality (34 mentions in 27 SRs) outcomes has received equal attention of policy makers across different civic infrastructure sectors.
- The comprehensiveness of systematic review was reflected in the number of primary studies from which evidence was synthesised for the individual systematic reviews (average – 63.14). Overall the quality assessment process indicates the shortlisted systematic reviews are of high quality.
- Among the different categories of interventions, physical infrastructure creation is the most popular form of intervention for the policy makers while participation by multilateral and developmental organisations is least preferred. The design of interventions, except for physical infrastructure creation, has accorded equal attention to access and quality outcomes.

Evidence Map:

- 18 out of 27 systematic reviews have used quantitative method for synthesis of evidence and only 3 systematic reviews have used mixed methods (qualitative and quantitative). The sectors with predominant social context like water supply and sanitation had higher focus on quality related outcomes while access and quality related to outcomes have received equal attention in electricity and transportation sectors. Out of four impact dimensions (health, economy, education and quality of life), health has been most often analysed. In terms of reporting evidences on outcomes vis a vis impacts, majority of

systematic reviews have focused on outcomes (19 out of 27 systematic reviews) as compared to impacts (15 out of 27).

- ***Water sector:*** Physical infrastructure investment is the most widely studied (14 SRs). The effect of this intervention was investigated prominently on product quality and health. Positive effect on affordability and health has been reported with the adoption of physical infrastructure interventions. The urban planning interventions yielded positive to mixed effect on connectivity and mixed parameters outcomes in access, quality related outcomes and health. The improvement in connectivity and service quality has been reported with the use of private sector participation interventions.

- ***Sanitation sector:*** The urban planning intervention (2 of the 8 SRs) and physical infrastructure (6 of the 8 SRs) interventions are predominantly studied in the sanitation sector. In outcomes, 6 of the 8 SRs mention access and 7 of the 8 SRs mention quality. The access parameter – connectivity and quality parameter – product quality are most studied in systematic reviews. The health impacts are prominently investigated. The effect of urban planning interventions on connectivity, mixed access parameters and product quality as well as health has been positive to mixed. The investment in physical infrastructure has positive effect on connectivity and product quality, and the impact on health has been mixed.

- ***Electricity sector:*** The evidence indicates that connectivity and affordability parameters are most frequently studied; All 6 SRs have mentioned access with 18 evidence counts for connectivity and 6 evidence counts for affordability. The investments in physical infrastructure and institutional and regulatory reform interventions are most often studied in electricity sector. There is a positive effect on connectivity and service quality and mixed effect on affordability with physical investments in infrastructure. Institutional and regulatory reforms have positive effect on affordability and mixed effect on connectivity and quality related parameters. Both of these interventions had positive impact on quality of life while only physical infrastructure investments have positive economic impacts. Positive effect has been observed with adoption of private sector participation on connectivity parameters.

- ***Road and public transportation:*** The investment in physical infrastructure (2 SRs) and urban planning interventions (2 SRs) have been most often studied. The physical infrastructure interventions results into positive effect on access parameters and results into positive impact on economy, education and quality of life. There has been divided evidence on effect of urban planning on outcomes parameters like connectivity, product quality as well as impact on health and education.

- ***Telecom***: The adoption of public private partnerships and privatisation initiatives leads to positive effect on connectivity whereas institutional and regulatory interventions has positive effect on access parameters. The evidence on impact has been reported only for physical infrastructure intervention and it has positive effect on economy and quality of life.

Key characteristics of successful interventions in urban areas

The interventions which are similar in nature are grouped for identifying the characteristics of successful interventions. These characteristics are described from the lens of people, policy, procedure, management and measurement associated with the interventions.

Physical infrastructure and urban planning interventions

Successful interventions in these two categories showcase features like consideration to diverse aspect to policy making, financial support to beneficiaries for covering connection costs, and innovative technical and planning mechanisms. The user/community involvement right from the stage of intervention design to implementation is necessary. This involvement has to be supported by the procedures having features like inclusivity, technological advancements and local / social knowledge. The successful interventions showcase two facets at implementation stage: 1) performance monitoring mechanisms supported by processes of data collection, compliance to standards and periodicity of assessment, and 2) management of interventions by asset management principles as well as recognising upstream and downstream linkages of network infrastructure like water supply, sanitation and electricity.

Private sector participation, institutional and regulatory reforms, social monitoring and multilateral and developmental organisations

These interventions transform the traditional mode of urban service delivery and the successful reforms ensured that the associated stakeholders are well informed about the necessity for reforms, regulatory institutions, financial viability and so on. Further, the process of implementation has been gradual wherein the social welfare functions performed earlier by utilities are recognised and interests of the urban poor/disadvantages communities are protected. The public sector agencies recognition of the changed role in service delivery phase, from provider to monitor/manager of services results into meeting of performance parameters and contractual obligations. As these reforms involves working with non-governmental actors, the procurement process should showcase elements like transparent bidding process and well defined performance parameters and financial instruments for protection of disadvantages communities in the concession agreement. While dealing with these demanding priorities, the successful reforms should not deviate from the principles of cost recovery and professional management of service delivery process.

Contents

List of Tables

List of Figures

Chapter 1. Background

> *"In the absence of an intentional civic infrastructure designed to broaden participation and, particularly, to engage those on the margins, other interests will fill the vacuum. The absence of a robust civic infrastructure risks giving rise to a system that serves a narrower and elite constituency where market and moneyed interests can replace the interests of a broader public purpose"* ***(Fung, October 2012).***

The concept of "infrastructure" continues to gain attention in the policy making process of developed as well as developing economics. The priorities and challenges in front of a country shapes the visualisation of this infrastructure (McKinsey, 2016). For example, risks faced by citizens owing to climate change and terrorism results in dialogue around critical and resilient infrastructure while socio-economic development creates a conceptualisation as hard and soft infrastructure as well as economic and social infrastructure (Vallejo & Mullan, 2017). Regardless of these conceptualisations, the civic infrastructure has been gaining prominent attention in the policy making process (Economist, 2015). Urban or civic infrastructure is understood as the "sinews of the city" comprising of 'road, bridge, and transit networks; its water and sewer lines and waste disposal facilities; its power system; its public building and its parks and recreation areas' (Hanson, 1984).

There are a slew of reasons behind this prominence of urban infrastructure. The rapid pace of urbanisation has been transforming the landscape of developing countries and has created an upsurge in the demand of civic services. The United Nations Population Fund published a report titled "State of World Population" which reported a momentous milestone achieved in the year 2008 indicating that more than half of human population resided in urban areas. Further, it mentions that by 2030 the global urban population was expected to reach five billion, with Asia and Africa being the urban growth centres. In many of the economies, the process of urbanisation have coincided with the wave of industrialisation as well as transformation towards service oriented economies. Typically, the economic activities are concentrated in and around the urban areas (Kim, 2005). As a result, these urban areas have started contributing substantially to the country's GDP (LSE, 2014).

The civic infrastructure is the backbone for the efficient functioning of the urban areas and therefore becomes obligatory for the government to fulfil the needs of civic infrastructure. The positive effect of urban infrastructure on productivity, efficiency, private investment and employment is well known. For example, the Global Competitiveness Report published by World Economic Forum in 2014 indicated that 15-17% of corporate decision-makers in India and Brazil identify infrastructure deficiencies as the top constraint on doing business (WEF, 2014). The demand for good infrastructure was not just from the industrial and commercial organisations, but also from the individual citizens, particularly the urban middle class. The urban areas lured the young citizens owing to employment opportunities offered and it ushered the emergence of urban middle class population (Beinhocker et al, 2007). The urban middle class showcased a new breed of citizenship with demand of transparency and quality in provision of civic infrastructure and services (Li & McElveen 2013; Smitha 2010).

Unfortunately, many governments in developing countries were caught unaware of this transition towards urbanisation. The policy making process followed in such countries was often skewed, either turning a blind eye towards the ongoing urbanisation or in some cases even discouraging it (Fox, 2014; Wang, 2011). These governments faced the conundrum of not only meeting the backlog created by past policy neglect but also to meet the future demand for civic infrastructure. In other words, the challenge was to keep the economic growth (urban contribution to GDP) unabated as well as fulfil the demand of urban citizens for quality civic infrastructure (Egedy and Uzzoli, 2016).

The poor state of civic services and its adverse effect on economic development as well as health and well-being of urban citizens have received considerable attention in many international forums. Several studies have highlighted the adverse effects of poor urban infrastructure. For example, young children worldwide suffer from several serious diseases that could easily be prevented through the interruption of the disease transmission mechanisms, which can be achieved through access to safe and sufficient water supply and provision for the hygienic removal of sewage (World Health Organisation, 2000). Similarly, the incidences of diarrhoea, which accounts for approximately 15%of all child deaths worldwide (UNICEF, 2001) can be controlled by access to quality water supply and sanitation services.

Apart from health, lack of planning and management of urban infrastructure such as roads, foot paths and buildings presented serious risk of flooding in cities. For instance, in Dhaka, buildings and roads were often constructed encroaching on the natural drains for rainwater (Alam and Golam Rabbani, 2007). Populations with poor sanitation infrastructure often experience increased rates of diarrheal diseases, cholera and typhoid fever after flood events. The transmission of enteric pathogens is generally higher during the rainy season (Nchito et al 1998; Kang et al., 2001). The lack of access to basic civic infrastructure also has a negative effect on other parameters that aid human development. For instance, poor access to drinking water where the water needs to be fetched from faraway places meant a huge proportion of time spent on accessing water. This has often led to low school attendance among girls and removal of women from economic processes due to lack of time for other activities (Hutton et. al., 2007).

The launch of Millennium Development Goals (MDGs) in 2000 was a historical landmark, wherein improvement of civic infrastructure has received special attention. The Target 10 and Target 12 under the Goal 7 strive to ensure environmental sustainability and aim to "Halve, by 2025, the proportion of people without sustainable access to safe drinking water and basic sanitation" and "Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers" respectively. The launch of MDGs set the ball rolling and the developmental organisations, aid agencies and governments initiated steps towards the improvement of the status of not only water supply, sanitation and slums but also a host of services that comes under the ambit of civic infrastructure (World Bank, 2016). After a review of the progress made during the millennium development goals (MDG) period, the United Nations had launched the Sustainable Development Goals (SDGs) in the year 2016. The SDGs aim to widen the development trajectories with principles of sustainability and equity (UN, 2012; 2015). Some of the prominent goals focusing on civic infrastructure are:

(i) *Goal 6* – Ensure availability and sustainable management of water and sanitation for all

(ii) *Goal 9* – Build resilient infrastructure, promote sustainable industrialisation and foster innovation

(iii) *Goal 11* – make cities inclusive, safe, resilient and sustainable (UN, 2015).

Under the guidelines laid out by MDGs and SDGs, governments have implemented various interventions that seek to improve the provision of civic services. These interventions encompass a wide canvas such as public private partnerships, direct investments in physical infrastructure development, enacting institutional and regulatory reforms, improving urban planning, involvement of NGOs and community participation, and involvement of multilateral and bilateral agencies in drafting the policies and financing the implementation of such programmes.

In many any of these interventions, some form of assessment is carried out. Either the funding agencies carry out investigations or academic researchers probe into the effectiveness of these programmes after their completion. The outcomes of such investigations are usually reported in the form of programme evaluation documents, impact summaries and journal articles. It is crucial for the policy making process to utilise such knowledge when new interventions are designed. The effectiveness of a policy making process hinges on answering the question – "To what extent do these programmes have delivered the intended and expected outcomes". It is of utmost importance for the policy makers to consolidate and synthesize the evidence on adoption and effectiveness of such interventions.

1.1 Overview of conceptual framework

We conducted a preliminary search in SR databases like Cochrane, EPPI, DFID, PLOS ONE and KfW. These reviews indicated the diversity in terms of sectors covered, geographical focus, methodology adopted, intervention and outcomes analysed. Also, the entire pathway, i.e., Intervention -> Sector -> Outcomes -> Impact reported in these reviews was significantly influenced by the context in which such interventions are implemented. The data available in primary studies analysed by these SRs resulted into major focus on immediate outcomes (access, quality, price, and so on) followed by long term outcomes (health, social, and so on).

Based on our understanding of the review question and the information reported in the SRs, we have used the PICO (Population, Intervention, Comparison and Outcomes) framework as the basis for formulating the conceptual framework for this review (Figure 1.1). Thus, the conceptual framework comprised of the above five major components: (i) intervention; (ii) sector; (iii) outcomes; (iv) impact; and (v) context. Each of these components are described in detail in the following section.

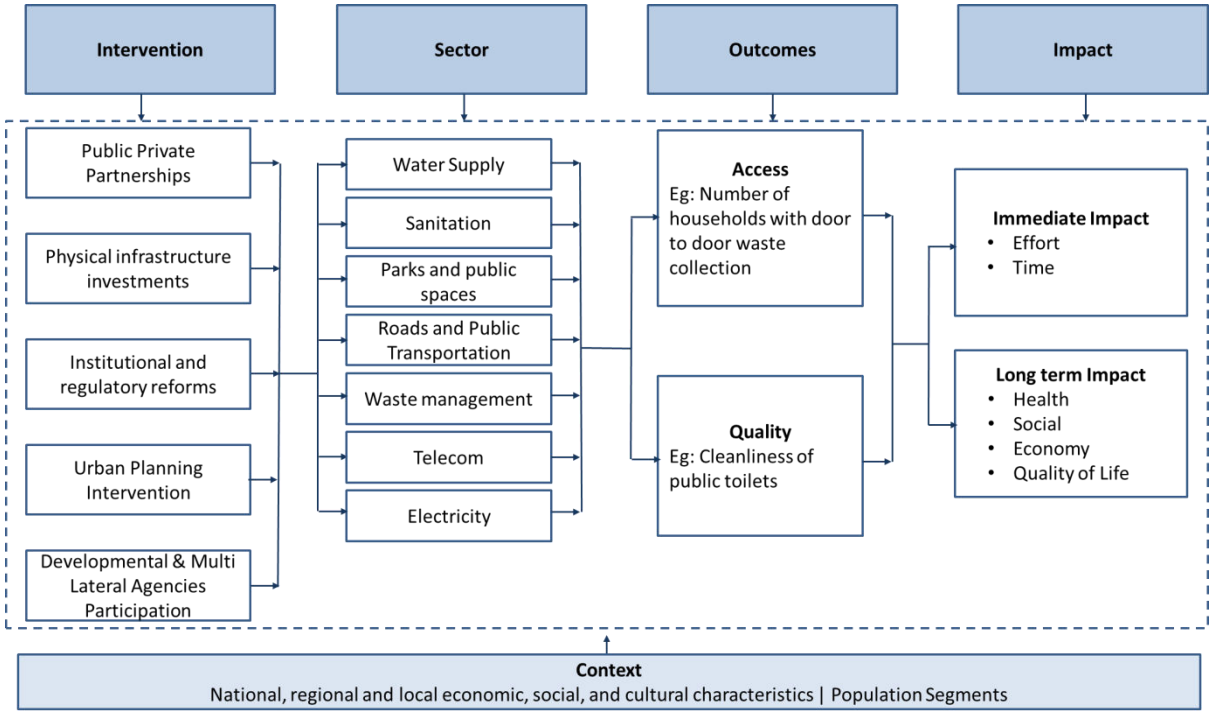


Figure 1.1 Conceptual Framework

1.2 Components of the conceptual framework

Interventions

The following interventions are looked at in this study:

- Public private partnerships – Such interventions involve the participation by private sector in terms of provision of the infrastructure, funding, tariff mechanisms etc. To facilitate the provision of infrastructure service by private developers and operators.
- Physical infrastructure investments – Such interventions include the establishment and creation of physical infrastructure facilities like building of a water treatment plant etc. The focus is on the creation of a physical built asset to cater to some infrastructure need.
- Institutional and regulatory reforms – Such interventions are instituted to bring about changes in the way the infrastructure service is typically delivered to the public. Such reforms might include de-centralisation measures, policy reforms, incorporation of bodies overlooking the infrastructure provision etc.
- Urban planning interventions – Such interventions are more focused on the provision of infrastructure as part of a larger urban planning policy making. Such interventions might look at integrated solutions to water including sewage treatment etc. Urban planning interventions can also include adaptation measures to look at environmental sustainability etc.
- Developmental and multi-lateral agencies participation- Such interventions involve the aid from developmental or multi-lateral agencies. Typical examples of such interventions could be guidelines on projects laid down by multi-lateral agencies, sector reforms instituted by multi-lateral agencies etc.

- Community and Non-Governmental Organisation based intervention: Such interventions are more bottoms-up kind of interventions where the community is empowered to enable provision of infrastructure. Such interventions also include the involvement of NGOs and other community level bodies which enable the users to take active part in the provision of the service

Sectors

While infrastructure covers a gamut of services and sectors, as discussed in chapter 1, for this Evidence Summary (ES) we consider the following sectors: waste management, water supply, sanitation, roads, public transportation, telecom, electricity, and parks and open spaces. To reduce heterogeneity and to facilitate generalisation of findings, we have included only those sectors that can be classified under "physical infrastructure" and have certain public good characteristics. Social infrastructure such as education or health or those sectors that have considerable private good characteristic, such as housing, have not been considered in the evidence summary.

Outcomes

This ES synthesizes the evidence in SRs primarily on two outcomes – access to infrastructure and improvements to the quality of infrastructure – in order to ascertain the extent to which different interventions have impacted infrastructure service delivery in the abovementioned sectors. Access indicates the extent to which members of a community can avail of an infrastructure service. In short, the more people q\in a community who can utilise a service, the greater the access. One of the fundamental questions that we ask is whether the intervention improves access to infrastructure. Our second construct – quality relates to physical properties of the infrastructure service as well as the perspective of the end user in terms of the level of satisfaction with the service provided. Quality would thus include both product quality and service quality. In a water-supply for instance, product quality might be measured based on quality of water supplied, number of hours for which water is supplied, and so on. Service quality on the other hand would reflect aspects like billing accuracy, time taken to resolve customer complaints, and so on.

Impact

This ES also synthesizes the evidence on the immediate and short term (such as impact on effort and time) as well as long term impact (such as health, social, economy, and quality of life) of outcomes. In water and sanitation sector, effort and time correspond to proportion of households who were able to access the services without excessive effort and time (or) the distance that people have to travel to accessing the services. The long term impacts corresponds to following: health (prevention of diseases, child nutritional status, reduction in morbidity rate), social (poverty indicators, education, social capital), economic (employment creation, agricultural productivity, household income) and quality of life indicators (change in rate of employment, purchasing power of individuals, labour productivity and wages).

1.3 Rationale for the study

The question of "What works?" is very pertinent for academic researchers and policy makers active in the field of evidence based policy making for improved delivery of civic infrastructure. The first step in this direction is the primary research by collecting and analysing relevant data pertaining to specific interventions. The evidence from these different studies is then consolidated by carrying out systematic reviews to assess the effectiveness of such interventions. Since provision of civic services has been a focus area since the launch of MDGs, the multilateral funding agencies and developmental actors have commissioned various systematic reviews focusing on different interventions for improved civic infrastructure. The launch of SDGs in the year 2016 provides a stage

to synthesize and summarise the evidence from those systematic reviews that focused on improvement of access and quality of civic infrastructure.

In this context, the present evidence summary would address following areas:

1. Effectiveness of policy making: It will provide an indication to the policy makers about the interventions that have been effective for improving access and quality of civic infrastructure, with specific focus on urban areas. Along with this, it will indicate the quality of evidence based on the methodological rigor followed in the systematic review.

2. Contextualisation of policy making: There is a growing debate and discussion on policy transfer which highlights that effectiveness of policy substantially depends on the context. The systematic reviews are expected to not only provide evidence on the effectiveness of interventions but also decipher the causal linkages highlighting "Why interventions worked?" and "What are the conditions inhibiting or enabling the interventions". This will provide indication to policy makers on settings to be created for effective policy implementation and missing dimensions of policy setting that can be investigated by researchers. This evidence summary also interprets the findings from the synthesis in the context of South Asia, with specific reference to Nepal.

3. Future direction for policy making: The systematic reviews identified through the search process would indicate the set of interventions and sectors that have sufficient evidence and those that do not. This will provide directions to the policy makers to commission systematic reviews to address the gaps in evidence based policy making process.

1.4 Structure of the report

The report is structured into five chapters

The first chapter gives an introduction and motivation for the present evidence summary. First, it sets out the background on the need to carry out the study. Next, it establishes the conceptual framework to be used in the evidence summary. A brief description of the various concepts which would be used in the synthesis is given in this chapter.

The second chapter presents the objectives of the present study. The third chapter elaborates on the research methodology adopted in the study. First it elaborates on the sources for the systematic reviews. It details out the search strategy adopted for the study presenting the inclusion and exclusion criteria adopted in the study. Next, the chapter illustrates the quality assessment criteria used and the process followed to extract and synthesize the data from the selected systematic reviews.

The fourth chapter describes in details the findings of the synthesis process. It presents an evidence map of the SRs in the field of provision of civic infrastructure. The chapter then discusses sector-wise findings on the evidence available on interventions that worked and the outcomes and impacts observed. The chapter concludes with a description of the characteristics of effective interventions as supported by the evidence.

The final chapter summarises the findings and answers the key objectives of the present study. Possible implications of the present study is discussed. The chapter concludes with contextualisation of the present findings to Nepal.

Chapter 2. Objectives of the Evidence Summary

The objective of the rapid evidence summary is to address the following research question by synthesizing the evidence in SRs:

How effective are interventions which seek to improve access and quality of civic infrastructure and amenities? What are the key characteristics of successful interventions in urban areas?

The above objective has been addressed through the following:

- Creation of an evidence map: This evidence map indicates the interventions and infrastructure sectors for which evidence on effectiveness is available in the different systematic reviews. This map also gives an indication of the strength of evidence present for the interventions.
- Identification of the key characteristics of successful interventions: Interventions that led to positive outcomes have been characterised in terms of their content and process. We have also highlighted how the variations in context could influence the content and process of the different interventions. Given the importance of civic infrastructure and amenities in urban areas the focus has been on identifying the characteristics of interventions that have been successful in urban areas.
- Contextualisation of the findings: The findings of the evidence summary have been contextualised to South Asian countries, specifically with reference to Nepal.

Chapter 3. Methods used in the review

This chapter provides the details of the search strategy and the methods used to identify the studies to be included in the review, and the methods used to synthesise the results reported in the included studies. Figure 3.1 provides an overview of the study design and synthesis process. This section provides the details of the different steps in the study.

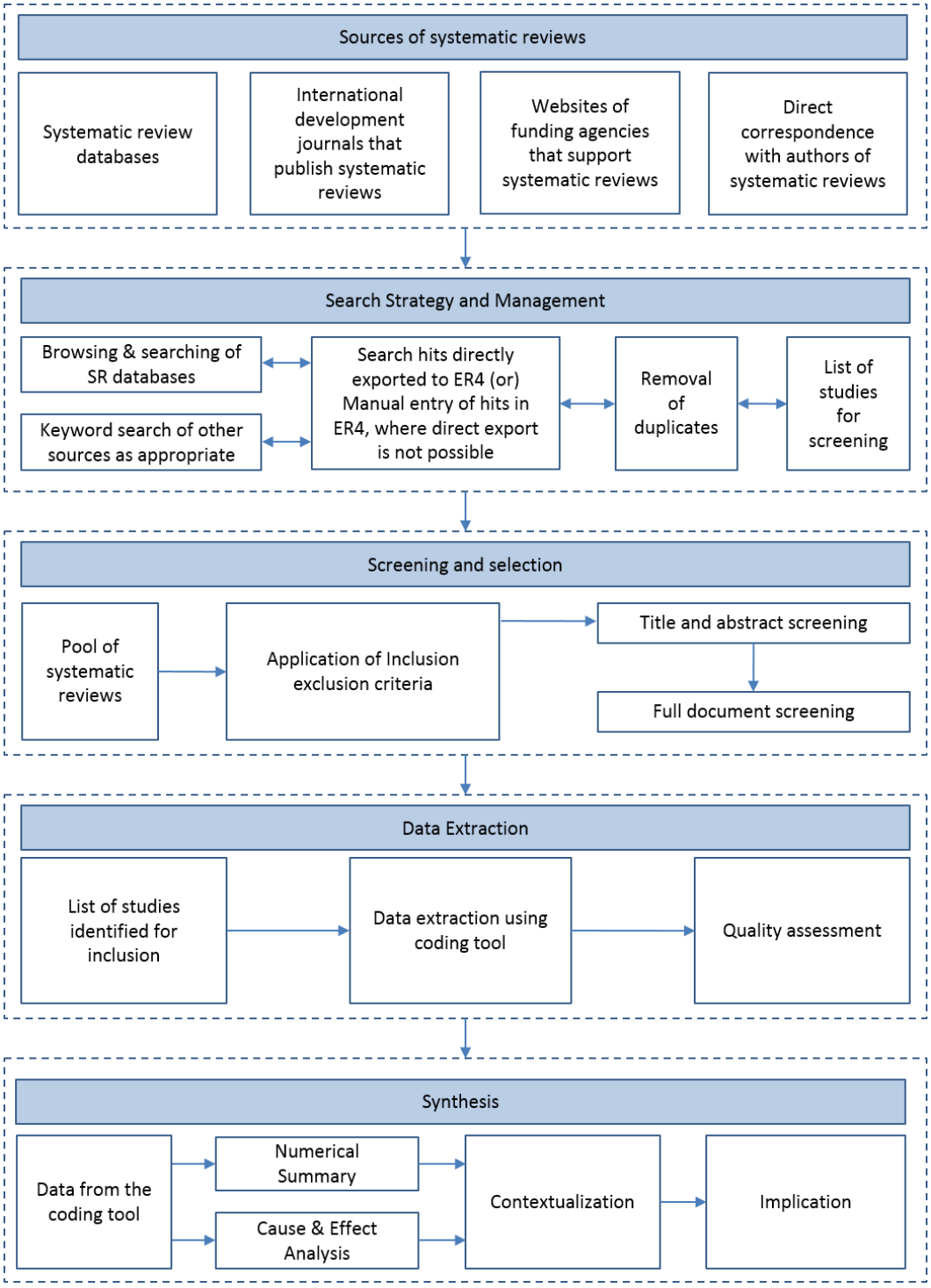


Figure 3.1 Methodology Map

3.1 Sources of systematic review

Approach and Rationale

Evidence based policy decision making is emerging as a major imperative. In recent times, international funding and development agencies have been increasingly using past evidence as one of the important parameters in their funding and developmental assistance decisions. The authors of this review clearly understand this imperative and would therefore target the review towards policy makers and practitioners

Study sources

The sources of systematic reviews for this evidence summary are as follows:

- Systematic review databases: The repositories of systematic reviews such as EPPI Centre, 3iE, Cochrane Review, Campbell Collaboration, and CRD database.
- Websites of funding agencies: Websites of funding agencies such as Research for Development (R4D) were searched.
- Key journals: Journals that publish systematic reviews were searched extensively and relevant publications in these journals were be assessed for inclusion in the review. This ensured that studies that were published in the most relevant journals in the area were not missed. Some of the included journals are: Journal of Development Effectiveness, Journal of Development Studies, Development Policy Review, World Development, and Utilities Policy.

Additional study sources: In addition to the above three study sources, the citations and references of the included systematic reviews were also examined for potential inclusion in the review.

User involvement

User involvement was achieved at three stages of the review:

- The first was at the protocol stage, when, in addition to a review of methods, we also requested the EPPI-Centre, the review co-ordinating agency for this study, to have the protocol reviewed by the policy team of the funding agency. The protocol was revised by including their suggestions. This ensured that the review adequately addressed those questions that were of relevance to the policy makers.

- Secondly, the authors of systematic reviews identified for inclusion from the above three sources were contacted to check whether they are aware of any studies that could be included in this study. The authors of systematic reviews published as journals were also contacted to get access the full report.

- Finally, a policy-advisory board was constituted, with members drawn from the government, a civil-society organisation, and the private sector. The inputs from the advisory board have been taken into account in developing the conceptual framework and objectives for the study. The policy-advisory team also reviewed the study protocol and the draft report of the study.

3.2 Search strategy and management

The search strategy for systematic review databases and key journals is as follows:

- Systematic review databases and websites of funding agencies: For important repositories of systematic reviews and funding agencies (such as 3ie, EPPI Centre and R4D), screening of all the titles of systematic reviews was done, so that no study is missed.

- For the other identified systematic sources, sector based keyword searches was done.
- Journals: Keyword was used to identify relevant systematic reviews for potential inclusion in this evidence summary.

Appendix C gives the details of the search strategy and the results that have been obtained. EPPI-Reviewer 4.0 was used to manage the search results (Thomas et al,. 2010). The hits obtained from database and journal search were directly exported to EPPI-Reviewer 4 or manually added to EPPI-Reviewer 4 for further analysis. Studies obtained from citations and references as well as correspondence with authors were manually entered in EPPI-Reviewer.

3.3 Study screening and selection

The first step involved is the formulation of appropriate inclusion and exclusion criteria to be used to identify the studies for inclusion in the review. Studies were searched for and shortlisted first by applying the exclusion criteria; those that were excluded were not evaluated further. The studies that remained were then evaluated on the basis of the inclusion criteria.

Exclusion criteria

This ES excluded SRs that synthesized evidence from developed or non-LMIC countries or those that did not separately present the evidence results for developing or LMIC countries when the review encompassed both developed and developing or LMIC countries. Specifically, the following criteria were adopted for the exclusion of studies from the review.

- Review studies other than SRs such as literature review were excluded.
- SRs when synthesizing the evidence on more than one sector, did not present the evidence separately for sectors included in this summary, viz., public transportation, roads, parks and public spaces, infrastructure, telecom, electricity, waste management, water supply and sanitation were excluded.
- SRs published prior to 2000 and after 2016.
- SRs which were not published in English.
- SRs that did not synthesize evidence on access and quality outcomes or if they covered more than one outcome, did not present the evidence separately for access and quality.

Inclusion criteria

- ***Context of the study:*** If the SRs had synthesized evidence from both developed and LMIC's, we included only those studies where the evidence was presented separately for developing countries and LMICs. Broadly, the ES includes SRs that are based on primary studies that have used data from African countries; Latin-American countries belonging to parts of South and Central America; Asian countries excluding Japan and the Four Asian Tigers (Hong Kong, Singapore, South Korea and Taiwan); and the transition and emerging economies in Eastern Europe and Central and East Asia. By restricting the domain of the study to LMICs, we are minimising the contextual heterogeneity.
- ***Domain:*** SRs that have synthesized evidence on one or more of the following sectors, viz., Public transportation, roads, parks and public spaces, infrastructure, telecom, electricity,

waste management, water supply and sanitation were included. If the SR had included sectors other than the above, the findings should be separately available for the above sectors

- ***Study year:*** SRs published during the period 2000 to 2016
- ***Language:*** SRs published in English were included.
- ***Outcomes:*** The SRs specifically analysed the impact on access and quality outcomes. While the SRs might also consider other outcomes, evidence pertaining to access and quality was analysed in this ES.
- ***Type of systematic reviews:*** The systematic reviews included in the ES used any of the following methodologies for synthesis: (a) quantitative, (b) qualitative, or (c) mixed methods.

Two members of the review team, working independently, evaluated and selected the studies for inclusion. The pairs of members, who used the same coding procedure, compared their evaluations and came to a consensus on those SRs to be included in the ES. In case where a consensus could not be reached between the two researchers, the researchers discussed the differences among themselves to arrive at a consensual decision.

The SRs that met the exclusion and inclusion criteria were taken up for full text screening. Finally, 27 SRs were selected to be included in this ES. Figure 3.2 gives an overview on how 27 studies were shortlisted. The list of included SRs is provided in Appendix D.

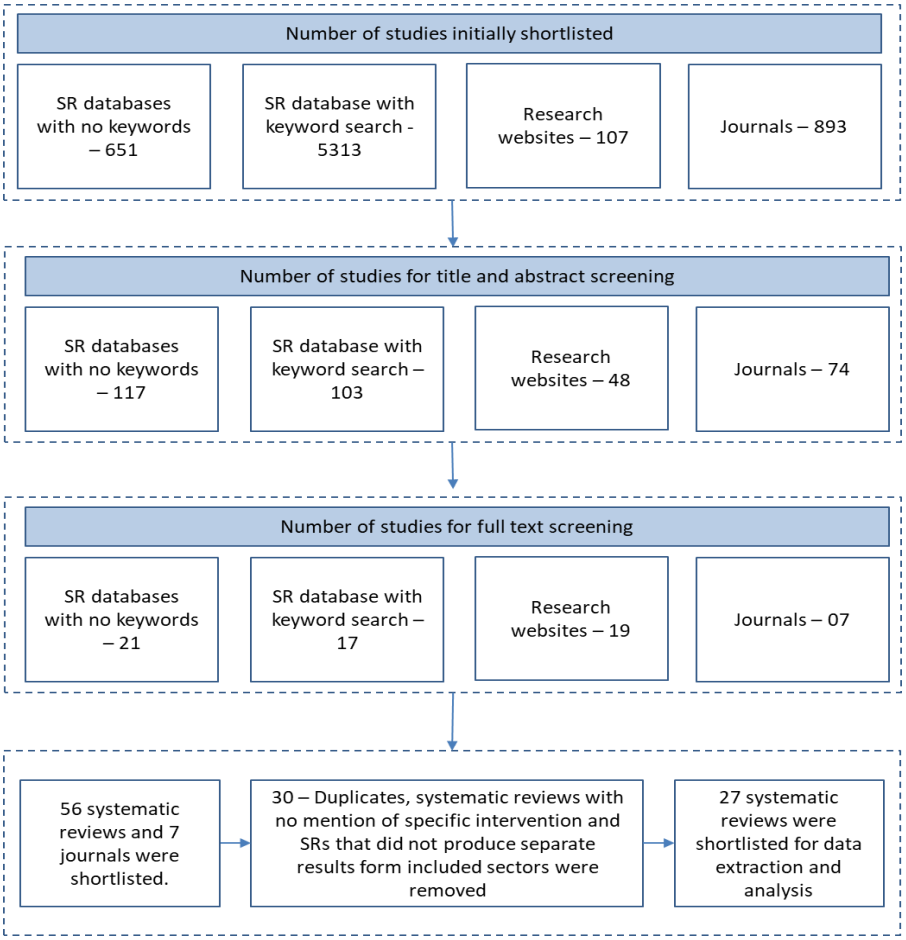


Figure 3.2 Screening process followed in the ES

3.4 Data extraction

Data pertaining to study characteristics and findings of the included SRs were extracted using a coding tool. Prior to the coding of SRs the coding tool was piloted amongst the team using the same set of sample studies. This is to ensure that coding decisions and data extraction was consistent amongst all the researchers and across documents. After sample data extractions and common understanding within the research team, the coding tool was used to extract the characteristics and findings of the included SRs. The data thus extracted by first researcher was reviewed by the second researcher and vice-versa. The data thus extracted from the SRs formed the data pool which was used for analysis.

The coding tool was used to extract the following types of data:

- Study characteristics, such as year of publication, sectors and interventions analysed, regions and countries included, No. of included studies and methods of synthesis.
- Characteristics of the intervention such as type of intervention, beneficiaries, outcomes or impact.
- Quality of study design, such as availability of protocol, source of studies, and potential biases.
- Study findings, including the results, causal pathways that explain the interventions and results, validity of the findings with respect to heterogeneity and biases.

The coding tool that was used for data extraction is given in Appendix E.

3.5 Quality assessment

Many of the included SRs were published in reputed peer reviewed journals and SR databases. Though the quality of the journals was not explicitly captured, the source of publication of the SRs ensured a basic level of quality. In the next stage, the SRs identified for inclusion were assessed using a critical appraisal tool. Appendix F gives the appraisal tool used in this ES.

The Quality Assessment Tool (QAT) had 11 areas and a total of 30 questions. These 30 questions can be classified into 5 broad categories; Research objective, search strategy, study selection, methodology and conflicts. A simple scoring tool was used to present the results of quality appraisal. The quality appraisal tool consisted of 30 questions, each having 4 options: (i) yes; (ii) no; (iii) not clear; and (iv) not applicable. The points associated with the each of the options respectively would be 4, 1, 2, and 0. The points obtained on all the questions was aggregated for each SR to arrive at the quality of the study.

3.6 Data synthesis and findings

The data captured in the coding tool was used to synthesize the results for the evidence summary. We employed a descriptive numerical summary approach, complemented by cause and effect analysis.

Descriptive numerical summary summarised key characteristics of the SRs such as the studies included and their characteristics and the findings of the SRs included in the ES. Light and Smith (1971) have indicated that the numerical summary of evidences is a useful review technique that helps to gather the body of evidence related to a theoretical relationship, and use that as the basis for drawing conclusions about the state of the literature. While there are some limitations to synthesizing evidence by numerical summary (Combs et al., 2011) we feel that the findings of a numerical summary would complement the cause and effect analysis. The procedure used for a numerical summary involves extracting data and the evidence pattern on the outcome and impact variables identified in the review, and visually representing the evidence in the form of tables, graphs and charts. We captured the evidence by count method and the evidence was categorised as positive, negative and mixed (inconclusive, not available, no change).

Since the SRs included in the ES had used different synthesis methods (qualitative, quantitative, or mixed methods), we used a visualisation technique called as fish bone diagram (also called as cause and effect diagram or Ishikawa diagram) to synthesize and present the evidence in a cogent fashion. This diagram represents potential causes for an effect or problem and it was used for synthesizing the characteristics of interventions reported in the SRs. The steps followed in developing these diagrams were as follows:

In the first step, evidences from the shortlisted SRs were grouped, based on the outcome effect, into two categories: 1) Effective: interventions that had “Positive” outcome effect, 2) Not effective: interventions that had “Negative” and “Inconclusive” outcome effect.

Furthermore, different evidence from the interventions that are similar in nature and interrelated were grouped in the second step. For example, the private sector participation interventions are often driven by multilateral development organisations, and accompanied by innovations in the form of intuitional and regulatory reforms as well as community monitoring. These interventions were, therefore, grouped together. Similarly, development of physical infrastructure, developmental and multilateral agencies, and urban planning interventions were grouped together.

The third step involved identification of characteristics of interventions. This involved a thorough reading of SRs for identification of contextual factors / variables mediating the effectiveness of interventions. The contextual factors were derived from the SRs regardless of types of synthesis methods used in the SRs. The SRs adopting the quantitative synthesis methods often made cursory reference to the contextual factors whereas SRs that have used qualitative synthesis methods provided detailed description of how contextual factors mediate between “cause” and “effect”. Typically the SRs have indicated a handful of contextual factors as prominent based on number of studies supporting and citing these characteristics. However, some of the factors were reported as weak or contradictory if studies indicated conflicting results on a particular characteristic. The factors having strong evidence were categorised as follows: 1) people, 2) policy, 3) procedures, 4) measurement and 5) management. These categories represented five elements that defined the characteristics of interventions, which in turn had an effect on the effectiveness of interventions.

In the final step, fish bone diagrams were prepared to showcase different categories of characteristics for both – effective and not effective evidences. As mentioned in the second step about grouping of interventions that are in similar nature, two fish bone diagrams were prepared. The diagram indicates both – reinforcing factors leading to effective implementation as well as factors that diminishes the effectiveness of interventions. The results from numerical summary and cause and effect analysis has been presented in Chapter 4.

Chapter 4. Results and Discussions

This chapter presents the results of the search process undertaken and the synthesis of the evidence from the SRs included in this ES. The results of the search process are presented first. This provides an overview and a description of the studies included in the ES. Next, the synthesis of the evidence in the included SRs is presented in three parts: First, an evidence gap map for the SRs in the area of civic infrastructure provision is presented. Next, the summary of the evidence present for various interventions, outcomes and impacts in different sectors of interest are presented. Finally, the contextualisation of the study findings to South Asian context, specifically Nepal is presented.

4.1 Results of the search process

A total of 27 Systematic Reviews (SRs) which met the inclusion and exclusion criteria were included for this ES. Table 4.1 summarises the number of SRs in different sectors. The highest number of SRs pertained to water supply. It should be noted that a single SR can have evidence on multiple sectors. In such cases, the SR was counted in each of the sectors. There were three SRs that dealt with multiple sectors, but did not provide the findings for each of the sectors separately. Such evidence has been consolidated under "Combined infrastructure sectors". A look at the count of access and quality outcomes (presented in Table 4.1) in each of the sectors indicated that on a whole, policy makers have accorded equal priority for both the outcomes.

Table 4.1 Number of Systematic Reviews from different sectors and outcomes synthesized

Sector	Number of studies	Percentage of total	Outcomes synthesized	
			Access	Quality
Water Supply	19	70%	12	16
Sanitation	8	30%	6	7
Electricity	6	22%	6	4
Road	4	15%	4	1
Telecom	3	11%	3	3
Combined Infrastructure Sectors	3	11%	3	2
Public Transportation	1	4%	1	1
Total number of Systematic Reviews	**27**		**35**	**34**

Table 4.2 illustrates the distribution of the SRs in terms of the category of interventions studied. When SRs have synthesized the evidence on multiple interventions, the evidence on each intervention was considered separately for this ES. While the SRs have synthesized the evidence on a wide range of interventions, the most commonly synthesized intervention category was physical infrastructure creation (19 of the 27 SRs). This indicates that improvement in infrastructure sectors has been largely seen as a capacity creation or operational improvement exercise. There was only one SR in the included list that looked at the evidence from participation of multi-lateral agencies and bilateral agencies. Except in the case of physical infrastructure creation, there has been more or less equal emphasis on the evidence on both access and quality outcomes.

Table 4.2 Number of studies in different intervention categories by outcome

Intervention category	Total Studies	Outcome	
		Access	Quality

Physical infrastructure creation	19	11	16
Urban planning intervention	7	5	5
Institutional and regulatory reforms	6	6	5
Public private partnerships	5	5	4
Community and Non-Governmental Organisation based intervention	3	3	3
Participation by Developmental and Multilateral Agencies	1	1	1

Table 4.3 presents the details of the different regions from which the evidence has been synthesized in the SRs. While the SRs have synthesized the evidence from multiple geographic regions, most of the evidence have been from Asia and Africa regions.

Table 4.3 Regions included in the evidence synthesis in the SRs

Regions	Number of studies	Percentage of total
Asia	22	81%
Africa	20	74%
South America	12	44%
Central and North America	8	30%
Eastern Europe	5	19%
Oceania	5	19%
Total number of studies	**27**	

Table 4.4 gives details of the number of primary studies used in the SRs for synthesizing the evidence. The proportion of SRs were equally distributed (i.e., one-third each) between those SRs that had included 30 studies or less, up to 60 studies, and more than 60 studies. The average number of studies included in the 27 SRs was 63.14. This gives an indication of the comprehensiveness of the evidence synthesized in the SRs included in this ES.

Table 4.4 Number of primary studies in the included Systematic Reviews

Number of included studies	Number of SRs
Less than or equal to 30	9
31-60	9
61-90	5
91-120	1
121-150	2
More than 150	1
Average	**63.14**

Table 4.5 provides details on the year of publishing of the included SRs. As it can be seen, a large majority of the SRs have been published in the recent years.

Table 4.5 Year of publication of the included SRs

Year of Publishing	Number of SRs
2000-2004	1
2005-2008	3
2009-2012	11
2013-2016	12

The number of years from which the primary studies were included varied between the SRs. Table 4.6 presents the number of years from which the primary studies have been obtained in the included SRs.

Table 4.6 Range of years of publication of the included studies in Systematic Reviews

Range (in years)	Number of SRs
Less than or equal to 10	3
11-20	7
21-30	6
31-40	8
Greater than 40	3

Table's 4.4, 4.5 and 4.6 demonstrate the SRs included in this evidence summary had a comprehensive coverage in synthesizing the available primary studies related to civic infrastructure provision. To that extent, the findings of this ES would also be comprehensive.

Table 4.7 illustrates the results of the quality assessment process. As indicated in Chapter 3, all included SRs were assessed using a Quality Assessment Tool (QAT; provided in Appendix F). The SRs was classified into quantiles based on the quality assessment score arrived for each SR. The average score of all the included SRs in this evidence summary was 91 out of a maximum of 120. This indicates that on the whole the SRs included in this study were of high quality. Quantile-wise analysis indicated that most number of SRs were placed in the second quantile. It is felt that the overall high QAT scores of SRs included in this study would lead to a robust ES.

Table 4.7 No. of SRs classified in different quantiles on the basis of QAT score

Quantile	No. of Systematic Reviews	QAT Score
1	2	115-106
2	11	105-96
3	7	95-86
4	2	85-76
5	5	75-66
Average Score		91
Maximum		114
Minimum		69

4.2 Results and discussion of the summary

The evidence map

Table 4.8 illustrates an evidence gap map that was developed from the 27 SRs included in the summary. The evidence map captures the following dimensions. First, it captures the synthesis method (qualitative/quantitative) used for the SR. Second, it captures the sector-wise outcomes analysed. Third, the interventions studied in these SRs are captured. Fourth, it presents the contextual factors considered and finally, presents the impacts and benefits that were realised.

While the results in Table 4.8 are self-explanatory, we would like to highlight the following for better understanding: If SRs have not reported the effect on sector level outcomes, but have reported only the impacts that have been achieved, then the sectors for those studies have been denoted as shaded area (See for example, Boullion et al, 2007, and Fewtrell et al., 2005). Further, no indication for any of the population segments (social or life cycle segments) indicate that the SRs have not reported the findings by specific population segments, but have reported only overall findings. For example, while Turley et al (2013) have reported the findings for urban and slum and low income segments of the population, Arnold and Colford (2007) have provided only the overall findings, without any specific reference to any of the population segments. Similarly, lack of any specific indication of the region showed that the SRs have not segregated their finding by region, but have provided only overall findings that synthesized the evidence from multiple regions. For example, while Watson et al (2012) have provided region wise synthesis of the findings in their SR, Bensch et al (2016) only give the overall findings without any region wise segregation. Finally, absence of any indication on dimensions of impact showed that the SRs have synthesized the evidence only on outcomes (such as access and quality), but have not extended their analysis to capture the benefits achieved as a result of implementing the interventions. Main findings from the evidence map are as follows.

Methods used in synthesis

Two-thirds of the SRs (i.e., 18 out of 27 SRs) have used quantitative tools to synthesize the evidence. This indicates that quantitative methods have been the preferred choice by investigators in conducting SRs. Quantitative methods help to measure the significance of the results in statistical terms and present numerical values that indicate the heterogeneity of the evidence, thereby making the findings more robust. Qualitative methods on the other hand help to capture the effect of context in the synthesis process and also help in making a rich description of the causal pathway. Thus synthesis of findings through quantitative and qualitative methods help in obtaining a holistic perspective of the underlying evidence. Given the predominance of quantitative methods used in the existing SRs, studies that are commissioned in the future could encourage the use of qualitative methods in evidence synthesis.

Sectors, outcomes, and impact

As illustrated in Table 4.1, Water Supply was covered in most number of SRs included in this ES. In terms of outcomes, quality of water supply was the outcome more frequently studied in this sector. However, in other sectors such as Road and transportation, telecom, and electricity both access and quality outcome were equally studied. It was thus observed that the sectors which have a predominant social context like water supply and sanitation had a higher focus on quality related outcomes. Whereas, sectors like electricity and transportation sectors where the connectivity takes precedent over social context, the outcomes on access was given as much importance as outcomes on quality. In terms of impact, we found that the effect on health was the most often analysed. Out of the 15 SRs that had synthesized the evidence on impact, there was only one SR (Molina et al, 2016) that analysed on the impact on all the four dimensions, viz., health, economy, education, and

quality of life. Similarly, there was only one SR that (Hine et al, 2016) analysed the impact on three dimensions. The remaining 13 SRs had synthesized the evidence on either one or two of the four dimensions of impact. None of the SRs had synthesized the evidence on the impact on environment. This suggests that SRs that are commissioned in the future should encourage the researchers not only to synthesize the evidence on impact in addition to outcomes, but also expand the range of impacts for which evidence can be synthesized (for e.g., environment). Eight of the 27 SRs included in the review did not report any specific evidence on the outcomes in the respective sectors. Similarly, 12 of the 27 studies did not report any evidence on the impact. Only one-third of the SRs included had evidence of the intervention on both outcomes and impact. Understanding the effect of interventions on both outcomes and long term impact would provide a better understanding of the causal pathway leading to the change. Future studies could therefore be directed to synthesize the evidence on both short term effects (outcomes) and long term effects (impact or benefit).

Interventions

The discourse on provision of civic infrastructure and amenities has considerably expanded over the years. Delivery of infrastructure services is no longer considered as creation of capacity or physical investment. Policy, procurement, and financing innovations has also been recognised as playing an important role in ensuring delivery of infrastructure services. However, our study indicates that most of the SRs have synthesized the evidence on interventions that are related to physical infrastructure creation. While other interventions such as PPP, urban planning, community participation, regulatory reforms, have accounted for a significant portion of policy paradigm in the last two decades, there have been very limited synthesis of evidence for these interventions.

Context

The contextual factors that were taken into account in the evidence synthesis in the SRs can be broadly classified into two categories: one related to population segments and the second based on the geographical region from where the primary evidence was obtained. Population segmentation can be based on social strata or on the population life cycle. Eight of the SRs had synthesized the evidence for social segments and seven of the SRs had synthesized the evidence on the basis of population lifecycle segments. More than fifty percent of the SRs included in this evidence summary (i.e., 14 of the 27 SRs) did not synthesize the evidence separately for different population segments. Among the social segment, the synthesis was most frequently done for rural segment, whereas in the lifecycle segment, the evidence was most often synthesized for children. On the whole, our findings indicate that the context of population has not been adequately considered in the SRs included in this summary.

Inclusion of region as a context was also very limited. Only six of the 27 SRs have synthesized the evidence separately by region. While the SRs were limited to evidence only from developing countries, there are significant differences in context between different developing country blocs such as Latin America, Asia, Africa, Eastern Europe and so on. Overlooking these regional differences in the synthesis process can limit the validity of the findings of the SRs. On the other hand, while synthesizing the evidence by different region can increase the relevance of the findings, it would be limited by the number of primary studies available for each region. Since many of the primary studies in infrastructure also use multi-country data in their analysis, the SRs may not able to incorporate the regional context in the synthesis, unless region level findings are available in the primary studies. However, our findings indicate that the efforts to include regional context in the SRs should be accentuated.

Table 4.8 Evidence map of the SRs included for the present study

Study Reference	Analysis method	Sector												Intervention						Social Segments			Lifecycle Segments			Region	Impact			
	Quantitative ● Qualitative O	Road and public transportation		Water Supply		Sanitation		Electricity		Telecom		Combined infrastructure Sector		Public private partnerships	Physical infrastructure investments	Institutional and regulatory reforms	Urban planning intervention	Developmental and Multilateral Agencies	Community and Non Governmental Organisation based intervention	Urban	Rural	Slum and Low income	Girls	Children	Adults		Health	Economy	Education	Quality of Life
		Access	Quality	Access	Quality	Access	Quality	Access	Quality	Access	Quality	Access	Quality																	
Annamalai et al. (2012)	O			●	●			●	●	●	●			●		●			●											
Annamalai et al. (2013)	●O			●	●			●	●	●	●			●																
Annamalai et al. (2016)	●O			●		●		●									●													
Arnold and Colford (2007)	●				●										●															
Bain et al. (2014)	●				●										●															
Bensch et al. (2016)	●							●	●					●		●												●		
Birdthistle et al. (2011)	O					●	●								●			●					●	●					●	
Bouillon et al (2007)	O													●	●					●		●		●		●	●			
Clasen et al. (2010)	●						●								●												●			
Clasen et al. (2015)	●			●	●										●		●													
Dangour et al. (2013)	●				●										●									●			●			
Fewtrell et al. (2005)	●														●					●	●						●			
Heijnen et al. (2004)	●						●										●									●	●			
Hepworth et al. (2013)	O				●												●					●								
Hine et al. (2016)	O														●						●						●	●	●	
Huges et al. (2013)	●				●										●											●				
Hunter (2009)	●				●										●															
Knox et al. (2013)	O														●						●							●		●
Molina et al (2016)	●																		●								●	●	●	●
Null et al. (2012)	O			●											●															
Petrosino et al. (2012)	●	●															●				●					●			●	
Taylor et al. (2015)	O				●										●									●	●	●	●			
Turley et al. (2013)	●O	●		●								●		●			●			●		●								
Waddington et al. (2009)	●			●	●	●	●								●	●											●			
Watson et al. (2012)	O														●	●					●	●				●		●		●
Wolf et al. (2014)	●														●									●			●			
Wright et al. (2004)	●				●										●									●						
Total Count		2	--	7	12	3	4	4	3	2	2	1	--	5	18	4	6	1	2	3	5	4	1	7	1	6	10	5	4	3

4.3 Sector-wise findings from the Evidence

This section presents the sector-wise findings from the SRs included in the ES. The evidence is presented in Table 4.10 through Table 4.15. Table 4.9 presents the notation used in these tables. The symbol denotes the existence of an evidence point in the SR related to the sector. For example, a "▲" indicates that there is one positive evidence in the SRs which used a quantitative synthesis method indicating that the intervention category has led to positive results on the outcome.

Table 4.9 Notation used to identify evidence in sector tables

Symbol	Meaning
▲	Quantitative study reporting positive effect
▼	Quantitative study reporting negative effect
↔	Quantitative study reporting mixed/no effect
△	Qualitative study reporting positive effect
▽	Qualitative study reporting negative effect
⇔	Qualitative study reporting mixed/no effect

For each sector, this study tabulates the evidence found in SRs on outcomes and impacts for different type of interventions. The key findings for each sector are summarised below.

Evidence in water supply

The evidence from SRs in water supply sector is illustrated in Table 4.10. Of the 27 SRs, 19 SRs concentrates on water sector. The quality assessment scores for the 19 SRs that had evidence on water supply sector is represented in the Table 4.16

Table 4.10 Qualitative representation of SRs in water sector

Quantile	No. of Systematic Reviews	QAT Score
1	0	115-106
2	8	105-96
3	6	95-86
4	4	85-76
5	1	75-66

The most common interventions studied were the creation of physical infrastructure (14 SRs). While the product quality was the main outcome of interest for the existing SRs (Evidence count = 51). In terms of long term impact health was predominantly studied (6 SRs with 30 evidence). There is a mixed to positive evidence (both quantitative and qualitative) suggesting that interventions in creating and investing in physical infrastructure will lead to better product quality in this sector (14 SRs). About 66% of the evidence points that the interventions led to an improvement in quality while 34% of the evidence suggests a mixed outcome for the intervention. The effect of creating physical infrastructure was more predominant in case of improving the health. SRs show a strong positive effect of this intervention on health related impact (80% of the evidence pointing in this direction).

Apart from improved product quality and health related effects, 5 SRs have reported a positive evidence on connectivity and affordability related as a result of investment in physical infrastructure. One positive evidence exists on the long term positive economic impact of these interventions (Knox

et al., 2013). While one evidence showed a positive impact on the quality of life as a result of the investment in infrastructure, we had three evidence from SRs that either indicated mixed or no effect.

The second most common category of interventions studied by SRs in water supply was urban planning interventions. This intervention was also the most common choice for SRs which employed qualitative techniques (evidence count=9). Synthesis of the evidence showed that for access outcomes there were 5 counts of positive impact, 2 counts of negative impact, and 7 counts of mixed or no effect on outcomes. For quality, there were 4 counts of positive impact, 4 counts of mixed or no impact and one count of negative impact. The evidence on impact could be found only on health, with two positive evidence, one negative evidence, and three evidence showing mixed or no effect.

Third, the PPP initiatives in this sector led to a positive effect on improving the connectivity and service quality in the sector (evidence count=2). However, the long term impact on health improvement is mixed with one evidence presenting positive and other presenting negative effect.

Finally, institutional and regulatory reforms had mixed effect on improving the access to water supply. However, micro level initiatives like NGO and community participation had a positive effect on improving access and quality, though there was just one SR that provided the qualitative evidence on this intervention. This ES therefore suggests a need for further evidence synthesis for interventions other than investment in physical infrastructure and also to expand the evidence on long term impacts and not just immediate outcomes.

Evidence in sanitation

Out of the 27 SRs, 8 SRs had synthesized evidence on sanitation. The quality assessment scores of the 8 SRs that had synthesized evidence on sanitation is given in the Table 4.11.

Table 4.11 Qualitative representation of SRs in sanitation sector

Quantile	No. of Systematic Reviews	QAT Score
1	0	115-106
2	2	105-96
3	1	95-86
4	3	85-76
5	2	75-66

Table 4.17 illustrates that the urban planning interventions (evidence count=27) and the interventions related to creation of physical infrastructure (evidence count=19) were the most commonly interventions for which evidence had been synthesized. In terms of long term impacts, most evidence was found for health. This is as expected, given the generally perceived relationship between sanitation and health (See for example, Wolf et al., 2014; Bouillon et al., 2007; Fewtrell et al., 2005; Clasen et al., 2010). However, not all of the evidence in health has been positive. Out of the 16 evidence counts, 7 indicated a positive impact, 3 indicated a negative impact, and 6 showed a mixed or no effect.

On access and quality outcomes, the impact has been in general positive when there has been an investment in physical infrastructure. However, in the case of urban planning interventions, there were 8 evidence for positive impact, 5 for negative impact, and 9 instances of mixed or no effect.

This, it can be said that urban planning interventions have not been as effective in improving outcomes as compared to that of creation of physical infrastructure. Institutional and regulatory reforms have also shown a positive impact, but there was only one SR that synthesized the evidence for this intervention.

There was one SR that had synthesized the evidence on the participation of multilateral agencies (Birdthistle et al., 2011) on access to sanitation and quality of services. However, the evidence did not indicate a strong positive or negative impact.

In sum, it can be said that synthesis of evidence was available for only four out of the six interventions. Out of the four, evidence count was minimal for Institutional & Regulatory reforms and participation from multilateral and bilateral agencies. Between urban planning and investment in physical infrastructure interventions, the later had a higher proportion of positive evidence counts indicating that creation of capacity is critical to improve outcomes in sanitation.

Evidence in electricity

Among the included SRs, 6 SRs had synthesized the evidence on electricity. The quality assessment scores of the 6 SRs studied under electricity sector is represented in the Table 4.12.

Table 4.12 Qualitative representation of SRs in electricity sector

Quantile	No. of Systematic Reviews	QAT Score
1	1	115-106
2	4	105-96
3	1	95-86

The evidence related to electricity sector is given in Table 4.18. While most evidence synthesis has been on connectivity still remains the choice of access outcomes in this sector, few SRs have synthesized the evidence on affordability. Between access and quality outcomes, however, it could be seen that evidence synthesis on access has been much higher, indicating the policy focus on access to electricity.

The investment in physical infrastructure (evidence count=18) category demonstrated a predominantly positive outcome on connectivity but had conflicting evidence on affordability (Watson et al., 2012, Knox et al., 2013). The service quality also usually improved. Provision of electricity also had a positive effect on the economy and quality of life (evidence count=2 and 4 respectively). Second, Institutional and Regulatory reforms (evidence count=15) did not have any strong positive or negative impact on connectivity but had a predominantly positive effect on affordability of the electricity (Bensch et al., 2016, Annamalai et al., 2012, Watson et al., 2012). The impact of institutional and regulatory reforms has also been mixed on quality outcomes. In general, there has been no long term negative impact on provision of electricity. The long term impacts have been positive or mixed at the least.

Evidence in SRs also indicate that urban planning has had a positive impact on connectivity but when the evidence was synthesized on multiple access parameters, there were two counts of negative evidence out of the total 5 available. PPP is another intervention where SRs have synthesized evidence. The impact of PPPs have been positive on connectivity (Watson et al., 2012), whereas in the case of quality the evidence was mixed.

In sum, the synthesis of evidence in electricity has been comparatively lower as compared to sectors such as water supply and sanitation. Between access and quality outcomes, the evidence synthesized for connectivity was higher as compared to that of quality, whereas for water supply and sanitation, the evidence synthesized for quality was higher. This indicates that policy makers tend to focus more connectivity to electricity rather than quality of electricity supplied. While there has been significant PPP and regulatory reforms in the electricity sector, the evidence synthesized has been limited. Our results also show that investment in physical infrastructure has been more effective in improving outcomes as compared to managerial, planning or institutional interventions.

Evidence in Road and Public Transportation

Evidence on Road and public transportation sectors have been synthesized from 5 SRs. The quality assessment scores of the 5 SRs studied under road and public transportation sector is given in Table 4.13.

Table 4.13 Qualitative representation of SRs in road and public transportation

Quantile	No. of Systematic Reviews	QAT Score
1	0	115-106
2	4	105-96
3	1	95-86

Table 4.19 reports the findings on evidence synthesized in Roads and public transportation sectors. Two categories of interventions for which evidence was available are investment in physical infrastructure and urban planning. Both of these had shown a predominantly positive impact on access outcomes. Hine et al. (2016) and Knox et al., (2013) show that investments in physical infrastructure had a positive impact on improving access outcomes. The synthesis of evidence on urban planning interventions (Petrosino et al., 2012, Turley et al., 2013) show a mixed evidence (evidence count=10). While, the studies were divided between no/mixed effect to positive effect on connectivity, the effect on product quality was mixed to negative.

In terms of long term impacts, there are 4 evidence counts of negative impact. However, there have been 12 counts of positive impact, indicating that the evidence in general has been positive.

Evidence in telecommunication

Only 3 of the 27 SRs have synthesized evidence on telecom. The quality assessment scores of the 3 SRs that focus on the telecom sector are given in Table 4.14.

Table 4.14 Qualitative representation of SRs in telecommunication sector

Quantile	No. of Systematic Reviews	QAT Score
1	0	115-106
2	2	105-96
3	1	95-86

Table 4.20 illustrates the evidence synthesized in Telecom. As can be witnessed from the table, the count of evidence for telecom are lesser that that of other sectors. Also, the evidence has been predominantly qualitative in nature in contrast to that of say, water supply, where the synthesis was done using quantitative methods.

In Telecom, PPP and privatisation initiatives (2 SRs with 5 evidence) usually resulted in better connectivity and access related outcomes, but had mixed effect on quality of such connections (Annamalai et al., 2012, Annamalai et al, 2013). Similar trend was observed with institutional and regulatory reforms which led to better access related outcomes, but a divided evidence on quality related outcomes. While one evidence states that the quality improve after enactment of reforms, the other study reports a negative effect (Knox et al, 2013). Overall, interventions in telecom had a predominantly positive impact on access related outcomes, but a mixed evidence on quality related outcome. Other intervention categories like community and NGO participation resulted in mixed effect on quality and access.

The synthesis of evidence on long term impact has also been limited. However, available evidence indicates that interventions pertaining to physical infrastructure in telecom had a positive impact on economy and quality of life.

Evidence in Combined Infrastructure sectors

A few SRs looked at the combination of civic infrastructure provision and the impact of various interventions on outcomes and impacts of interest. In these SRs, the evidence was not presented sector-wise but only the overall results were reported. 3 SRs were categorised under combined infrastructure sector. The quality assessment scores of the 3 SRs are represented in Table 4.15.

Table 4.15 Qualitative representation of SRs in combined infrastructure sector

Quantile	No. of Systematic Reviews	QAT Score
1	1	115-106
2	2	105-96
3	0	95-86
4	0	85-76
5	0	75-66

The evidence from such SRs was presented in Table 4.21. Predominantly, two types of interventions of studied. First, studies looked at impacts of investments in physical infrastructure. Second, they studied the effect of urban planning on access and impacts.

Investments in physical infrastructure (2 SRs with 8 evidence) across sectors had a mixed evidence on the effect on long term impacts (Molina et al., 2016, Fewtrell et al., 2005). Urban planning (1 SR with 4 evidence) initiatives had a positive impact on connectivity and affordability outcomes (Turley et al. (2013) but such studies reported mixed effect on health, economy and quality of life.

It is to be noted that the waste management and park & public spaces categories did not occur in the final 27 shortlisted systematic reviews for research.

Table 4.16 Evidence from SRs in Water Supply

Water Supply	Outcome											
	Access				Quality			Impact				
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure	▲	▲▲ ▲▲			▲▼↔↔▲▲▲▲▲▲▲↔ ↔ ↔ ↔ ↔ ▲ ▲ ▲ ▲ ↔ ▲↔ ↔↔↔△△△△▲▲▲▲▲▲ ↔↔△△▽⇔▲▲▲▲			△▲▲▲▲ ▲▲▲▲▲ ↔▲▲▲▲↔ ↔ ⇔△▽▽▲	▲		↔↔ ↔ ▲	
Institutional & Regulatory Reforms				⇔								
Urban Planning	⇔⇔⇔ ⇔△△△ ↔			▽▽△ △⇔⇔ ⇔	↔▲▲⇔△	△▽⇔ ⇔		↔↔ ▲▼⇔△				
Participation from Multilateral and Bilateral Agencies												
PPP and Privatization initiatives	△▲			⇔		△△	⇔	△▼				
Micro level initiatives such as NGO and Community Participation				△			△					
Others - Multiple Reforms				⇔								

Table 4.17 Evidence from SRs in Sanitation sector

Sanitation	Outcome							Impact				
	Access				Quality							
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure	▲▲△		⇔		△△△			▲▲▼△▲↔ ↔⇔⇔		⇔⇔⇔		
Institutional & Regulatory Reforms				▲			▲	▲▲				
Urban Planning	▲▲↔↔↔↔ △△△		▽	▽▽△△⇔⇔⇔	▼▼△⇔⇔			▼▼⇔⇔△				
Participation from Multilateral and Bilateral Agencies	⇔									⇔		
PPP and Privatization initiatives												
Micro level initiatives such as NGO and Community Participation												
Others												

Table 4.18 Evidence from SRs for Electricity sector

Electricity	Outcome							Impact				
	Access				Quality							
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure	▲▲▲▲▲▲▼△	▲▼				▲▲			△△△⇔		△⇔	
Institutional & Regulatory Reforms	↔↔↔	↔△△△		⇔⇔		↔	⇔⇔		△⇔		△	
Urban Planning	↔↔△△△			△△▽▽⇔								
Participation from Multilateral and Bilateral Agencies												
PPP and Privatization initiatives	△△			⇔↔			⇔↔					
Micro level initiatives such as NGO and Community Participation												
Others Multiple Reforms				⇔			⇔					

Table 4.19 Evidence from SRs from Roads and Public Transportation Sectors

Roads and Public Transportation	Outcome							Impact				
	Access				Quality							
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure				△△△ △△				⇔	△△△ △▽⇔ △△△	△	△△	
Institutional & Regulatory Reforms												
Urban Planning	⇔↔ △⇔ △				△⇔▽ ▼▼			△⇔▽ ▼▼⇔		⇔▲⇔	△	
Participation from Multilateral and Bilateral Agencies												
PPP and Privatisation initiatives												
Micro level initiatives such as NGO and Community Participation												
Others												

Table 4.20 Evidence from SRs in Telecom Sector

Telecom	Outcome							Impact				
	Access				Quality							
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure									△△⇔		△⇔	
Institutional & Regulatory Reforms				△△			△▽					
Urban Planning												
Participation from Multilateral and Bilateral Agencies												
PPP and Privatisation initiatives	△ △ △			△▲			⇔↔					
Micro level initiatives such as NGO and Community Participation							⇔					
Others – Multiple Reforms				⇔			⇔					

Table 4.21 Evidence from SRs for combined infrastructure

Infrastructure	Outcome							Impact				
	Access				Quality							
Intervention Category	Connectivity	Affordability	Capacity	Mixed access parameters	Product quality	Service quality	Mixed quality parameters	Health	Economy	Education	Quality of life	Environment
Investment in Physical Infrastructure								▲↔↔↔	▲	↔↔	↔	
Institutional & Regulatory Reforms												
Urban Planning	▲	▲▲▲						↔	↔		▲↔	
Participation from Multilateral and Bilateral Agencies												
PPP and Privatisation initiatives												
Micro level initiatives such as NGO and Community Participation												
Others												

4.4 Characteristics of effective interventions

From the evidence present across SRs selected and studied for this review, common characteristics for effective interventions were identified. This section presents such characteristics in the form of fish bone diagrams. The characteristics are presented in five dimensions – people, policy, measurement, procedure and management.

Figure 4.1 showcases a combined fishbone diagram for physical infrastructure and urban planning interventions. The characteristics that determines the effectiveness of these interventions are as follows:

People: The involvement of beneficiaries / users from diverse population and social segments across lifecycle of interventions holds the key to effective urban planning and physical infrastructure interventions (Annamalai et. al., 2016). Their involvement is expected not only during the design and implementation but also maintenance and sustenance of interventions (Turley et. al., 2013). The lip service paid to the community involvement and gender equity at the stage of intervention design results into lack of community ownership of created infrastructure. This consequently leads to poor upkeep of infrastructure, and bottlenecks in trickling of benefits to all sections of society respectively. Two systematic reviews had specifically indicated that these lacunae affects effectiveness of interventions undertaken in the slums (Hepworth et. al., 2013; Annamalai et. al., 2016).

Policy: The public policy cycle involves following stages: agenda setting, formulation, implementation, budgeting and evaluation. Six SRs discussed the features incorporated in the successful interventions: 1) Agenda setting and formulation involved consideration to social, economic, and technical aspects in policy making process and the governments' stand on legal status of slums and community participation in infrastructure creation and urban planning process (Watson et. al., 2012; Annamalai et. al., 2016; Turley et. al., 2013), 2) Budgeting involved provision of financial support in the form of credits and subsidies (especially to cover connection costs) (Watson et. al., 2012), and 3) Implementation involving encouragement and approval for innovative technical and planning mechanisms (Null et. al., 2012; Hepworth et. al., 2013; Huges et. al., 2013). These features have been discussed in most of the SRs in the context of provision of urban services and successful interventions targeted for urban services had policy contents like security of tenure for slum dwellers, targeted subsidies to cover costs of new water supply and / or sewerage connection and political commitment for improvement and upgradation of slums (Turley et. al., 2013; Watson et. al., 2012; Annamalai et. al., 2016). Apart from these features, the policy stability and government commitment to address status quo (housing problems and poor infrastructure) has been reported as important features for effective interventions (Watson et. al., 2012). The weaknesses in the policy formulation and implementation stages in the form of lack of legal mandate for slum improvement and clarity on roles and responsibilities of governmental agencies, especially in the case of mandate to deliver urban services to the urban poor, has been indicated as factors adversely affecting outcomes of interventions (Annamalai et. al., 2016).

Measurement: The interventions that put in place performance monitoring mechanism comprising features like data collection, compliance to standards and periodicity of performance assessment led to improved upkeep of infrastructure and services (Bain et. al., 2013; Hepworth et. al., 2013).

Procedure: The procedures adopted for urban planning and physical infrastructure development should inculcate features like inclusivity, technological advancement and local / social knowledge. Specifically,

the absence of collaboration among stakeholders – administrators, NGOs, CBOs, elected representatives and community inhibits realisation of benefits (Taylor et. al., 2015; Hepworth et. al., 2013).

Management: The evidence from successful interventions highlights the importance accorded to asset management and recognised the upstream and downstream linkages of the infrastructure systems (Heijnen et. al., 2014; Watson et. al., 2012). The asset management had elements like periodic maintenance of infrastructure and development of skills / capacities in the community and / or service delivery agencies to undertake this maintenance (Hughes et. al., 2013; Taylor et. al., 2015). The SR highlighted higher and unaffordable maintenance charges as an impediment for efficient asset management, and it has been highlighted that rural communities as well as urban poor faces this impediment resulting in poor access to water supply and sanitation services (Bain et. al., 2013). The successful interventions ensured quality and quantity of supporting infrastructure as well as their safety (Heijnen et. al., 2014; Bain et. al., 2013; Wright et. al., 2004). Three SRs discussed some of these management process with specific reference to provision of urban services like understanding linkages between water supply and sanitation services, provision of adequate water supply to community toilets, upkeep of septic tanks or sewerage networks for improved toilet facilities and protection of water source (Heijnen et. al., 2014; Wright et. al., 2004; Clasen et. al., 2010). The availability of donor finance and support for asset management and infrastructure network improvements further improves outcomes of interventions (Hepworth et. al., 2013).

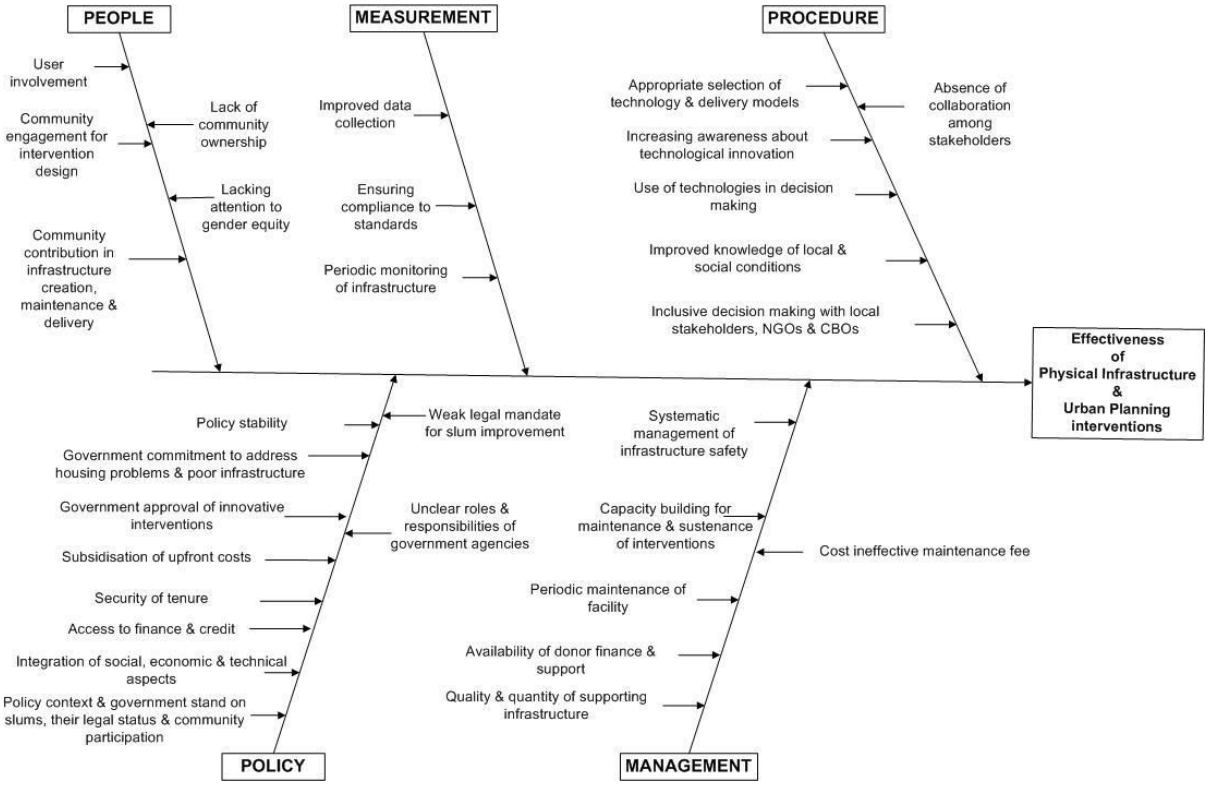


Figure 4.1 FBD - Physical infrastructure and urban planning interventions

Figure 4.2 showcases a combined fishbone diagram for private sector participation, institutional and regulatory reforms, social monitoring and multilateral and development organisations interventions. The characteristics that determines the effectiveness of these interventions are as follows:

People: Two SRs highlighted that interventions like involvement of private partner for delivery of infrastructure, creation of infrastructure regulatory agencies, and involvement of multilateral and bilateral funding organisations radically transforms traditional procurement models and institutional mechanisms followed for infrastructure delivery (Bensch et. al., 2016; Annamalai et. al., 2012). This transition towards new modes and mechanisms has been managed effectively by successful interventions with two prominent ways: i) service provision utilities, that had recently adopted reforms, realised the social welfare functions served over the years and decided to tread this path of reforms with caution and adopted the reforms gradually (Bensch et. al., 2016), and 2) adopting of reforms raises concerns in the minds of community and users, and successful interventions had undertaken activities to address these concerns by highlighting reasons behind adoption of regulatory reforms or Private Sector Participation models and ensuring financial viability in service provision (Annamalai et. al., 2013).

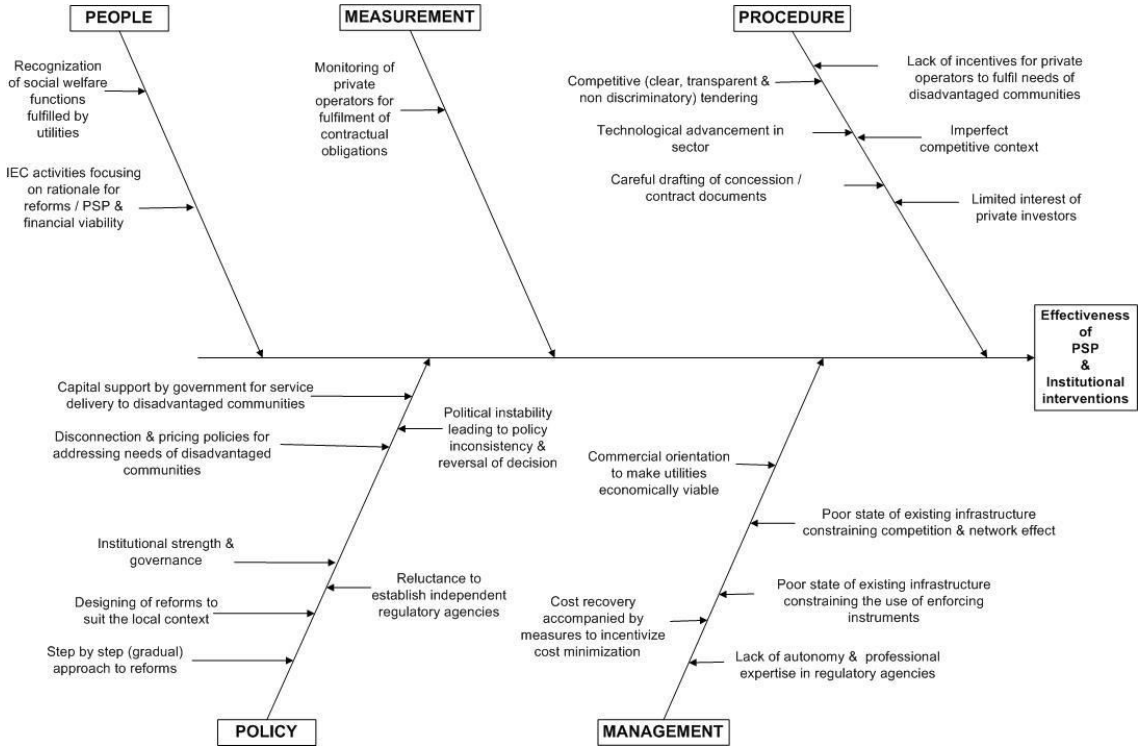
Policy: The successful interventions have designed reforms in line with expectation and aspiration of concerned stakeholders and local conditions, and these reforms are often gradually implemented (Annamalai et. al., 2012). The gradual reforms had advantages like incorporating learnings from earlier phase of reforms, sequencing and combination of reforms like private sector participation, creation of regulatory agencies and involvement of community in monitoring (Annamalai et. al., 2012). The principles of cost recovery and financial viability gets priority over social and economic goals with involvement of private sector in service provision. Under these circumstances, the poor section of society suffer owing to inability to pay upfront connection fees as well as user charges. Two SRs indicate the policy measures undertaken to protect the interests of urban poor, which includes capital support to private partner for expansion and connection of water supply and sanitation network in slums, subsidised tariff for urban poor and measures to avoid immediate disconnection of service owing to non-payment of tariff/dues (Annamalai et. al., 2013; Bensch et. al., 2016). The quality of policy formulation and implementation process hinges on institutional strength and governance of different layers – central, state and local and this has been highlighted in SRs with examples of political corruption, administrative and regulatory capacity (Annamalai et. al., 2012). These reforms necessitate strong political and administrative commitment to address the poor state of urban services or status quo, and the unwavering policy support needed throughout the policy cycle. Two SRs indicated that policy inconsistency, reversal of policy decisions and reluctance to create independent regulatory agencies resulted in unsuccessful reforms (Bensch et. al., 2016; Annamalai et. al., 2012).

Measurement: The successful interventions had recognised the change in the role of public sector agencies/service delivery agencies after implementation of reforms from being a provider to that monitoring the provision of services. Hence, utmost priority has been given to monitor the performance of private partners as well as social groups to ensure that the performance parameters and contractual obligations were met (Annamalai et. al., 2013).

Procedure: The involvement of private sector in service delivery often raises the concerns of private monopoly and collusion in procurement process. Also, the effectiveness of these mechanisms is decided to the large extent by defining the contractual roles and responsibilities of parties involved in the service delivery. The successful interventions addressed these issues with competitive tendering and careful

drafting of concession/contract documents (Annamalai et. al., 2013). There has been specific reference made in two SRs towards protecting the interests of urban poor while designing the concession agreements by indicating network expansion targets in slums and procedure for provision of subsidies and capital grants for new connections, collection of dues and disconnection (Bensch et. al., 2016; Annamalai et. al., 2012). The reforms that failed to reach desired objectives came across hurdles in the form of small pool of private partners leading to imperfect competition/oligopoly, limited interest of private partners to work in innovative arrangements - PSP, regulation and social involvement, and failure of contracting agencies to create incentive mechanisms for private operators to serve disadvantaged communities (Bensch et. al., 2016). Two SRs observed that private operator primarily focus on service areas providing higher revenues and this results in lack of incentives to serve far off rural areas as well as slums in urban areas (Bensch et. al., 2016; Annamalai et. al., 2012). The inability of service delivery agencies to understand this conundrum and take measures during contract design stage resulted in poor outcomes of reforms.

Management: The cost recovery and professional management of utilities has been the cornerstone of reforms. Often, among the different priorities – social, political, economic and administrative faced by utilities the cost recovery and professional management takes a backseat. The successful reforms had strong management commitment to bring commercial orientation in utilities operation, justification for cost recovery and competitive marketplace to minimise cost of service provision (Bensch et. al., 2016). Three SRs highlighted the following impediments to adopting commercial orientation and professional management: poor state of existing infrastructure constraining competition, network effect, and enforcing instruments, and lack of autonomy and professional expertise in regulatory agencies (Bensch et. al., 2016; Annamalai et. al., 2012; Annamalai et. al., 2013).



Chapter 5. Figure 5.2 FBD- Effectiveness of private sector participation and institutional reforms and other intervention**Summary, Implications & Contextualization**

5.1 Evidence Summary Question

The questions addressed by this rapid evidence summary were:

- *How effective are interventions which seek to improve access and quality of civic infrastructure and services?*
- *What are the key characteristics of successful interventions?*

Following were the outputs of this evidence summary:

- Evidence map that summarised the SRs on two set of parameters:
  - ***Background context***: Regional coverage, sectoral coverage, outcomes synthesized, years of publication, quality assessment, analysis method, social and lifecycle segments analysed, nature of impact reported and interventions covered
  - ***Effectiveness:*** Outcomes and impacts for different types of interventions
- Key characteristics of successful interventions
- Contextualisation of findings to Nepal, which can also be relevant for South Asian Countries in general

5.2 Method

This ES adopts the methodological rigor adopted in the SRs. The methodology used in this ES consists of five steps: sourcing, search strategy and management, screening and selection, data extraction and synthesis.

- Sourcing and search strategy: SR studies were sourced from repositories of SRs, websites of funding agencies and journals publishing systematic reviews.
- Search management: This involved management of search results with the EPPI Reviewer software for title screening, sector based keyword searching and removal of duplicate studies.
- Screening and selection: Appropriate inclusion and exclusion criteria was formulated to identify the SRs that would qualify for inclusion in this ES. This criteria focused on context of study, infrastructure sectors, study year, language, outcomes and synthesis methods. Finally, 27 SRs were identified for inclusion in this ES. These 27 SRs were used in data extraction and synthesis.
- Data extraction: A data extraction cum coding and quality appraisal tool was used for extracting the data from the SRs identified for inclusion and for assessing the quality of SRs respectively. The consistency and rigor was ensured in the quality assessment process by involvement to two review team members, who worked independently and assessed the included studies. The data extraction cum coding tool was used to extract data pertaining to study characteristics and findings on the systematic review.
- Data synthesis: Two methods - numerical summary and cause and effect analysis were used for synthesszing the data obtained from the SRs.

5.3 Summary of results

The results pertaining to two questions addressed by this ES are discussed below:

How effective are interventions which seek to improve access and quality of civic infrastructure and services?

In answering these questions we draw attention to the background of the SRs. Key successful characteristics of the different interventions in the ES are also highlighted in this section. The description of the intervention types is also explained.

Characterization of included SRs

- The water supply (19 SRs) sector has been the prominent focus sector of SRs, followed by sanitation (8 SRs) and electricity (6 SRs). The public transportation has received very less attention (1 SR). Both – access (35 mentions in 27 SRs) and quality (34 mentions in 27 SRs) have received equal attention of policy makers across different civic infrastructure sectors. Most number of evidence synthesis in the SRs has been for Asia and Africa – regions that are experiencing significant urbanisation.
- The comprehensiveness of the SRs was reflected in the number of primary studies from which the evidence was synthesized in the different SRs included in this ES (average of 63.14

primary studies). It could also be noted SRs focusing on civic services has been a recent phenomenon, with 23 out of 27 included SRs having published after 2009. There has been a wide variation in the range of years of publication included in the systematic reviews, with 16 systematic reviews falling in the range of 10 to 30 years and 11 systematic reviews in the range of greater than 30 years. Overall the quality assessment process indicated the high quality of SRs included in this ES.

- Among the different categories of interventions for which evidence has been synthesized, most common intervention category was physical infrastructure creation. The intervention where there has been least amount of synthesis in the SRs has been participation by multilateral and developmental organisations is least preferred. Except in the case of interventions pertaining to physical infrastructure creation, equal focus was given to synthesizing evidence on both access and quality outcomes. In the case of physical infrastructure creation, the number of evidence counts on quality outcomes was higher.

- Eighteen out of 27 SRs have used quantitative methods for synthesis of evidence and only 3 systematic reviews have used mixed methods (qualitative and quantitative). The sectors with predominant social context like water supply and sanitation had higher focus on quality related outcomes while access and quality related to outcomes have received equal attention in electricity and transportation sectors. Out of four impact dimensions (health, economy, education and quality of life), the evidence on health had been most often analysed. None of SRs have focused on all these four dimensions and only one SR focused on environment. In terms of reporting evidences on outcomes (short term benefits) vis a vis impacts (long term gains), majority of SRs have focused on outcomes (19 out of 27 systematic reviews) as compared to impacts (15 out of 27).

Evidence map

- **Water supply**: Among the different types of interventions seen in water supply, evidence on outcomes as a result of interventions related to physical infrastructure investment has been most widely synthesized (14 SRs). The effect of this intervention was investigated prominently on product quality and health. The large number of counts of positive evidence indicated that investment in physical infrastructure has been effective in improving product quality. While the evidence has been positive on connectivity and affordability outcomes under access, the count of evidence has been small. Intervention which had the second highest number of evidence synthesized was urban planning and related interventions. Comparatively, the count of negative evidence has been higher in this case, indicating that effectiveness of planning interventions has been context specific. Evidence on the other interventions has been few. In terms of long term benefits, most evidence has been on health. As expected, much of the evidence of water supply on health has been positive. However the proportion of the count of positive evidence has been higher in the case of physical infrastructure investments as compared to that of other interventions. Nevertheless, the evidence on other impacts such as economy, education, and so on has been minimal.

- **Sanitation**: Similar to the trends in water supply, physical infrastructure investment (6 of the 8 SRs) and urban planning (2 of the 8 SRs) have been the two interventions for which the

evidence have been commonly synthesized. In outcomes, 6 of the 8 SRs have synthesized the evidence on access and 7 of the 8 SRs on quality. Much of the evidence under access has been for connectivity, whereas for quality, it has been product quality. Evidence synthesis has been very poor for the remaining categories of interventions. Urban planning has more instances of negative evidence as compared to that physical infrastructure investments. This indicates that urban planning has not been very effective in improving outcomes. In terms of impacts, most evidence has been on health. While one would have expected positive impacts as a result of provision of sanitation, there have been three counts of negative impact, indicating that in some instances the desired benefit could not be realized. On the whole, evidence synthesis have to be enriched by studying more interventions and expanding the categories of outcome and impact.

- **Electricity**: In terms of outcomes, evidence synthesis has been the highest for access outcomes as compared to that of quality. Within access, most evidence has been on connectivity. The pattern of evidence available departs significantly from the patterns seen for water supply and sanitation. The counts of evidence on quality have been very few as compared to that of access outcomes. Counts of evidence available has also been higher for other interventions such as institutional and regulatory reforms, and PPP and privatisation initiatives. There has been a dominance of positive evidence across the different interventions. Negative evidence was seen in the case of affordability and on mixed access parameters. The evidence on long term impacts, in general, has been fewer. Where available, evidence synthesis has been for economy and quality of life. This again departs from the trend seen in water supply and sanitation, where much of the evidence synthesis has been on health impacts.

- **Road and public transportation**: The count of evidence synthesis for road and public transportation has been much lesser as compared to that of the three sectors discussed previously. There were only two categories of interventions for which evidence has been synthesized – investment in physical infrastructure (2 SRs) and urban planning interventions (2 SRs). The results show interesting patterns. While investment in physical infrastructure has resulted in positive outcomes on access, urban planning interventions have resulted in mixed impacts. This indicates that effectiveness of those interventions that are categorised as urban planning interventions have to be improved. Evidence synthesis results are available on more dimensions of impact when compared to the results in other sectors. The results on impact also show interesting features. While impact on economy has been a primary focus when pertaining to investment in physical infrastructure, health, education and quality of life has been the focus in the case of urban planning interventions.

- **Telecom**: Despite being one of the major infrastructure sectors, the SRs that have synthesized the evidence on telecom access and quality have been very few. While investment in physical infrastructure and urban planning were the intervention categories for which evidence has been widely synthesised for other sectors, in the telecom sector synthesis of evidence on outcomes has been for the following intervention categories: institutional and regulatory reforms and PPP and privatisation initiatives. Going by the nature of the sector, urban planning and investment in physical infrastructure have not been the dominant interventions. Since the count of evidence has been few, strong

generalisations could not be made. However, the results indicate that while the impact of various interventions have in general resulted in positive impacts on access outcomes, the same cannot be said on quality. Much of the evidence synthesis on quality has indicated mixed or no effect from the interventions.

Key characteristics of effective interventions in urban areas

The interventions which are similar in nature were grouped for identifying the characteristics of effective interventions. The characteristics of these interventions have been identified on the following attributes: people, policy, procedure, management, and measurement.

Physical infrastructure and urban planning interventions

Effective interventions in these two categories showcased the following features:

People: The user and community involvement through the lifecycle - right from the stage of intervention design to implementation. In addition to community involvement, the addressing aspects of gender equity in the intervention design improves community ownership of created infrastructure.

Procedure: This community involvement was supported by the process having features like inclusivity, technological advancements and local or social knowledge.

Policy: Security of tenure for slum dwellers, targeted subsidies to cover costs of new water supply and sanitation connection, and commitment for improvement and upgradation of slums should be a key objective of the policy. Further policy stability and government commitment to address status quo (housing problems and poor infrastructure) and rather than just keeping it as a policy statement have been common features of effective interventions.

Measurement: At implementation stage, performance monitoring mechanisms should be supported by processes of data collection, compliance to standards and periodicity of assessment.

Management: Interventions has to be managed with by asset management principles as well as recognising upstream and downstream linkages of network infrastructure like water supply, sanitation and electricity. It includes features like periodic maintenance, capacity building in community and service delivery agencies to undertake maintenance, quality and quantity of supporting infrastructure and their safety. The efforts in asset management and infrastructure creation can be further improved with donor finance and support.

Private sector participation, institutional and regulatory reforms, social monitoring and multilateral and developmental organisations

Effective interventions in these four categories showcase the following features:

People: Interventions that have been grouped together here transform the traditional mode of urban service delivery and the interventions have been effective when associated stakeholders are well informed about the necessity for implementing the interventions such as reform, regulations, and so on. In many instances, where the outcomes have been positive, the implementation of interventions has been gradual wherein the social welfare functions performed earlier by utilities were recognised and interests of the urban poor/disadvantages communities were protected.

Procedure: Interventions that have been grouped here involves working with non-governmental agencies. Therefore, the procurement process should incorporate processes such as transparent bidding, well defined performance parameters and financial instruments for protection of disadvantaged communities in the concession agreement.

Policy: Institutional strength and governance of different layers – central, state and local determine the quality of policy formulation and implementation processes. Along with these aspects, the political and administrative commitment to address the poor state of urban services has to be ensured, with measures like capital support for network expansion in slums, subsidised tariff for urban poor, and avoiding immediate disconnection owing to non-payment of tariff/ dues.

Measurement: The realisation within the public agencies to the change from being a provider of civic services and amenities to that of monitoring and management of services results in achievement of performance parameters and contractual obligations.

Management: While dealing with the demanding priorities – social, political, economic and administrative faced by utilities, the successful reforms should not deviate from the principles of cost recovery and professional management of service delivery process.

5.4 Implications

The scope of SRs should be expanded to include those interventions, sectors, outcomes, population segments, and regions where evidence synthesis has been limited. This would further strengthen evidence based policy making.

This ES suggests the need to commission additional SRs on sectors like sanitation, electricity, road, telecom and public transportation. These reviews can focus on those interventions where evidence synthesis has been limited. The three most common interventions where evidence has been synthesized are: creation of physical infrastructure, urban planning, and institutional and regulatory reforms. There has been limited synthesis on other interventions. Similarly, the outcome variables for which the evidence has been synthesized has been very limited. Outcomes such as access and quality are composite in nature and can be represented by several indicators. Expanding the scope of the SRs to include multiple outcome variables can provide new insights on the effectiveness of the interventions. Evidence synthesis has largely focused on countries in Asia and Africa. Inclusion of other developing regions such as South, Central and North America, Eastern Europe and Oceania would be able to highlight what types of interventions work in different regions.

The sustainable development goals (SDGs) have highlighted that despite remarkable progress made on the front of improving access to basic services, there exists growing disparity among different segments of population owing to discrimination based on caste, gender, regions, and so on. In this context, it is very important to analyse the effect of interventions in SRs on different population segments. The population segment could be either on the basis of social and economic status (urban, rural, slum and low incomes) or on the basis of lifecycle (girls, children and adults) segments.

In addition to outcomes (short term benefits) SRs should focus on impacts (long term benefits) also, as it would help in understanding the causal pathway between interventions and impacts.

The urban infrastructure projects has long gestation period, therefore, the impact of infrastructure interventions are realised over a long period of time. It is a well understood fact that the policy makers

are keen to know the immediate impact of any intervention. It is generally expected that the long term benefits of provision of infrastructure is expected to be positive. However, understanding the causal pathway between interventions and benefits would help in designing the various components of interventions to make it more effective. Inclusion of impacts in the scope of SRs would further cause of better understanding of the causal pathway.

Secondly, focusing on impacts would also expand the range of impacts where evidence would be synthesized. While "health" has been the most common impact variable for which evidence has been synthesized, there is also a need to focus on other impact variables such as economy, education, environment, and quality of life.

Sector specific components need to be included in interventions to make it more effective.

Water sector: The physical infrastructure interventions can be encouraged more in the water sector, which would result into positive effect on product quality, connectivity, affordability and health as indicated by the evidences. Further, these interventions can be designed to address parameters like service quality and bring long term effect on dimensions like economy, education and quality of life. Although, the formulation and implementation process of urban planning interventions which has been currently followed can be revisited and improved to bring positive effect on both –access and quality parameters as well as long term impacts.

Sanitation sector: The design and implementation of physical infrastructure investment reforms in sanitation sector can be encouraged in the sanitation sector, although, with aim to bring improvements on additional parameters like affordability and service quality as well as long term impact on economy, education, quality of life and environment. The urban planning reforms can be encouraged and improved to bring positive effect in access as well as quality outcomes and long term impacts on all fronts.

Electricity sector: Provision of electricity services can be improved with combination of following reforms: investments in physical infrastructure, institutional and regulatory reforms, urban planning and private sector participation. These reforms should be targeted not only to address connectivity and affordability in general but also product and service quality parameters. These reforms should also be attuned to bring long term impacts on health, education, quality of life and environment.

Telecom sector: Private sector participation should be encouraged for improving access to telecom services. Further, this intervention can be designed to look into parameters like affordability, service quality and product quality and bring long term improvement on all fronts.

Involvement of the community and protecting the interests of the poor can improve the effectiveness of urban planning and creation of physical infrastructure interventions in water supply and sanitation sectors.

The effectiveness of urban planning and physical infrastructure investment reforms, which are more popular in water supply and sanitation, can be improved by involvement of users and members of the community across all stages of policy making, implementation, and monitoring. The interests of poor section of society should be protected by provision of government subsidies for connection cost and political commitment to address issues like poor infrastructure in slums, security of tenure, legal and policy stance over slums and community participation, and so on.

The changing role of the public sector from being a provider to manager of urban services and additional focus on quality can lead to improved outcomes in electricity and telecom sectors.

The private sector participation and institutional & regulatory reforms, which are popular in electricity and telecom sectors, can be improved by reorienting the focus from "access" to "quality" as well as "provider" to "manager" of urban services. This transformation requires imbibing characteristics like careful drafting of concession and contract documents and subsequent monitoring of private operators and utilities performance to ensure fulfilment of contractual obligations, drafting of reforms in line with local conditions and state of infrastructure sector, and disconnection and pricing policies to protect the interests of poor and disadvantaged communities.

5.5 Contextualisation

The contextual factors that were taken into account in the evidence synthesis in the SRs can be broadly classified into two categories: one related to population segments considered and the second based on the geographical region from where the primary evidence was obtained. Population segmentation can be based on social strata or on the population life cycle. Eight of the SRs had synthesized the evidence for social segments and only seven of the SRs had synthesized the evidence on the basis of population lifecycle segments. More than 50% of the SRs included in this evidence summary (i.e., 14 of the 27 SRs) did not synthesize the evidence separately for different population segments. Among the social segment, the synthesis was most frequently done for rural segment, whereas in the lifecycle segment, the evidence was most often synthesized for children. On the whole, our findings indicate that the context of population has not been adequately considered in the SRs included in this summary.

Inclusion of region as a context was also very limited. Only six of the 27 SRs have synthesized the evidence separately by region. While the SRs were limited to evidence only from developing countries, there are significant differences in context between different developing country blocs such as Latin America, Asia, Africa, Eastern Europe and so on. Considering the regional context in interpreting the findings would enhance the validity of the findings. While synthesizing the evidence by different region can increase the relevance of the findings, it would be limited by the number of primary studies available for each region. Since many of the primary studies in infrastructure also use multi-country data in their analysis, the SRs may not able to incorporate the regional context in the synthesis, unless region level findings are available in the primary studies. Since there has been limited use of contextual variables in the analysis both in the primary studies as well as the systematic reviews, we have contextualised the findings of the ES by understanding the political, geographical and physical features of the country and interpreting the findings of ES in a way that can have relevance for the targeted country. In this report, we have contextualised the findings of the evidence summary for Nepal.

A look at the included SRs for the study reveals that 6 SRs have direct reference to the studies from Nepal. Out of these 6 SRs, 2 SRs have reviewed studies related to Sanitation sector, 2 SRs have considered WASH sectors, 1 SR dealt with provision of water and the final SR dealt with Roads sector. Further, from the quality of evidence present in the SRs, the SRs had QAT scores ranging from 70 to 105. At this point, it should be noted, though there are only 6 SRs with direct reference to studies from Nepal, the other SRs findings would be useful to Nepal as well due to the similarities in the economic development, since this evidence summary included SRs focussing only on LMICs. Finally, about 20 SRs had references to Asian countries, particularly to South Asian countries and thus the results of such studies could be quite relevant to Nepal as well.

Short background on Nepal

Nepal, is a landlocked country and extremely diverse. It comprised mainly of three main geographic regions; the mountain region, the hill region and the Terai region, with a variety of structures ranging from mountains to valleys and plains. Nepal is highly susceptible to natural disasters, and recovery is slow, as evidenced by the Nepal earthquake (UNDP, 2017). Nepal is ranked in 98th position out of 138 countries in the recently released Global Competiveness Index (GCI) (Schwab, 2016: 274). Moreover, Nepal is in the bottom rank within South Asia region in infrastructure, innovation, business sophistication and technological readiness according to the GCI report (ibid, 18). Table 5.1 provides a snapshot of the key socio-economic indicators of Nepal and also compares with the global indicators and indicators of South Asia. It can be seen that on many of the indicators Nepal fares poorly when compared to the global average. Also it becomes clear that Nepal as a demographic has to be looked at specifically and not as a part of South Asia.

Nepal as a country becomes a specific context different from South Asia. It is less densely populated than average South Asian countries and percent of people living in rural areas are significantly higher compared to South Asia on an average. Such low density and rural populations might pose additional challenges in terms of provision and connectivity of infrastructure facilities to the population. However, Nepal has fared well than South Asia in terms of access to electricity and mobile phone connectivity. Such demographic and geographic distinctions of Nepal from the rest of South Asia mandates a specific look at the context of Nepal and contextualise the present findings to that country.

Table 5.1 Key socio-economic indicators of Nepal in comparison to global average

Indicators	Unit of measurement/ expression	Nepal	South Asia	World Average
	Demographic Indicator			
Population in 2015	In millions	28.5	1744	7340
Population density in 2015	Number of people per square km	199	365.53	56.63
Population growth rate	Percentage change from 2014 to 2015	1.2%	1.29%	118.5%
HDI (2014)	Index	0.54	-	-
BPL population in 2014	Percentage of population	25.20%	-	-
Rural population in 2015	Percentage of population	81%	66.97%	46.14%
Population living in slums in 2014	Percentage of population	54%	-	-
Literacy rate of 15-24 year olds in 2015	Percentage of population	89.90%	-	-
	Health Indicator			
Infant Mortality Rate in 2015	For every 1000 births	29	40.3	31.7
Maternal Mortality Rate in 2015	For every 100,000 births	258	-	216
Health expenditure in 2014	Percentage of total expenditure	40.30%	-	60.00%
Life expectancy at birth in 2015	In years	70	68.5	71.676

	Environment Indicator			
Total greenhouse gas emissions	Percentage change from 1990 to 2015	62%	108.2%	40%
CO2 emissions in 2013	Metric tonnes per capita	0.2	1.4	4.9
	Social Indicator			
Mobile phone subscriptions in 2015	Per 100 people	97	75.1	98.3
Electric power consumption in 2014	kWh per capita	140	707.5	3144.37
Access to electricity in 2014	Percentage of population	84.90%	80.1%	85.50%
Access to sanitation in 2015	Percentage of population	46%	44.4%	67.50%
	Economic Indicator			
GDP per capita in 2015	US$	743.3	1538.1	10,112
GDP growth rate (annual)	Percentage	3%	6.1%	2.72%

***Source**: World Bank Indicators (http://data.worldbank.org/indicator)*

Nepal was a Hindu kingdom ruled by a monarchy until 2006, after which the powers of the king were curtailed and Nepal was made a democratic country formally by the passing of a Bill in 2008 (GON, 2017:1). A long civil war and political uncertainty has considerably weakened the economic condition and the investment climate in the country. Caste based social inequalities have been one of the primary reasons for conflict in the country, with the previous monarchy chastised for being 'feudal', after having catered largely only to upper-class urban interests. Landlessness, no access to political participation, a lack of financial support and the like have largely been seen as key elements that developed as catalysts to conflict in the region (Wennmann, 2009). While there have been constitutional and legal amendments that focus on gender equality and inclusion, discriminatory attitudes and social norms have hindered women's progress and participation on a number of spheres (Asian Development Bank, 2010).

Apart from this, predicaments such as high rate of inflation, tax compliance, and mounting deficits are causing the country to plummet to economic impotency (World Bank, 2011). In order to achieve the SDG goals within the stressed economic environment and limited government resources, it is important for Nepal to collaborate with the private, co-operative and civil society sector. While civil society and co-operative organizations with a total membership of over six million have made some significant contributions, the inclusion of private sector can be enhanced with better investment climate, easier administrative processes, liberalized labor laws and improved infrastructure (GON, 2017: 10). Nepal has an access to information legislation in place since 2007 yet the implementation has been very slow and mostly inadequate (Article 19, 2015). Transparency International's Corruption Perception Index (CPI) have Nepal ranked at 131 among 176 countries (TI, 2017). Corruption is deep rooted within the central up to the local bodies which allocates billions of rupees for development work (Bhattarai, 2011). In order to increase the rate of growth and infrastructure development in Nepal it is important to strengthen accountability, transparency and good governance mechanisms.

Interventions

Nepal has a weak investment climate, poor economic condition and 81% of the population lives in rural areas. Multilateral agency and community organisations are two important actors that can play a leading role in improving the infrastructure scenario. The key for successful intervention lies in balancing out roles and close collaboration between these two agencies.

Big multilateral organisations such as the World Bank, Asian Development Bank and the United Nations have assumed active role in Nepal's growth. They have been involved in democratic, human rights and investment causes in the country in addition to dealing with situations such as natural disasters (Bhandari, 2014). However, a criticism with regard to functioning of multilateral organisations include poor problem assessment and funding of projects which are not the key issues of Nepal (ibid). The working of the multilateral agencies can be made more effective if they have close partnership with community based organisation. Community based organisation have the expertise of micro planning at par with local needs along with local population, non-governmental organisation and other stakeholders. The involvement of the community is also important for maintenance and sustainability of the infrastructure as emerging from the finding of our study. These are effective tools could be used for building effective infrastructure projects in the country. In the rural areas, collaboration between these two agencies can provide successful interventions in water supply, sanitation, health and education projects. Such sentiments were expressed by the systematic reviews which dealt with urban planning, institutional and regulatory reforms and multilateral institutions interventions in their studies (3 SRs had references to such interventions). This is further reinforced by other SRs with focus on South Asian countries. Thus, such findings become quite relevant to the context of Nepal.

The planning and implementation of any infrastructure project for water, sanitation, health or education intervention needs conclusive environment. However, most infrastructure projects in Nepal remain incomplete, are delayed due to corruption and are not strong enough to withdraw adverse externalities (Ali & Pernia, 2003). Lack of corruption and effective transparency mechanisms are key components for successful interventions. Transparency indicators can be enhanced by periodic monitoring of infrastructure, improved data collection and ensuring compliance to standards. Multi-lateral agencies play important role in a number of developing countries for ensuring transparency standards. One SR from the sanitation sector with studies included from Nepal had evidence pointing towards this. World Bank has stringent transparency legislation by the client country as a clause for initiating big development projects. Most of the times, pressure by the multilateral agency causes the client country to adopts the legislation but fails to implement it successfully e.g. Nepal and Pakistan. The political will among the government to ensure transparency and good governance are major steps towards ensuring an amicable environment for participation of multilateral and private agencies.

In Nepal it has been noticed that that private public partnerships are much more successful at the local level. There is strong evidence that PPPs have been quite successful at the municipality level and other such civic levels in the country (Ullah, 2014). In 2015, Nepal drafted a PPP policy that gives private enterprises the power to work in areas pertaining to physical infrastructure, transport, electricity, information and communication, waste management, environment management and infrastructure related to education and health. Government support and incentives are necessary for PPP to thrive in rural and far flung areas. There should also be an intensive cost recovery policy accompanied by measures to incentivise cost minimisation to promote infrastructure investment projects.

Urban planning is also an important area of intervention especially in major metropolis like Kathmandu. Nepal has recognised the need for staged urban planning due to the fast pace of development in the country. Right from the 10th Five Year Plan of the country, the focus of the country has been extensively on urban planning, but numerous challenges have been faced along the way (Dhakal, 2012). Community participation through improved knowledge of local and social conditions and inclusive decision making with local stakeholders, NGOs and CBOs are important steps for successful urban infrastructure. A study in 2005 identified 137 slum neighbourhoods in Kathmandu, with 6,985 households and 31,463 people (UN. n.d). In order to effectively upgrade the slums apart from community participation there should be stable policy context for slum up gradation, firm commitment from government to address housing problems and poor infrastructure, defined legal status and promotion of innovative interventions.

For successful infrastructure in Nepal, maintenance cost has to be reduced in addition to innovative technology and attention to gender equity. Local and social knowledge is mandatory preparatory groundwork that must be done during the planning stage. In the context of disaster prone topography of Nepal, it is important that access to insurance, credit and capacity building for sustenance be included from the planning stage. To ensure sustainability of the infrastructure, the implementing agency should ensure community ownership and hand-hold the community about maintenance. It may also be noted the present evidence summary points to the fact that more specific studies related to various civic infrastructure sectors are needed in the contexts like Nepal to objectively determine the areas of concern and possible interventions that could be effective.

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Appendices

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   Prof. Kumar is Assistant Professor at the Department of Civil Engineering, IIT Bombay. He has been actively involved in numerous projects that understand governance of PPPs across various sectors including water and sanitation and has worked extensively on qualitative comparative analysis.

4. **Vinod Ramanarayanan, Indian Institute of Technology, Madras**
   Mr. Ramanarayanan is a development professional with 6 years of experience in various issues such as behavior understanding in public transport, energy consumption and public service delivery. He earned his post-graduation in Environmental Management specializing in sustainable cities from National University of Singapore. Vinod has worked in the Government of India's Smart Cities Mission Program.

5. **Suchismita Goswami, Indian Institute of Technology, Madras**
   Ms. Goswami is a social science professional with experience in research with government, use of technology for development and human rights reform. She earned her first post-graduation in social work from Tata Institute of Social Studies and the second in public policy analysis from Erasmus University Rotterdam.

Internal reviewers

1. **Ashwin Mahalingam, Indian Institute of Technology, Madras**
   Prof. Mahalingam is an Associate Professor at the Dept. of Civil Engineering, IIT Madras. His current research interests include public private partnerships in infrastructure, cross cultural issues in large engineering projects and sustainable development.

2. **Akash Deep, Senior Lecturer in Public Policy, Harvard Kennedy School, Harvard University**
   Dr. Deep earned his Ph.D. in Economics and Finance from Yale University. His current research interests are in public private partnership and private sector participation in urban and

infrastructural development project. He has directly worked with Tamil Nadu Urban Development Fund and Tamil Nadu Infrastructure Development Act

Advisory Board

1. **Ashok Natarajan, Chief Executing Officer, Tamil Nadu Water Investment Company Ltd**
   Mr. Natarajan is the CEO of Tamil Nadu Water Invest Company Ltd (TWIC). Tamil Nadu Water Investment Company Limited is a Joint Venture between Government of Tamil Nadu and Infrastructure Leasing & Financial Limited (IL&FS). Ashok Natarajan has been previously the CEO of UPL Group heading their Water Management Company and earlier as MD of Hydro-Comp an International Water Utility consulting company.

2. **Kalpana Sankar, Chairperson and Managing Trustee, Hand in Hand, India**
   Dr. Sankar is the chairperson and managing trustee of Hand in Hand, India. She has specialized in participatory assessment, gender differentiated impact as well as in monitoring tools and indicators. She has been involved in the women's self-help group movement in Tamil Nadu for the last 18 years. She is a double doctorate in Physical Sciences and in Women's Studies and Self-Help Groups. She was also a Consultant with the Government of South Africa and has supported microfinance and poverty reduction programmes in Afghanistan and Brazil.

3. **S Krishnan, Principal Secretary, Planning, Development and Special Initiatives, Government of Tamil Nadu**
   Mr. Krishnan is an Indian Administrative Services Officer of 1989 batch, & currently serves as the Principal Secretary, Planning, Development and Special Initiatives, Government of Tamil Nadu. He has also served as a Senior Advisor in the Office of the Executive Director for India, International Monetary Fund, Washington DC from 2007-2010. He has also held various administrative positions such as Private Secretary to Finance Minister- GoI, Deputy Director (Senior) - Lal Bahadur Shastri National Academy of Administration, Mussoorie, Secretary to the GOI - Department of Fertilizers, Ministry of Chemicals & Fertilizers., etc.

4. **Narayanan Ramaswamy, Partner, KPMG**
   Mr. Ramaswamy is a partner with KPMG – Management Consulting. He has held leadership position responsibilities in education & skill development, development, financial services sector. Additionally, Narayanan has also held advisory position with Ministry of Human Resources Development, National Aviation University and Indian Institute of Information Technology.

5. **Raj Cherubal, Chief Executive Officer, Chennai Smart City Ltd**
   Mr. Cherubal is the CEO of the Chennai Smart City Ltd. Prior to this assignment with Greater Chennai Corporation, he was the COO of Chennai City Connect and a Coordinator, Janaagraha Centre for Citizenship and Democracy in Chennai. His specialties include traffic and transportation, urban policy and governance, economic freedom, school choice, livelihood, capitalism for poor.

6. **Santha Sheela Nair, Former Secretary, Municipal Administration and Water Supply (MAWS) and MD of Chennai Water Supply & Sewerage Board (CMWSSB)**

   Mrs. Nair is an Indian Administrative Services Officer of 1973 batch, and has had an illustrious career in urban development, public administration, planning portfolios and has also functioned as the Officer on Special Duty (OSD) at the office of Chief Minister, Govt of Tamil Nadu. She has also spear-headed the Tamil Nadu State Planning Commission in India in the capacity of Vice President and has held various administrative positions in the past, such as Secretary-MAWS, Chairperson and Managing Director of CMWSSB, Secretary of the Drinking Water Supply Department in the Union Rural Development Ministry etc.

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Appendix B. List of Databases

The following systematic review databases and websites of funding agencies that support systematic reviews were searched for this study

- Research for Development
- 3ie
- Cochrane Collaboration
- Campbell reviews
- Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre)
- CRD Systematic review databases
- OXFAM

The following journals that publish systematic reviews were also searched

- Journal of Development Effectiveness
- Journal of Development Studies
- Development Policy Review
- World Development
- Utilities Policy
- Environmental evidence

Appendix C. Search Strategy

To ensure the search process is effective, we did not have a generic search strategy for all data sources. We employed multiple search strategy for different database. Below we highlight the salient features of our search strategy for different sources.

Systematic review databases

3ie and EPPI Centre are two important repositories of systematic reviews. In addition to systematic reviews that they support, they syndicate systematic reviews that are published and publicly available in other sources. To ensure that we do not miss out on any potential study because of automated searches, we did a hand search of these two databases, whereby we reviewed all the systematic review titles in International Development and then short listed the potential studies for inclusion. The details are as follows:

- In 3ie, we screened 443 titles, out of which 95 were short listed for abstract and full document screening.
- In EPPI Centre, we screened 208 titles, out of which 22 were shortlisted for abstract and full document screening.

For the remaining systematic review databases, we used key word based searches as follows. Boolean operators were used appropriately (in those databases that support Boolean search) to improve the effectiveness of the search process.

Table C.1 Search results of systematic review databases

No	Databases	Publication/Document Type	Search Phrase	Fields Searched	Sector	Hits
1	Cochrane Collaboration	Systematic Review	Transport	All Text	Public Transportation	657
		Systematic Review	Road	All Text	Roads	299
		Systematic Review	Parks	All Text	Parks and public spaces	558
		Systematic Review	Public Spaces	All Text		13
		Systematic Review	Infrastructure	All Text	Infrastructure	1168
		Systematic Review	Telecom	All Text	Telecom	9
		Systematic Review	Electricity	All Text	Electricity	64
		Systematic Review	Waste	All Text	Waste Management	355
		Systematic Review	Water	All Text	Water Supply	1576
		Systematic Review	Sanitation	All Text	Sanitation	76
2	Campbell reviews	Systematic Review	Transport	All Text	Public Transportation	0
		Systematic Review	Road	All Text	Roads	18
		Systematic Review	Parks	All Text	Parks and public spaces	1
		Systematic Review	Public	All Text		0

No	Databases	Publication/Document Type	Search Phrase	Fields Searched	Sector	Hits
			Spaces			
		Systematic Review	Infrastructure	All Text	Infrastructure	2
		Systematic Review	Telecom	All Text	Telecom	0
		Systematic Review	Electricity	All Text	Electricity	0
		Systematic Review	Waste	All Text	Waste Management	0
		Systematic Review	Water	All Text	Water Supply	1
		Systematic Review	Sanitation	All Text	Sanitation	1
3	CRD Database	Systematic Review	Transport	All Text	Public Transportation	127
		Systematic Review	Road	All Text	Roads	36
		Systematic Review	Parks	All Text	Parks and public spaces	6
		Systematic Review	Public Spaces	All Text		0
		Systematic Review	Infrastructure	All Text	Infrastructure	93
		Systematic Review	Telecom	All Text	Telecom	1
		Systematic Review	Electricity	All Text	Electricity	10
		Systematic Review	Waste	All Text	Waste Management	18
		Systematic Review	Water	All Text	Water Supply	213
		Systematic Review	Sanitation	All Text	Sanitation	11

Websites of funding agencies

A similar strategy to that of systematic review repositories was adopted for websites of funding agencies as well. Websites of agencies that are well known for funding systematic review searches were subjected to hand search, i.e., all the systematic review titles were screened for potential studies for inclusion. For this study, all the systematic reviews featured in the website of Research for Development (R4D) were screened. Out of a total of 107 systematic review titles, 48 were shortlisted for abstract and full document screening.

Journals that publish systematic reviews

Key word search was used to identify systematic reviews published in journals. The results of the search process are given in Table C.2

Table C.2 Results of journal search

S.No	Journal	Search Phrase	Hits
1	Journal of Development Effectiveness	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	17
2	Journal of Development Studies	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	505
3	Development Policy Review	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	266
4	World Development	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	0
5	Utilities Policy	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	1
6	Environmental evidence	(Systematic Review) AND ("Water" OR "Sanitation" OR "Waste" OR "Transport" OR "Electricity" OR "Telecom" OR "Road" OR "Parks" OR "Public Spaces"OR "Infrastructure")	104

Appendix D. List of included SRs in the study

1. Annamalai TR, Rajan S.C, Deep A, Gómez-Ibáñez J.A (2012). Impact of changes in the transparency of infrastructure procurement and delivery on infrastructure access, costs, efficiency, price and quality: a systematic review of the evidence in developing countries. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

2. Annamalai TR, Mahalingam A, Deep A (2013) Impact of private-sector involvement on access and quality of service in electricity, telecom, and water supply sectors: a systematic review of the evidence in developing countries. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

3. Annamalai TR, Devkar G, Mahalingam A, Benjamin S, Rajan SC, Deep A (2016) What is the evidence on top-down and bottom-up approaches in improving access to water, sanitation and electricity services in low-income or informal settlements? London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

4. Arnold B.F and Colford Jr JM., (2007) Treating Water with Chlorine At Point-Of-Use To Improve Water Quality and Reduce Child Diarrhea In Developing Countries: A Systematic Review And Meta-Analysis. *Am J Trop Med Hyg.* 76(2), 2007, pp. 354–364.

5. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, et al. (2014) Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *PLoS Med* 11(5): e1001644. doi:10.1371/journal.pmed.1001644

6. Bensch, G, Sievert, M, Langbein, J, Kneppel, N (2016). Effects and mechanisms of market-based reforms on access to electricity in developing countries: a systematic review. 3ie Systematic Review 31. London: International Initiative for Impact Evaluation (3ie).

7. Birdthistle I, Dickson K, Freeman M, Javidi L (2011). What impact does the provision of separate toilets for girls at schools have on their primary and secondary school enrolment, attendance and completion?: A systematic review of the evidence. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

8. Bouillon CP and Tejerina L (2007). Do We Know What Works? A Systematic Review of Impact Evaluations of Social Programs in Latin America and the Caribbean. Poverty and Inequality Unit, Sustainable Development Department, Inter-American Development Bank (IDB)

9. Clasen TF, Bostoen K,Schmidt WP, Boisson S, Fung ICH, Jenkins MW, Scott B, Sugdens, Cairncross S. (2010). Interventions to improve disposal of human excreta for preventing diarrhoea. Cochrane Database of Systematic Reviews 2010, Issue 6. Art. No.: CD007180. DOI: 10.1002/14651858.CD007180.pub2

10. Clasen TF, Alexander KT, Sinclair D, Boisson S, Peletz R, Chang HH, Majorin F, Cairncross S (2015)Interventions to improve water quality for preventing diarrhoea. *Cochrane Database of Systc Rev.* 20(10).

11. Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, Cavill S, Allen E, Uauy R. (2013) Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. Cochrane Database of Syst Rev 1(8).

12. Fewtrell, L, Colford, J M. Jr. (2004) Water, Sanitation and Hygiene: Interventions and Diarrhoea. HNP discussion paper. World Bank, Washington, DC.

13. Heijnen M, Cumming O, Peletz R, Chan GK-S, Brown J (2014). Shared Sanitation versus Individual Household Latrines: A Systematic Review of Health Outcomes. *PLoS ONE* 9(4): e93300. doi:10.1371/journal.pone.0093300

14. Hepworth, N., Hooper, V., Hellebrandt, D., and Lankford, B (2013). What factors determine the performance of institutional mechanisms for water resources management in developing countries in delivering pro-poor outcomes and supporting sustainable economic growth? CEE review 11-006. Collaboration for Environmental Evidence.

15. Hine J, Abedin M, Stevens RJ, Airey T, Anderson T (2016) Does the extension of the rural road network have a positive impact on poverty reduction and resilience for the rural areas served? If so how, and if not why not? A systematic review. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

16. Huges J, Peters J, Whear R, Cooper C, Evans H, Depledge M and Person M (2013). Are interventions to reduce the impact of arsenic contamination of groundwater on human health in developing countries effective? A systematic review. *Environmental Evidence* 2:11.

17. Hunter, P (2009). Household Water Treatment in Developing Countries: Comparing Different Intervention Types Using Meta-Regression. *Environ Sci Technol*. 43, 8991–8997.

18. Knox. J, Daccache.A and Hess, T; (2013). What is the impact of infrastructural investments in roads, electricity and irrigation on agricultural productivity? CEE .11-007. Collaboration for Environmental Evidence

19. Molina E, Carella L, Pacheco A, Cruces G, Gasparini L (2016) Community monitoring interventions to curb corruption and increase access and quality of service delivery in low- and middle-income countries. *Campbell Systematic Reviews*. 2016:8 DOI: 10.4073/ csr.2016.8

20. Null. C, Hombrados J.G, Meeks, R, Miguel.E, Zwane. A.P (2012) Willingness to Pay for Cleaner Water in Less Developed Countries: Systematic Review of Experimental Evidence. 3ie

21. Petrosino A, Morgan C, Fronius TA, Tanner-Smith EE, Boruch RF (2012). Interventions in Developing Nations for Improving Primary and Secondary School Enrollment of Children: A Systematic Review. *Campbell Systematic Reviews* 19 DOI: 10.4073/csr.2012.19

22. Taylor DL, Kahawita TM, Cairncross S, Ensink JHJ (2015). The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review. *PLoS ONE* 10(8).

23. Turley R, Saith R., Bhan N, Rehfuess E and Carter B (2013). Slum upgrading strategies and their effects on health and socio-economic outcomes: a systematic review, 3ie Systematic Review 13. London: International Initiative for Impact Evaluation (3ie).

24. Waddington, H., Snilstveit, B., White, H. and Fewtrell, L. (2009) Water, sanitation and hygiene interventions to combat childhood diarrhoea in developing countries. New Delhi, India: 3ie.

25. Watson, J., Byrne, R., Morgan Jones, M., Tsang, F (2012) What are the major barriers to increased use of modern energy services among the world's poorest people and are interventions to overcome these effective? CEE Review 11 – 004. Collaboration for Environmental Evidence.

26. Wolf J, Prüss-Ustün A, Cumming O, Bartram J, Bonjour S, Cairncross S, et al.(2014) Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle income settings: systematic review and meta-regression. *Tropical Medicine & International Health*. 19(8): 928–42.

27. Wright, J., Gundry, S. and Conroy, R. (2004). Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use. *Tropical Medicine & International Health.*

Appendix E. Data extraction tool

Data extraction tool for systematic review that is shortlisted after screening based on inclusion and exclusion criteria. This tool captured the most relevant information from the systematic reviews. The summary of the information captured is represented in Appendix G.

Screening	Full Text	
Study ID:	Data Extractor ID:	Date form completed:
Citation:		

Section I: General information

Title of the study:	
Funding source: *Do authors report how the study was funded?*	
Aim/Objective: *What are the broad aims of the study?* *(Please write in authors' description if there is one. Elaborate if necessary, but indicate which aspects are reviewers' interpretations. Other, more specific questions about the research questions and hypotheses are asked later.)*	
Question: *What are the research questions of the study?* *(Please write in authors' description if there is one. Elaborate if necessary, but indicate which aspects are reviewers' interpretations. Other, more specific questions about the research questions and hypotheses are asked later.)*	

Year of publication: When was the study carried out? *(State the year the authors have stated. If not, give a 'not later than' date by looking for a date of first submission to the funding / supporting organization, or for clues like the publication dates of other reports from the study.)*	
Search period: *What was the search period for identification of primary studies?*	
Institutions involved: *What are the institutions involved in conducting the systematic review?*	
Source (databases): *Which were the databases used for identifying primary studies?*	
Number of studies *How many studies were totally included in the systematic review?*	
Scope of future work *Was the gap identified and scope of future work on the topic of study mentioned? If yes, what was it?*	
Causal pathway *What was the causal pathway of the systematic review?*	
Bias and other validity tests *Was there a test for bias from any of the stakeholders towards the research topic studied? Please specify.*	
Conclusions *What were the conclusions drawn from the research in the systematic review?*	

Implications *What are the different implications of the study?*	☐ Policy ☐ Practical ☐ Research ☐ Other, please specify

Section II: Context of systematic review

Regions and Countries: *What are the regions and countries focused in the systematic review?*	Regions: ☐ Asia ☐ Africa ☐ South America ☐ Central and North America ☐ Oceania ☐ Eastern Europe
	Country/regional/local or city specific studies Please specify the location of the study and categorize based on – county, region, *or city/town if mentioned.*
Population / Participants *Which were the lifecycle segments and geo graphical and social segments analyzed in the systematic review?*	Geography and social segments ☐ Rural ☐ Urban ☐ Poor and low income ☐ Caste and ethnic groups ☐ Migrants ☐ Vulnerable by occupation ☐ Other, please specify…….
	Life-cycle segments ☐ Children ☐ Adults ☐ Adolescent girls & boys ☐ Women ☐ Men ☐ Transgender ☐ Senior citizens ☐ disabled people ☐ People living with HIV/AIDS ☐ Other, please specify…….
Sector: Which was the sector analyzed in the systematic review?	☐ Water supply ☐ Sanitation ☐ Parks and public spaces ☐ Public transportation ☐ Waste management ☐ Road ☐ Infrastructure

	☐ Telecom ☐ Electricity

Section III: Interventions

Interventions: What were the interventions studied / analyzed?	☐ Public private partnerships ☐ Physical infrastructure investments ☐ Institutional and regulatory reforms ☐ Urban planning intervention ☐ Developmental and Multilateral Agencies ☐ Other, Please specify ----------
Description of intervention: *What is the description of intervention?* *(Please write in authors' description if there is one.)*	
Level of intervention: *What was the level at which intervention acted?*	☐ Community ☐ Household ☐ Shared Households Other, Please specify ----------
Theoretical Framework *Were theoretical basis / rationale for design and implementation of intervention described? (Yes / No)*	

Section IV: Study design and data analysis

Design: *What is the overall design and method of the study?*	☐ Quantitative ☐ Qualitative ☐ Mixed methods
What is the specific method used to analyze the data?	
Outcomes: *What were the outcomes analyzed?*	☐ Access ☐ Quality
Please write in authors' description, on outcomes if there is one	

Impact: *What were the impact analyzed?*	Immediate Impact ☐ Effort ☐ Time ☐ Other, please specify……. Long Term Impact ☐ Health ☐ Social ☐ Economy ☐ Quality of Life ☐ Other, please specify……..
Results: *What are the results of the study as reported by the author?*	
Limitations: *What are the limitations of the study?*	

Appendix F. Quality Assessment Tool

The quality assessment tool is used as a measurement tool to assess the methodological quality of systematic reviews. This tool was developed based on the AMSTAR methodology (Shea, 2007). Table 4.7 is a representation of the output from Quality Assessment Tool (QAT).

1. Was an 'a priori' design provided?

a. Research Question

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

b. Research methodology

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

c. Statement of inclusion and exclusion criteria

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

2. Was there a duplicate study selection and data extraction

a. At least 2 independent researchers for study selection

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

b. At least 2 independent researchers for data extraction

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

c. Consensus process or one person checks the other's work

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

3. Was a comprehensive search performed?

a. At least 2 electronic databases should be searched

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

b. Use of specific keywords

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

c. Involvement of experts in the specific study area for identification of additional sources

☐ Yes ☐ Not clear

☐ No ☐ Not applicable

4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?

a. The authors should state that they searched for reports regardless of their publication type

☐ Yes

☐ No

☐ Not clear

☐ Not applicable

b. The authors state whether or not they excluded any reports, based on their publication status, language, etc.
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
c. "Non -English papers were translated" or readers sufficiently trained in foreign language
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable

5. Was a list of studies (included or excluded) provided?

a. List of included studies should be provided with table, list and names. Only reference will not suffice
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
b. List of excluded studies should be provided with table, list and names. Only reference will not suffice
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
c. Accessibility of the included and excluded studies should also be provided
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable

6. Were the characteristics of the included studies provided

a. Data on the participants from the original studies in an aggregated form such as a table
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
b. Data on the interventions from the original studies in an aggregated form such as a table.
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
c. Data on the outcomes from the original studies in an aggregated form such as a table
    - ☐ Yes

- ☐ No
- ☐ Not clear
- ☐ Not applicable

7. Was the scientific quality of the included studies assessed and documented?

a. 'A priori' methods of assessment is be provided
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

b. Quality assessment tool is used
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

c. Data or information on quality of included studies is provided in an aggregated form such as table
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

8. Was the scientific quality of the included studies used appropriately in formulating conclusions?

a. The results of the methodological rigor and scientific quality were explicitly stated in the analysis
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

b. The results of the methodological rigor and scientific quality were explicitly stated in the conclusion
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

c. The results of the methodological rigor and scientific quality were explicitly stated in formulating recommendations
   - ☐ Yes
   - ☐ No
   - ☐ Not clear
   - ☐ Not applicable

9. Were the methods used to combine the findings of studies appropriate?

a. Application or use of test for accessing the homogeneity
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
b. If heterogeneity exists, author state a rationale for additional statistical test
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
c. Describe heterogeneity, i.e., if studies cannot pool because of heterogeneity/variability between interventions
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable

10. Was the likelihood of the publication bias assessed?

a. Use of graphical aids and/or statistical tests for assessment of publication bias
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable

11. Was the conflict of interest included?

a. Potential sources of funding for the systematic reviews are clearly acknowledged
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable
b. Potential sources of funding for the included studies are clearly acknowledge
    - ☐ Yes
    - ☐ No
    - ☐ Not clear
    - ☐ Not applicable

Appendix G. Characterization of included SRs

1. Annamalai T R, Rajan S.C, Deep A, Gómez-Ibáñez J.A (2012). Impact of changes in the transparency of infrastructure procurement and delivery on infrastructure access, costs, efficiency, price and quality: a systematic review of the evidence in developing countries. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

I. General Information	
Authors	Thillai Rajan Annamalai, Sudhir Chella Rajan, Akash Deep and José A Gómez-Ibáñez
Year	2012
Title	Impact of changes in the transparency of infrastructure procurement and delivery on infrastructure access, costs, efficiency, price and quality: A systematic review of the evidence in developing countries.
Journal/ Database	EPPI-Centre
Aim	To synthesize the evidence on the impact of changes in the transparency of infrastructure on outcomes in the electricity, telecom, transport and water supply sectors.
Sector:	Electricity, Water Supply, Public Transportation and Telecom

II. Methods	
Search Period	1995 – 2010
No. of primary studies included	90
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia , Africa, South America, Central and North America and Eastern Europe
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Institutional and Regulatory Reforms, Multiple/Reform, Public Private Participation and Micro level intervention

IV. Interventions, Outcome and Impact	
Private sector Participation	• Access: Y • Quality: Y • Outcome: Combined access and quality indicators • Impact: NA
Regulation	• Access: Y • Quality: Y • Outcome: Combined access and quality indicators • Impact: NA
Competition	• Access: N

	• Quality: Y • Outcome: Combined access and quality indicators • Impact: NA
Multiple Reform	• Access: Y • Quality: Y • Outcome: Combined access and quality indicators • Impact: NA
Micro Level	• Access: Y • Quality: Y • Outcome: Combined access and quality indicators • Impact: NA

V. Causal Pathway

The primary focus of this study was to understand the role of infrastructure in the growth of economy and poverty reduction. Following were the parameters used to map the causality of the study.

- **Susceptibility of infrastructure sector to corruption**
- **Different macro, sector based and micro level interventions to study the impact on interventions on outcomes**
- **The importance of governance indicators and institutions also the need to continue the next stage of interventions were mapped in this review**

VI. Policy Implications

The Policy implications were to establish as following

- **Presence of a strong link between infrastructure project outcomes and other governance indicators and institutions**
- **Creation of strong regulatory institutions (such as incentive based regulation rather than rate of return regulation) and enable competition in the marketplace.**
- **An explicit focus on transparency as that played positive role in several of the outcomes**

2. Annamalai T R, Mahalingam A, Deep A (2013) Impact of private-sector involvement on access and quality of service in electricity, telecom, and water supply sectors: a systematic review of the evidence in developing countries. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

I. General Information	
Authors	Thillai Rajan Annamalai, Ashwin Mahalingam and Akash Deep
Year	2013
Title	Impact of private-sector involvement on access and quality of service in electricity, telecom, and water supply sectors: a systematic review of the evidence in developing countries.
Journal/ Database	EPPI-Centre
Aim	The main research objective of this study is to undertake a systematic review of the evidence on the impact of private sector participation on access and quality in select infrastructure sectors – electricity, telecom, and water supply.
Sector:	Electricity, Telecom and Water Supply

II. Methods	
Search Period	In the inclusion post 1995 was chosen as the cutoff date for selecting studies.
No. of primary studies included	67
Research Design	Qualitative and Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia , Africa, South America, Central and North America and Eastern Europe
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Public Private Participation

IV. Interventions, Outcome and Impact	
Appropriate regulation and changes in organisational processes and practices	• Access: N • Quality: Y • Outcome: Continuous Supply • Impact: NA
Targeted investment programmes and different forms of assistance	• Access: Y • Quality: N • Outcome: Continuous Supply • Impact: NA
Effective management of the exclusivity period	• Access: Y • Quality: N • Outcome: Connectivity • Impact: NA

Private-sector led competition	• Access: Y • Quality: N • Outcome: Connectivity • Impact: NA
Optimal design of context specific reforms	• Access: Y • Quality: N • Outcome: Connectivity • Impact: NA
Incentives for network expansion in poor areas	• Access: Y • Quality: N • Outcome: Coverage • Impact: NA
Strong co-operation between the public and private sector	• Access: N • Quality: Y • Outcome: Coverage • Impact: NA
Contractual and policy safeguards	• Access: N • Quality: Y • Outcome: Coverage • Impact: NA

V. Causal Pathway

The causality was categorized into 4 components

- **Reform**
  - **Private sector Participation (primary scope)**
  - **Restructuring, regulation and competition (interdependencies)**
- **Sector**
  - **Electricity, Telecom, Water Supply**
- **Segments**
  - **Delivery of services**
- **Outcomes**
  - **Cost, efficiency, price, access, quality**

VI. Policy Implications

The following were considered as the policy implications from the study

- **Implementation of PSP should not be done in isolation but as a part of a broader reform strategy that includes regulatory reform and introduction of competition.**
- **Higher improvements can be achieved in outcomes if incentives for improvements are built into PSP contracts.**
- **In the absence of financial support from the government, PSP does not lead to improvements in access for rural and poor consumers.**

3. Annamalai TR, Devkar G, Mahalingam A, Benjamin S, Rajan SC, Deep A (2016) What is the evidence on top-down and bottom-up approaches in improving access to water, sanitation and electricity services in low-income or informal settlements? London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

I. General Information	
Authors	Thillai Rajan Annamalai, Ganesh Devkar, Ashwin Mahalingam, Solomon Benjamin, Sudhir Chella Rajan and Akash Deep
Year	2016
Title	What is the evidence on top-down and bottom-up approaches in improving access to water, sanitation and electricity services in low-income or informal settlements?
Journal/ Database	EPPI-Centre
Aim	The review addresses the following question: What is the evidence on what makes an effective urban-planning framework for improved access to water, sanitation and electricity services in low-income or informal settlements?
Sector:	Electricity, Water and Sanitation

II. Methods	
Search Period	1999-2013
No. of primary studies included	104
Research Design	Quantitative and Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America, Central, Oceania, East Europe & North America
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Urban Planning Intervention

IV. Interventions, Outcome and Impact	
Top down	• Access: Y • Quality: N • Outcome: Connectivity, Coverage • Impact: NA
Bottom Up	• Access: Y • Quality: N • Outcome: Connectivity, Coverage, Design and maintenance • Impact: NA

V. Causal Pathway
Synthesis of contextual factors suggests a need for the customisation of solutions to meet local

needs, and better delivery of services by alternative/non-government service providers. Bottom up participatory approaches are effective for opening up to customization of solution to meet local needs.

VI. Policy Implications

This study established the following policy implications

- **Participation of the local community is an important moderator in influencing outcomes.**
- **Project planning should specifically include components that involve the local community in different stages of the project life-cycle and removal of legal hurdles like tenure security for impacting access to basic services.**
- **The setting up of specialised agencies or cells that exclusively deal with the provision of basic services in slums for improving access to services.**

4. Arnold B.F and Colford Jr JM., (2007) Treating Water with Chlorine At Point-Of-Use To Improve Water Quality and Reduce Child Diarrhea In Developing Countries: A Systematic Review And Meta-Analysis. Am. J. Trop. Med. Hyg., 76(2), 2007, pp. 354–364.

I. General Information	
Authors	Benjamin F. Arnold and john M. Colford Jr
Year	2007
Title	Treating water with chlorine at point-of-use to improve water Quality and reduce child diarrhea in developing countries: A systematic review and meta-analysis
Journal/Database	The American Society of Tropical Medicine and Hygiene
Aim	To measure diarrheal health impacts in children and the impact on water quality for point-of-use chlorine drinking water treatment
Sector:	Water supply

II. Methods	
Search Period	1985-2006
No. of primary studies included	22
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia and Africa
Population / Participants	Geographical and social segments: NA
	Lifecycle segments: Children, Adult
Interventions	Physical infrastructure investment

IV. Interventions, Outcome and Impact	
Technology based interventions	• Access: N • Quality: Y • Outcome: E-coli in water reduced due to interventions that managed proper sanitation disposal • Impact: Health and Quality of life

V. Causal Pathway
The impact of intervention on the risk of child diarrhea and the risk of stored water contamination with Escherichia coli.

VI. Policy implications
This study result concentrates on the implication of large health impacts observed during shorter

trials persistent over longer periods.

5. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, et al. (2014) Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. PLoS Med 11(5): e1001644. doi:10.1371/journal.pmed.1001644

I. General Information	
Authors	Robert Bain, Ryan Cronk, Jim Wright, Hong Yang, Tom Slaymaker, Jamie Bartram
Year	2014
Title	Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis
Journal/Database	Plus One
Aim	To measured diarrheal health impacts in children and the impact on water quality of point-of-use chlorine drinking water treatment
Sector:	Water supply

II. Methods	
Search Period	1990-2013
No. of primary studies included	310
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	LMIC
Population / Participants	Geographical and social segments: Rural, Urban
	Lifecycle segments: NA
Interventions	Physical infrastructure investment

IV. Interventions, Outcome and Impact	
Well and rain water harvesting	• Access: N • Quality: Y • Outcome: Fecal contamination in water reduced due to protected wells and rain water harvesting • Impact: NA

V. Causal Pathway
The following were captured while studying the causal pathway • **Safety of water sources** • **Contextual applicability of conditions and interventions to check water safety at sources** • **Combinations of sanitary status with water quality measurements**

VI. Policy implications
The following were established to understand effect on policy

- **Quality and sanitary risks are heterogeneous indicating that it is possible to substantially enhance safety and reduce exposure through incremental improvements in service.**
- **Greater use should be made of sanitary inspections as these provide a complementary means of assessing safety and are able to identify corrective actions to prevent contamination.**
- **Studies of microbial contamination and sanitary risk could be improved by adhering to higher standards**

6. Bensch, G, Sievert, M, Langbein, J, Kneppel, N (2016). Effects and mechanisms of market-based reforms on access to electricity in developing countries: a systematic review. 3ie Systematic Review 31. London: International Initiative for Impact Evaluation (3ie).

I. General Information	
Authors	Gunther Bensch, Maximiliane Sievert, Jörg Langbein and Nadine Kneppel
Year	2016
Title	Effects and mechanisms of market-based reforms on access to electricity in developing countries: A systematic review
Journal/ Database	3ie Systematic Review
Aim	The overall objective of this review is to systematically examine the impacts of market-based reforms on access to electricity in developing countries, compiling evidence from both quantitative and qualitative rigorous impact evaluations.
Sector:	Electricity

II. Methods	
Search Period	1980 - 30 June 2015
No. of primary studies included	60
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa and Oceania
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Institutional and Regulatory Reforms and Public Private Participation

IV. Interventions, Outcome and Impact	
Privatisation	• Access: Y • Quality: Y • Outcome: Increase in Electricity generation capacity, (Net) electricity generation, (Residential) electricity price, Residential electricity access (%) and quality • Impact: NA
Liberalisation	• Access: Y • Quality: N • Outcome: Increase in electricity generation capacity

	and (Net) electricity generation. • Impact: NA
Private sector involvement	• Access: Y • Quality: Y • Outcome: Increase in Electricity generation capacity. No change in (Residential) electricity price and residential electricity access (%) • Impact: NA
Regulation	• Access: Y • Quality: Y • Outcome: No change in Electricity generation capacity, (Net) electricity generation, (Residential) electricity price and Residential electricity access (%) • Impact: NA

V. Causal Pathway

The following were considered when mapping the causality of this study

- **Market based reforms on electricity markets**
- **Electricity access to different groups of populations**
- **Mechanisms to identify and reduce the service delivery differences in varied contexts**
- **The cost-effectiveness of the market-based reform measures**
- **Impact of privatization, liberalization and regulations**

VI. Policy Implications

Electricity sector reforms are not stand alone solutions. They rather have to be understood as complex interventions taking place at the intersection of the technological, economic and political sphere that require strong collaboration between these fields of expertise.

7. Birdthistle I, Dickson K, Freeman M, Javidi L (2011). What impact does the provision of separate toilets for girls at schools have on their primary and secondary school enrolment, attendance and completion?: A systematic review of the evidence. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

I. General Information	
Authors	Isolde Birdthistle, Kelly Dickson, Matthew Freeman, Leila Javidi
Year	2011
Title	What impact does the provision of separate toilets for girls at schools have on their primary and secondary school enrolment, attendance and completion?
Journal	The EPPI-Centre
Aim	The objective of the study was described in two questions • Is there evidence of an impact of providing separate-sex toilets on the enrolment, attendance and/or completion of girls' education in primary or secondary schools? and • Is there evidence of associations between separate toilets and girls' educational outcomes?
Sector:	Sanitation

II. Methods	
Search Period	1978-2009
No. of primary studies included	73
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	LMICs
Population / Participants	Geographic and social segments: NA
	Lifecycle segments: Adolescent girls
Interventions	Physical infrastructure investments, Developmental and multilateral agencies

IV. Interventions, Outcome and Impact	
Separate gender toilets	• Access: Y • Quality: Y • Outcome: Access to gender separate toilets did not provide anything specific to education • Impact: Education
Knowledge management and training programs	• Access: Y • Quality: N • Outcome: The effect of knowledge management and training programs was inconclusive • Impact: Education

V. Causal Pathway

To help verify whether WASH conditions contribute to girls' educational outcomes. The causal pathway was mapped with Girls' health, social and behavioral issues at the center. Also looks at

- **Process evaluation – toilet per pupil ratio**
- **Control for possible confounders – Economic indicators, social and cultural norms, Gender discrimination**

VI. Policy implications

All studies in the SR had shared separate sex toilets thereby precluding drawing of direct implications. However below are some of the learning from existing conditions

- **It would be useful to map government policies or regulations related to ratios of latrines to pupils, and whether and how toilets should be separated for girls and boys. And to assess how well practice reflects policy**
- **It would be useful to document models of best practice in this area, by governmental or non-governmental efforts to improve WASH conditions in schools.**
- **It would be useful to build strong monitoring and evaluation plans into existing programmes to improve WASH conditions in schools (ideally from the design stage).**

8. Bouillon CP and Tejerina L (2007). Do We Know What Works? A Systematic Review of Impact Evaluations of Social Programs in Latin America and the Caribbean. Poverty and Inequality Unit, Sustainable Development Department, Inter-American Development Bank (IDB)

I. General Information	
Authors	César Patricio Bouillon and Luis Tejerina
Year	2007
Title	Do we know what works? A Systematic Review of Impact Evaluations of Social Programs in Latin America and the Caribbean.
Journal/ Database	Inter-American Development Bank Sustainable Development Department Poverty and Inequality Unit
Aim	This study reviews a set of rigorous impact evaluations, placing emphasis on extracting lessons to assess the development effectiveness and cost effectiveness of these interventions
Sector:	Water and Sanitation

II. Methods	
Search Period	1974-2006
No. of primary studies included	88
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	South America (Argentina, Ecuador)
Population / Participants	Geography and social segments - NA
	Life-cycle segments - Children
Interventions	Physical infrastructure investments and Public Private Participation

IV. Interventions, Outcome and Impact	
Expansion of water system	• Access: Y • Quality: N • Outcome: N • Impact: Decrease in Child Mortality
Expansion of sewerage system	• Access: Y • Quality: N • Outcome: N • Impact: Decrease in Child Mortality
Privatization of water services	• Access: Y • Quality: N • Outcome: N • Impact: Decrease in Child Mortality

V. Causal Pathway

The following were the points studied to consider to understand causality

- **The evaluation in the effects of the privatization of water services on child mortality.**
- **The effectiveness of the sewerage expansion in reducing child mortality.**
- **Contextualization based on gender and economic stability.**

VI. Policy implications

• Include community participation and community strengthening as key elements of success at all stages of execution, from the identification of needs and investments to project preparation and monitoring/supervision of execution.

• Include training components and institutional arrangements to ensure that communities and local governments are involved in the management and maintenance of investments, and to ensure sustainability.

• Take into account inter-institutional coordination with line ministries and national agencies (generally, education, health, and public works). The role of social investment funds vis-à-vis that of other government agencies should be clearly defined with respect to responsibilities in critical policy areas for carrying forward the poverty strategy and building infrastructure.

• Focus on decentralization and coordination with local governments, including mechanisms for sharing financial responsibilities with and delegating the project cycle to local governments (preparation, implementation, maintenance, and other steps of the project cycle).

• Place attention on updating and maintaining databases and information systems for monitoring implementation.

9. Clasen TF, Alexander KT, Sinclair D, Boisson S, Peletz R, Chang HH, Majorin F, Cairncross S (2015)Interventions to improve water quality for preventing diarrhoea. Cochrane Database of Systematic Reviews 2015, Issue 10.

I. General Information	
Authors	Clasen TF, Alexander KT, Sinclair D, Boisson S, Peletz R, Chang HH, Majorin F, Cairncross
Year	2015
Title	Interventions to improve water quality for preventing diarrhoea (Review)
Journal	The Cochrane Collaboration
Aim	To assess the effectiveness of interventions to improve water quality for preventing diarrhoea.
Sector:	Water

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa
Population / Participants	Geographical and social segments: Poor and low income
	Lifecycle segments: NA
Interventions	Physical infrastructure investments, urban planning interventions

II. Methods	
Search Period	1982-2014
No. of primary studies included	52
Research Design	Quantitative

IV. Interventions, Outcome and Impact	
Point of use filtration systems	• Access: N • Quality: Y • Outcome: Pathogens impurities in water were removed effectively with point of use filtration systems • Impact: Health
Usage of ceramic filters	• Access: N • Quality: Y • Outcome: Use of ceramic filters to remove pathogens in water was effective • Impact: Health
Bio sand filtering systems	• Access: N • Quality: Y • Outcome: Use of bio sand filters to remove pathogens in water was effective

	• Impact: Health
Life straw filtration systems	• Access: N • Quality: Y • Outcome: No case was reported on the effect of life straw filtrations systems' effect on impurities in water • Impact: Health
Solar water disinfection systems	• Access: N • Quality: Y • Outcome: Microbial water quality reduced after introduction of solar based disinfection systems • Impact: Health
Piped water connections	• Access: Y • Quality: N • Outcome: There was no evidence reported on the effectiveness of introducing piped water connections for access to clean water • Impact: Health
Protected wells and water storage infrastructure	• Access: N • Quality: Y • Outcome: Effectiveness of interventions that improve water quality due to water storage were not reported. • Impact: Health
Chlorination – household level intervention	• Access: N • Quality: Y • Outcome: Chlorination was effective in reducing the impurities in water • Impact: Health
Flocculation and disinfection	• Access: N • Quality: Y • Outcome: Flocculation and disinfection was effective in reducing the impurities in water • Impact: Health

V. Causal Pathway
The effect on interventions on health at household and community levels of poor and low income groups.

VI. Policy implications
Interventions that address the microbial contamination of water at the point of use are important interim measures to improve drinking water quality until homes can be reached with safe, reliable, household piped-water connections.

10. Clasen TF, Bostoen K, Schmidt WP, Boisson S, Fung ICH, Jenkins MW, Scott B, Sugden S, Cairncross S. (2010). Interventions to improve disposal of human excreta for preventing diarrhoea. Cochrane Database of Systematic Reviews 2010, Issue 6. Art. No.: CD007180. DOI: 10.1002/14651858.CD007180.pub2

I. General Information	
Authors	Clasen TF, Bostoen K, Schmidt WP, Boisson S, Fung ICH, Jenkins MW, Scott B, Sugden S, Cairncross S
Year	2012
Title	Interventions to improve disposal of human excreta for preventing diarrhoea (Review)
Journal	The Cochrane Collaboration
Aim	To assess the effectiveness of interventions to improve the disposal of human excreta for preventing diarrhoeal diseases.
Sector:	Sanitation

II. Methods	
Search Period	1957-2005
No. of primary studies included	13
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa
Population / Participants	Geographical and social segments: Rural, urban
	Lifecycle segments: Children, adults
Interventions	Physical infrastructure investments

IV. Interventions, Outcome and Impact	
Construction of latrines, sanitary platforms, biogas reactors, private latrine connected to piped water system, private multi-component system	• Access: N • Quality: Y • Outcome: The interventions that reduced contamination by sanitation was effective. • Impact: Health

V. Causal Pathway

The trials provide some evidence that excreta disposal interventions are effective in preventing diarrhoeal diseases. However, major differences among the studies, including the conditions in which they were conducted and the types of interventions deployed, as well as methodological deficiencies in the studies themselves, makes it impossible to estimate with precision the protective effective of sanitation against diarrhoea.

VI. Policy implications

The target for sanitation is intended to inspire the political will to advance the implementation of basic sanitation. But the pace of implementation could be reduced due to the dearth of reliable

evidence of the health outcomes.

11. Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, Cavill S, Allen E, Uauy R. (2013) Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. Cochrane Database of Systematic Reviews 2013, Issue 8.

I. General Information	
Authors	Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, Cavill S, Allen E, Uauy R
Year	2013
Title	Interventions to improve disposal of human excreta for preventing diarrhoea (Review)
Journal	The Cochrane Collaboration
Aim	To evaluate the effect of interventions to improve water quality and supply (adequate quantity to maintain hygiene practices), provide adequate sanitation and promote handwashing with soap, on the nutritional status of children under the age of 18 years and to identify current research gaps.
Sector:	Water

II. Methods	
Search Period	1981-2011
No. of primary studies included	19
Research Design	Quantitative

IV. Interventions, Outcome and Impact	
Filtration and chemical treatment	• Access: N • Quality: Y • Outcome: Filtration and chemical treatment to pathogens in drinking water was effective. • Impact: Health

V. Causal Pathway	
This review focuses on the water supply quality interventions that act through the direct pathways impacting health outcomes such as diarrhoea, environmental enteropathy and nematode infections	
Population / Participants	Geographical and social segments: Rural, urban
	Lifecycle segments: NA
Interventions	Physical infrastructure investments
VI. Policy implications	
NA	

12. Fewtrell, L., Kaufmann RB., Kay D., Enanoria W, Haller L and Colford JM Jr,.(2005) Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. Lancet Infect Dis 2005; 5: 42–52.

I. General Information	
Authors	Lorna Fewtrell, Rachel B Kaufmann, David Kay, Wayne Enanoria, Laurence Haller, and John M Colford Jr
Year	2005
Title	Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis.
Journal/ Database	The Lancet Infectious Diseases
Aim	To assess the impact of inadequate water and sanitation on diarrhoeal disease through multiple interventions and the evidence for any change arising from the interventions in diarrhoeal disease occurrence in non-outbreak conditions.
Sector:	Water and Sanitation

II. Methods	
Search Period	1970-2003
No. of primary studies included	46
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	LDC
Population / Participants	Geography and social segments - Urban and Rural
	Life-cycle segments - NA
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Latrine installation	• Access: Y

	• Quality: N • Outcome: NA • Impact: Health
Household connection	• Access: Y • Quality: N • Outcome: NA • Impact: Health
Standpipe connection	• Access: Y • Quality: N • Outcome: NA • Impact: Health
Treatment at water source	• Access: N • Quality: Y • Outcome: NA • Impact: Health
Treatment at water source	• Access: N • Quality: Y • Outcome: NA • Impact: Health
Treatment at water source	• Access: N • Quality: Y • Outcome: NA • Impact: Health
Multiple hygiene, water and sanitation intervention	• Access: N • Quality: Y • Outcome: NA • Impact: Health

V. Causal Pathway
The review suggests that water, sanitation, and hygiene interventions, as well as their combination, are effective at reducing diarrheal illness, and water quality interventions (point-of-use water treatment) were more effective than has been previously acknowledged

VI. Policy Implications
• **The need for careful selection of water, sanitation, and hygiene interventions should receive particular attention.** • **The sustainability of interventions is a crucial factor.**

13. Heijnen M, Cumming O, Peletz R, Chan GK-S, Brown J (2014). Shared Sanitation versus Individual Household Latrines: A Systematic Review of Health Outcomes. PLoS ONE 9(4): e93300. doi:10.1371/journal.pone.0093300

I. General Information	
Authors	Marieke Heijnen, Oliver Cumming, Rachel Peletz, Gabrielle Ka-Seen Chan, Joe Brown, Kelly Baker, Thomas Clasen
Year	2014
Title	Shared Sanitation versus Individual Household Latrines: A Systematic Review of Health Outcome
Journal	PLOS ONE
Aim	To examine the evidence comparing the impact of shared sanitation versus individual household latrines (IHLs) on health outcomes.
Sector:	Sanitation

II. Methods	
Search Period	1983-2013
No. of primary studies included	22
Research Design	Quantitative, Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa and Central and North America
Population / Participants	Geographical and social segments: Rural, Urban, Migrants
	Lifecycle segments: Children, Adults
Interventions	Urban Planning interventions

IV. Interventions, Outcome and Impact	
Sanitation and hygiene interventions	• Access: N • Quality: Y • Outcome: interventions to regularize Improper disposal of sanitation did not have an effect on impurities in water • Impact: Health

V. Causal Pathway

The following parameters were used to map the causality

- **Slum upgrading and reduction of diarrhoea in slum dwellers and their water-related expenses.**
- **Slum upgrading related parasitic infections, general measures of communicable diseases, financial poverty and unemployment outcomes.**
- **Reasons to map what kind of facilities are used as intended and which may have reduced the benefits.**

VI. Policy implications

Evidence to date does not support a change of existing policy of excluding shared sanitation from the definition of improved sanitation used in international monitoring and targets. However, such evidence is limited, does not adequately address likely confounding, and does not identify potentially important distinctions among types of shared facilities. As reliance on shared sanitation is increasing, further research is necessary to determine the circumstances, if any, under which shared sanitation can offer a safe, appropriate and acceptable alternative to individual household latrines.

14. Hepworth, N., Hooper, V., Hellebrandt, D., and Lankford, B. 2013. What factors determine the performance of institutional mechanisms for water resources management in developing countries in delivering pro-poor outcomes and supporting sustainable economic growth? CEE review 11-006.

I. General Information	
Authors	HEPWORTH, N., HOOPER, V., HELLEBRANDT, D.,& LANKFORD, B.
Year	2013
Title	What Factors Determine The Performance Of Institutional Mechanisms For Water Resources Management In Developing Countries In Terms Of Delivering Pro-Poor Outcomes, And Supporting Sustainable Economic Growth?
Journal/Database	Collaboration for Environmental Evidence
Aim	Its aims for an empirical & qualitative analysis of water resource management (WRM), in light of undermining, sustainable and pro-poor growth
Sector:	Water supply

II. Methods	
Search Period	1995-2011
No. of primary studies included	38
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	India, China, Tanzania and Chile.
Population/ Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Urban Planning Intervention

IV. Interventions, Outcome and Impact	
Water resources management	• Access: N • Quality: Y • Outcome: 40% had inconclusive result in water conservation, 16% positive, 24% negative and 8% no change was recorded • Impact: N

V. Causal Pathway
The causality of the study depends on • **Institutional mechanisms for water resources** • **Delivery of water resources management to poor economies** • **Description of the nature of coverage in the topic area**

- **Information and influence future research priorities, design and reporting**

VI. Policy implications

- **Unquestioning and simplistic promotion of any of the range of institutional approaches to Water resource management should be avoided.**
- **Efforts towards optimal institutional mechanism design, support and operation should be based on situated analysis on a case-by-case basis which takes into account the full range of factors identified in the map.**
- **Efforts to design, implement and support Water Resource Management should pay greater attention in building monitoring and outcome evaluation into interventions.**

15. Hine J, Abedin M, Stevens RJ, Airey T, Anderson T (2016) Does the extension of the rural road network have a positive impact on poverty reduction and resilience for the rural areas served? If so how, and if not why not? A systematic review. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

I. General Information	
Authors	John Hine, Masam Abedin, Richard Stevens, Tony Airey and Tamala Anderson
Year	2016
Title	Does the extension of the rural road network have a positive impact on poverty reduction and resilience for the rural areas served? If so how, and if not why not? A systematic review.
Journal/Database	EPPI-Centre
Aim	The objectives of this review include the systematic collection of evidence from existing reviews and rural road impact studies in low- and middle-income countries.
Sector:	Road

II. Methods	
Search Period	1990 - 2014
No. of primary studies included	56
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America and Eastern Europe
Population / Participants	Geography and social segments - Rural
	Life-cycle segments - NA
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Extension of road network	• Access: Y • Quality: N • Outcome: N • Impact: increase in traffic volumes, non-agricultural employment, education, income and consumption, agricultural output, values, inputs, cost and prices. Decrease in Change in transport costs. Inconclusive impact on accessibility of health outcomes and marketing.

V. Causal Pathway
The following were mapped as the parameters for causality • **The connections between road investment and impact**

- **To develop a credible pathway there is a need to be able to connect variations in road engineering design with variations in impact**
- **Road engineering inputs and outputs, and its connection to the road engineering design process**

VI. Policy Implications

The link between road interventions and transport costs has been established by this review. Road investment is shown to have a direct effect in reducing transport fares and tariffs. However, this is insufficient in itself to provide a strong mechanism of change that can be used for transport planning. Classic economic theory predicts the effect of reduction in transport costs to be an increase in supply, and this has been evidenced by at least five studies in this review. With regard to the longer-term impact on poverty change, the review has found very strong positive impacts on employment, income and consumption, and quite strong positive impacts on health care take-up (but with some negative impacts on disease incidence) and agricultural activity. Mixed conclusions can be reached with respect to marketing.

16. Huges J, Peters J, Whear R, Cooper C, Evans H, Depledge M and Person M (2013). Are interventions to reduce the impact of arsenic contamination of groundwater on human health in developing countries effective? A systematic review. Environmental Evidence 2013 2:11.

I. General Information	
Authors	Tracey Jones-Hughes, Jaime Peters, Rebecca Whear, Chris Cooper, Hywel Evans, Michael Depledge and Mark Pearson
Year	2013
Title	Are interventions to reduce the impact of arsenic contamination of groundwater on human health in developing countries effective? A systematic review
Journal/Database	Environmental Evidence
Aim	The aim of this review was to determine the effectiveness of field-based technologies for the removal of arsenic from groundwater in developing countries
Sector:	Water supply

II. Methods	
Search Period	1980 to August 2011
No. of primary studies included	51
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia
Population/ Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Oxidation and filtration interventions	• Access: N • Quality: Y • Outcome: Not effective in decreasing arsenic concentrations in treated water samples • Impact: N
Coagulation, Co-precipitation and filtration	• Access: N • Quality: Y • Outcome: Not effective in decreasing arsenic concentrations in treated water samples • Impact: N
Arsenic removal in situ, membrane and electrolytic technologies	• Access: N • Quality: Y • Outcome: Not effective in decreasing arsenic concentrations in treated water samples

	• Impact: N
Adsorption and zero valent technologies	• Access: N • Quality: Y • Outcome: Effective in decreasing arsenic concentrations in treated water samples • Impact: N

V. Causal Pathway

The success of each technology is mapped based on its dependency on context, especially their acceptability to users, perception of the arsenic problem by the users, cost, flow rate and maintenance. The sense of ownership and expectations of women's roles in society also played an important role.

VI. Policy implications

- **Acceptability to users: Technologies that are time consuming to draw sufficient water from for a family's needs or require frequent maintenance were unlikely to be used.**
- **Sense of ownership: Participation can be determined by the extent of education, training and through sharing of information at regular interval**
- **Perception: Participation and inclusion of the participants about the problem can lead to behavior change**
- **Women's role in society: Technology changes and its acceptance as influenced to change women's behavior in the society.**

17. Hunter, P (2009). Household Water Treatment in Developing Countries: Comparing Different Intervention Types Using Meta-Regression. Environ. Sci. Technol. 2009 43, 8991–8997.

I. General Information	
Authors	Paul Hunter
Year	2009
Title	Household Water Treatment in Developing Countries: Comparing Different Intervention Types Using Meta-Regression
Journal/ Database	Environmental Science & Technology
Aim	This study aims to quantify the benefit of Household water treatment over and above the potential impact of recall bias on published effectiveness. Furthermore, the opportunity has been taken, where possible, to investigate some of the potential causes of heterogeneity in the results to better inform policy regarding Household water treatment interventions.
Sector:	Water Supply

II. Methods	
Search Period	All the studies included in the analysis by Schmidt and Cairncross have been included. In addition the recent literature for 2007, 2008, and 2009 has been searched for further studies to add to the database.
No. of primary studies included	28
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	NA
Population / Participants	Geography and social segments - NA
	Life-cycle segments - Children
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Biosand Filter	• Access: N • Quality: Y • Outcome: Microbiological contamination between source and point-of-use • Impact: NA
Ceramic Filter	• Access: N • Quality: Y • Outcome: Microbiological contamination between source and point-of-use • Impact: NA
Combined Coagulant-Chlorine Disinfection Systems	• Access: N • Quality: Y • Outcome: Microbiological contamination between

	source and point-of-use • Impact: NA
Chlorination and safe water storage	• Access: N • Quality: Y • Outcome: Microbiological contamination between source and point-of-use • Impact: NA
Solar water Disinfection (SODIS)	• Access: N • Quality: Y • Outcome: Microbiological contamination between source and point-of-use • Impact: NA

V. Causal Pathway

Therefore, this systematic review principally focussed on the following four main areas:

- **Road infrastructure (incorporating road networks and transport vehicles) and its impact on farmer access to agricultural markets. In this context, the whole road network is critical – feeder road projects are often linked into poorly maintained and degraded secondary/primary roads and their agricultural impact can diminish as a result**
- **Rural electricity supplies (consumption and expenditure) and its impact on agricultural productivity (irrigation, storage, cooling/refrigeration), product price, labour wages and rural GDP**
- **Telecommunications (telephones and internet) and its impact on crop prices, response to market demands, feed and fertilizer supply and costs**
- **Irrigation infrastructure (incorporating water storage capacity per unit area, access to water and expansion of irrigated areas) and its impact on crop diversity, crop productivity (yield), crop prices, labour costs, rural consumption and returns of irrigation investment to the rural community and poverty reduction.**

VI. Policy implications

Road infrastructure: Most evidence (37% of observations) related to this investment, and the majority of reported impacts on agricultural productivity were positive, particularly in relation to GDP gains and poverty reduction.

Electricity infrastructure: Limited evidence (16% of observations) on the impacts of electricity investment on agricultural productivity; but again more positive, especially for poverty reduction.

Telecommunication infrastructure: Very limited evidence (6% of observations) on the impacts of telecommunication, but the majority positive. The impacts for this area are most likely to be mixed in with other forms of infrastructural investment.

Irrigation infrastructure: A third of all evidence related to irrigation development, with the majority of impacts on agricultural productivity being positive, especially in relation to income and poverty reduction.

18. Knox. J, Daccache.A and Hess, T; (2013). What is the impact of infrastructural investments in roads, electricity and irrigation on agricultural productivity? CEE .11-007. Collaboration for Environmental Evidence

I. General Information	
Authors	Jerry Knox, Andre Daccache and Tim Hess
Year	2011
Title	What is the impact of infrastructural investments in roads, electricity and irrigation on agricultural productivity?
Journal/Database	The International Initiative for Impact Evaluation
Aim	What is the impact of infrastructural investments in roads, electricity and irrigation on agricultural productivity?"
Sector:	Electricity, Road, Electricity and Telecom

II. Methods	
Search Period	1960-2003
No. of primary studies included	155
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, Eastern Europe and South America
Population / Participants	Rural
Interventions	Physical infrastructure investment and Institutional and regulatory investments

IV. Interventions, Outcome and Impact	
Electricity infrastructure	• Access: Y • Quality: N • Outcome: Effect on electricity consumption per capita and households with electricity (rural) inconclusive • Impact: Economy, Quality of life
Road infrastructure	• Access: Y • Quality: N • Outcome: Average distance travelled and transportation cost reduced • Impact: Quality of life, Economy
Telecom infrastructure	• Access: Y • Quality: N • Outcome: Number of telephone connections and tele density increased

	• Impact: Economy
Water service related infrastructure	• Access: N • Quality: Y • Outcome: General impurities in water reduced • Impact: Economy

V. Causal Pathway

The systematic review principally focused on four main areas (i) road infrastructure (incorporating road networks and transport vehicles) and its impact on farmer access to agricultural markets; (ii) rural electricity supplies (consumption and expenditure) and its impact on agricultural productivity (irrigation, storage, cooling/refrigeration), product price, labour wages and rural GDP; (iii) telecommunications (telephones and internet) and its impact on crop prices, response to market demands, feed and fertilizer supply and costs, and (iv) irrigation infrastructure (incorporating water storage capacity per unit area, access to water and expansion of irrigated areas) and its impact on crop diversity, crop productivity (yield), crop prices, labour costs, rural consumption and returns of irrigation investment to the rural community and poverty reduction.

VI. Policy implications

Road infrastructure: Most evidence (37% of observations) related to this investment, and the majority of reported impacts on agricultural productivity were positive, particularly in relation to GDP gains and poverty reduction.

Electricity infrastructure: Limited evidence (16% of observations) on the impacts of electricity investment on agricultural productivity; but again more positive, especially for poverty reduction.

Telecommunication infrastructure: Very limited evidence (6% of observations) on the impacts of telecommunication, but the majority positive. The impacts for this area are most likely to be mixed in with other forms of infrastructural investment.

Irrigation infrastructure: A third of all evidence related to irrigation development, with the majority of impacts on agricultural productivity being positive, especially in relation to income and poverty reduction.

19. Molina E, Carella L, Pacheco A, Cruces G, Gasparini L (2016) Community monitoring interventions to curb corruption and increase access and quality of service delivery in low- and middle-income countries. Campbell Systematic Reviews. 2016:8 DOI: 10.4073/ csr.2016.8

I. General Information	
Authors	Ezequiel Molina, Laura Carella, Ana Pacheco, Guillermo Cruces, Leonardo Gasparini
Year	2016
Title	Community monitoring interventions to curb corruption and increase access and quality of service delivery in low- and middle-income countries: a systematic review
Journal/Database	Campbell Collaboration
Aim	This systematic review assesses the effectiveness of community monitoring interventions in reducing corruption
Sector:	Infrastructure

II. Methods	
Search Period	2009 - Until November 2013.
No. of primary studies included	15
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa and South America
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Community and Non-Governmental Organisation based intervention

IV. Interventions, Outcome and Impact	
Community monitoring	• Access: Y • Quality: Y • Outcome: N • Impact: Decrease in corruption measure. No impact in immunization, weight for age, child mortality, enrolment and dropout rate

V. Causal Pathway
Parameters that were understood to map causality • **Effectiveness of Community monitoring interventions (CMI) when they citizens and providers or politicians.** • **Effectiveness of improving outcomes when they promote direct contact between** • **CMIs are also effective when they include tools for citizens to monitor the performance of providers and politicians.** • **Effectiveness of the interventions to understand the participation of communities in**

responsiveness and monitoring activities

VI. Policy implications

- **Considering the potential bottlenecks that may arise given the local context it is important to design complementary policies to enhance the effect of community monitoring interventions.**
- **Policy design should focus on either improving the accountability of institutions to motivate citizens to participate or focus on the interventions on policy options that do not require involvement of state institutions, such as remedial education programmes run by local citizens.**
- **To provide accessible information for citizens on how to monitor providers.**

20. Null. C, Hombrados J.G, Meeks, R, Miguel.E, Zwane. A.P (2012) Willingness to Pay for Cleaner Water in Less Developed Countries: Systematic Review of Experimental Evidence. 3ie

I. General Information	
Authors	Clair Null, Jorge Garcia Hombrados, Michael Kremer, Robyn Meeks, Edward Miguel and Alix Peterson Zwane
Year	2012
Title	Willingness to Pay for Cleaner Water in Less Developed Countries: Systematic Review of Experimental Evidence
Journal/ Database	3ie
Aim	Establish experimental evidence on willingness to pay for cleaner water in less developed countries
Sector:	Water Supply

II. Methods	
Search Period	1997-2011
No. of primary studies included	24
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	Africa and South America
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Chlorine	• Access: Y • Quality: N • Outcome: Affordability for clean water • Impact: NA
Flocculant disinfectant	• Access: Y • Quality: N • Outcome: Affordability for clean water • Impact: NA
Ceramic Filter	• Access: Y • Quality: N • Outcome: Affordability for clean water • Impact: NA
Protected springs	• Access: Y • Quality: N • Outcome: Affordability for clean water • Impact: NA

V. Causal Pathway

Response of households to contamination. Economic feasibility of the measures taken to improve water quality. Willingness to pay for cleaner water and the factors that it depends on.

VI. Policy Implications

Given the evidence of low valuation for water quality, despite the impact of water-borne disease on child health, the challenge for research and policy is to identify innovative service delivery models and technological innovations that drive prices down and make public subsidies more feasible

21. Petrosino A, Morgan C, Fronius TA, Tanner-Smith EE, Boruch RF (2012). Interventions in Developing Nations for Improving Primary and Secondary School Enrollment of Children: A Systematic Review. Campbell Systematic Reviews 2012:19 DOI: 10.4073/csr.2012.19

I. General Information	
Authors	Anthony Petrosino, Claire Morgan, Trevor A. Fronius, Emily E. Tanner-Smith, Robert F. Boruch
Year	2012
Title	Interventions in Developing Nations for Improving Primary and Secondary School Enrollment of Children: A Systematic Review
Journal	The Campbell Collaboration
Aim	Main Question: What are the effects of interventions implemented in developing countries on measures of students' enrollment, attendance, graduation, and progression? Supplemental Question: Within those studies that report the effects of an intervention on measures of students' enrollment, attendance, graduation or progression, what are the ancillary effects on learning outcomes as measured by students' test scores, grades, and other achievement measures?
Sector:	Road

II. Methods	
Search Period	1995-2009
No. of primary studies included	73
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, Eastern Europe, Oceania
Population / Participants	Geographical and social segments: Rural, urban
	Lifecycle segments: Children, Adults
Interventions	Urban Planning interventions

IV. Interventions, Outcome and Impact	
Road related infrastructure upgradation	• Access: Y • Quality: N • Outcome: The effect of road improvement for better access to schools was inconclusive • Impact: Education

V. Causal Pathway
Interventions and the connection pathway to addressing the underlying barrier to influencing

school enrollment, attendance, dropout, or progression outcomes.

VI. Policy implications

Policy implications from the point of

- **Effect of the interventions on other individual outcomes such as morbidity and mortality, as well as larger community level outcomes.**
- **Specific focus on social and life cycle segments such as gender and socio economic status can greatly vary within a specific country.**

22. Taylor DL, Kahawita TM, Cairncross S, Ensink JHJ (2015). The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review. PLoS ONE 10(8).

I. General Information	
Authors	Dawn L. Taylor, Tanya M. Kahawita, Sandy Cairncross, Jeroen H. J. Ensink
Year	2015
Title	The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review
Journal/Database	International Initiative for Impact Evaluation
Aim	This paper presents a systematic literature review investigating the function, use and impact of WASH interventions implemented to control cholera.
Sector:	Water supply

II. Methods	
Search Period	1974-2013
No. of primary studies included	18
Research Design	Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America and Central and North America
Population / Participants	Geographical and social segments: Rural, Urban
	Lifecycle segments: Children, Adult
Interventions	Urban Planning interventions and Public Private Partnership

IV. Interventions, Outcome and Impact	
Precautionary based intervention Storage vessel disinfection	• Access: N • Quality: Y • Outcome: The free coliforms count reduced in water due to the precautionary based intervention • Impact: Health
Solar Disinfection	• Access: N • Quality: Y • Outcome: Free residual in drinking water chlorine had mixed results after solar disinfection • Impact: Health
Filtration	• Access: N • Quality: Y • Outcome: Free residual chlorine in water reduced after introduction of filtration • Impact: Health

V. Causal Pathway

To identify and assess the evidence for the effectiveness of WASH interventions to control cholera, and provide recommendations to implementers during cholera outbreaks, while a secondary objective was to highlight the gaps in knowledge and identify areas for further research.

VI. Policy implications

Seeking pre-emptive funding commitments and ethics approval to avoid delays in the collection of baseline data which will be critical to sound evaluation. Participation of international agencies and institutions to integrate research protocols into their response strategy, and make the necessary funding and resources available. The results of this much needed operational research will be invaluable to informing international WASH policy, standards and practice with the ultimate aim being, to contribute to reducing the global burden of cholera.

23. Turley R, Saith R., Bhan N, Rehfuess E and Carter B (2013). Slum upgrading strategies and their effects on health and socio-economic outcomes: a systematic review, 3ie Systematic Review 13. London: International Initiative for Impact Evaluation (3ie).

I. General Information	
Authors	Ruth Turley, Ruhi Saith, Nandita Bhan, Eva Rehfuess Ludwig, Ben Carter
Year	2013
Title	Slum upgrading strategies and their effects on health and socio-economic outcomes
Journal/Database	International Initiative for Impact Evaluation
Aim	To examine the evidence comparing the impact of shared sanitation versus individual household latrines (IHLs) on health outcomes.
Sector:	Road, Water Supply and Combined Infrastructure sector

II. Methods	
Search Period	1981-2012
No. of primary studies included	21
Research Design	Quantitative, Qualitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America and Central and North America
Population / Participants	Geographical and social segments: Urban poor
	Lifecycle segments: NA
Interventions	Urban Planning interventions and Public Private Partnership

IV. Interventions, Outcome and Impact	
Private water connection	• Access: Y • Quality: N • Outcome: Private water connections improved household level access to water • Impact: Health
Road paving	• Access: Y • Quality: N • Outcome: road paving had an positive effect on area based walk and path connectivity • Impact: Quality of life, education
Slum upgradation	• Access: Y • Quality: N • Outcome: Basic access to civic infrastructure and affordability to water increased after slum upgradation • Impact: Quality of life, health and economy

V. Causal Pathway

The study mapped the following

- **Incidence of diarrhoea is reduced following slum upgrading**
- **Slum upgrading improved occurrence of parasitic infections, or broader indicators of communicable diseases**
- **The impact of slum upgrading on other health outcomes (including non-communicable and injuries) or quality of life outcomes.**
- **The slum upgrading on measures of financial poverty and employment outcomes.**
- **The impact of upgrading on education, social capital, crime and violence.**

VI. Policy implications

The availability and use of reliable, comparable outcome measures to determine the effect of slum upgrading on health, quality of life and socio-economic wellbeing would make a useful contribution to useful policy in this area.

24. Waddington, H., Snilstveit, B., White, H. and Fewtrell, L. (2009) Water, sanitation and hygiene interventions to combat childhood diarrhoea in developing countries. New Delhi, India: 3ie.

I. General Information	
Authors	Hugh Waddington, Birte Snilstveit, Howard White, Lorna Fewtrell
Year	2009
Title	Water, sanitation and hygiene interventions. To combat childhood diarrhoea in developing Countries
Journal/Database	The International Initiative for Impact Evaluation
Aim	The effectiveness of interventions in water, sanitation and hygiene (WSH) in promoting better health outcomes in developing countries as measured by the incidence of diarrhoea among children.
Sector:	Water supply, Sanitation

II. Methods	
Search Period	1991-2009
No. of primary studies included	144
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa and South America
Population / Participants	Geographical segments: NA
	Lifecycle segments: NA
Interventions	Physical infrastructure investment and institutional regulatory reforms

IV. Interventions, Outcome and Impact	
Hygiene and sanitation impact evaluation reforms	• Access: Y • Quality: Y • Outcome: Sanitation and hygiene interventions were effective to improve access and quality of sanitation infrastructure • Impact: Health
Provision of sewer connections	• Access: Y • Quality: Y • Outcome: Provision to sewer connection and storage devices improved the provision quality and access to sanitation infrastructure • Impact: Health

V. Causal Pathway

The causal pathway in this study is defined in 4 stages

1. **Intervention provided**
2. **Intervention functionality (hardware) or Knowledge transfer (software)**
3. **Behavior change: implementation of knowledge**
4. **Health outcomes**

VI. Policy implications

Theory based impact evaluation analysis helps to understand why an intervention has, or has not, been effective among immediate beneficiaries, by examining behavioural mechanisms and contextual factors influencing outcomes, thus providing crucial information for evidence based policy making and the design of interventions that effectively reduce diarrhoeal disease.

25. Watson, J., Byrne, R., Morgan Jones, M., Tsang, F (2012) What are the major barriers to increased use of modern energy services among the world's poorest people and are interventions to overcome these effective? CEE Review 11 – 004. Collaboration for Environmental Evidence.

I. General Information	
Authors	Watson J, Byrne R, Morgan Jones M, Tsang F, Opazo J, Fry C and Castle Clarke S
Year	2011
Title	What are the major barriers to increased use of modern energy services among the world's poorest people and are interventions to overcome these effective?
Journal/Database	The International Initiative for Impact Evaluation
Aim	To understand the interactions, and increase the chances that the poor can gain access to modern energy services, analyses of barriers and implementation of interventions should be more systemic.
Sector:	Electricity

II. Methods	
Search Period	2005-2011
No. of primary studies included	41
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa and South America
Population / Participants	Geographical and social segments: NA
	Lifecycle segments: NA
Interventions	Physical infrastructure investment and Institutional regulatory reforms

IV. Interventions, Outcome and Impact	
Financial Assistance for installing and operational maintenance of renewable energy technology - Solar	• Access: Y • Quality: N • Outcome: Operation and maintenance cost rural electrification were reduced by Government subsidies • Impact: Economy and Quality of life
Off-grid electrification technologies and micro grid infrastructure setup	• Access: Y • Quality: N • Outcome: Process of establishing a grid connection, off-grid and micro grid based connectivity improved • Impact: Quality of life
Cost reflective tariffs, link to productive users	• Access: Y • Quality: N • Outcome: Financial support for cost recovery,

	provision of capital subsidies increased willingness to pay • Impact: Economy

V. Causal Pathway
Evidence on economic and technical barriers to energy access under the following parameters high upfront costs of energy conversion technologies, grid-connection charges, cost-recovery difficulties, poor performance of equipment, and technical capacities for operation and maintenance.

VI. Policy implications
The evidence relates to High upfront costs of energy conversion technologies and rid connection charges, cost recovery difficulties, poor performance of equipment and technical capabilities of operation and maintenance. Policies will be designed as proof of concept to facilitate the mentioned parameters.

26. Wolf J, Prüss-Ustün A, Cumming O, Bartram J, Bonjour S, Cairncross S, et al.(2014) Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle income settings: systematic review and meta-regression. Tropical Medicine & International Health; 19(8): 928–42.

I. General Information	
Authors	Jennyfer Wolf, Annette Pruss-Ustun, Oliver Cumming, Jamie Bartram, Sophie Bonjour, Sandy Cairncross, Thomas Clasen, John M. Colford Jr, Valerie Curtis, Jennifer De France, Lorna Fewtrell, Matthew C. Freeman, Bruce Gordon, Paul R. Hunter, Aurelie Jeandron, Richard B. Johnston, Daniel Mausezahl, Colin Mathers, Maria Neira and Julian P. T. Higgins
Year	2014
Title	Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle income settings: systematic review and meta-regression.
Journal/ Database	Tropical Medicine & International Health
Aim	The objective of this study was to estimate the effect of different water and sanitation interventions on diarrhoeal disease morbidity, based on pooled estimates from existing studies
Sector:	Water and Sanitation

II. Methods	
Search Period	1970- 2013
No. of primary studies included	72
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America and Central America
Population / Participants	Geography and social segments - NA
	Life-cycle segments - Children
Interventions	Physical infrastructure investments

IV. Interventions, Outcome and Impact	
Provision of improved community water supply from unimproved source	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea
Provision of basic piped water from unimproved source	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of Basic piped water from improved community source	• Access: N • Quality: Y • Outcome: N

	• Impact: No decrease in diarrhea
Provision of higher quality piped water from unimproved source	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of higher quality piped water from Improved community water source.	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of higher quality piped water source from basic piped water source.	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of chlorine/solar technology and safe storage from unimproved source	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea
Provision of chlorine/solar technology and safe storage from improved community source.	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea
Provision of chlorine/solar technology and safe storage from basic piped water.	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea
Provision of water source with Filter and safe storage from unimproved source	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of water source with Filter and safe storage from improved community source	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of water source with Filter and safe storage from basic piped water	• Access: N • Quality: Y • Outcome: N • Impact: Decrease in Diarrhea
Provision of Improved Sanitation with no sewer from Unimproved sanitation	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea

Provision of Sewer Connection from Unimproved sanitation	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea
Provision of Sewer connection from Improved sanitation with no sewer connection	• Access: N • Quality: Y • Outcome: N • Impact: No decrease in diarrhea

V. Causal Pathway

Diarrhea risk can be reduced by improving household water storage. Combining the water intervention with hygiene education and/or improved sanitation than through the water intervention alone will give better results.

VI. Policy implications

For water, the most effective household-level intervention was found to be a point-of-use filter in combination with safe water storage. At the community level, introduction of high-quality piped water (i.e. water supplied continuously to the household of good microbial water quality) was found to be most effective. There were also differences in the impact of sanitation interventions, and there is evidence that sewer interventions are associated with a greater reduction in diarrhea than basic household sanitation.

27. Wright, J., Gundry, S. and Conroy, R. (2004). Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use. Tropical Medicine & International Health.

I. General Information	
Authors	Jim Wright, Stephen Gundry and Ronan Conroy
Year	2004
Title	Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use
Journal/ Database	Tropical Medicine & International Health.
Aim	To assess the extent and causes of microbiological contamination of household drinking water between source and point-of-use in developing countries
Sector:	Water Supply

II. Methods	
Search Period	Papers published before 2003
No. of primary studies included	57
Research Design	Quantitative

III. Context of Systematic Review	
Regions and Countries:	Asia, Africa, South America and Oceania
Population / Participants	Geography and social segments - NA
	Life-cycle segments - NA
Interventions	Physical Infrastructure Investments

IV. Interventions, Outcome and Impact	
Infrastructure to prevent water contamination	• Access: N • Quality: Y • Outcome: Impurities in water • Impact: NA

V. Causal Pathway

The following parameters map he causal pathway of the study

- **The bacteriological quality of drinking water**
- **The extent of contamination after water collection**
- **Fecal and total coliform counts in source water**
- **Microbiological contamination of water between source and point-of-use**
- **Increased fecal and total coliform counts in stored domestic water**

VI. Policy Implications

The results imply that samples taken from storage vessels may provide a better reflection of the quality of water consumed than source samples, particularly in urban areas with safe water sources. Though direct policy implications are not mentioned, policy can be designed with this result.

Appendix H. Outcomes

Study	Sector	Outcome Indicators	
		Access	Quality
Annamalai et al. (2012)	Electricity	Combined access such as electricity generation per capita	Quality of Service
	Telecom	Combined access such as telecommunication connection	Quality of service
	Water Supply	Combined access such as water connection	Quality of service
	Public Transportation	Combined access	Quality of service
Annamalai et al. (2013)	Electricity	Continuous Supply	Continuous Supply
	Telecom	Increase in telecommunication connections	-
	Water Supply	Coverage	Coverage
Annamalai et al. (2016)	Water Supply	Connectivity to individual, community water connections	-
		Coverage	
	Sanitation	Connectivity to individual, community toilets and sewerage connection	-
		Design and maintenance	
	Electricity	Connectivity to electricity supply	-
Arnold and Colford (2007)	Water supply	-	Impurities in water
			E-Coli content in water
Bain et al. (2014)	Water supply	-	Impurities in water source
Bensch et al. (2016)	Electricity	Continuous Supply	Quality of service
		Affordable price of electricity	
		Connectivity in residential areas	
Birdthistle et al. (2011)	Sanitation	Connectivity to Sanitation infrastructure	Treated water supply in sanitation infrastructure
Clasen et al. (2010)	Sanitation	-	Impurities in water
Clasen et al. (2015)	Water supply	Access to clean water	Impurities in water

Study	Sector	Outcome Indicators	
		Access	Quality
Dangour et al. (2013)	Water supply	-	Impurities in water microbial content in water
Heijnen et al. (2004)	Sanitation	-	Impurities In water due to improper sanitation disposal
Heijnen et al. (2004)	Road	Connectivity to road and transportation infrastructure	-
Hepworth et al. (2013)	Water Supply	-	Conservation
Hine et al. (2016)	Road	Connectivity with one place to another	-
Huges et al. (2013)	Water Supply	-	Impurities in water
Hunter (2009)	Water Supply	-	Impurities in water
Knox et al. (2013)	Road	Affordability and connectivity – Distance travelled	-
	Electricity	Affordability and Connectivity - Electricity consumption per capita and households with electricity	-
	Telecom	Connectivity - Telephone connection and rural tele density	-
	Water Supply	-	Impurities in water
Null et al. (2012)	Water Supply	Affordability for clean water	-
Taylor et al. (2015)	Water supply	-	Impurities in water – residual chlorine and e-coli count
Turley et al. (2013)	Water supply	Connectivity to water supply connections	-
	Road	Area based road and walking path connectivity	-
	Combined infrastructure sector	Reduction in water expenditure	-
Waddington et al. (2009)	Sanitation	Connectivity and provision of sewer connection	-
	Water Supply	Access to water at point of use	Quality of water at point of use
Watson et al. (2012)	Electricity	Connectivity – Process of establishing a grid connection	-

Study	Sector	Outcome Indicators	
		Access	Quality
		Affordability - operation and maintenance cost and willingness to pay	-
Wolf et al. (2014)	Water Supply	-	Impurities in water
	Sanitation	-	Impurities in water
Wright et al. (2004)	Water Supply	-	Impurities in water

Appendix I. Study wise list of interventions

Study	Sector	Intervention category	Intervention description
Annamalai et al. (2012)	Electricity	Institutional and Regulatory Reforms	Mechanism for cross subsidy and pricing
		Public Private Participation	Private sector participation
		Multiple/Reform	Restructuring for impact on labour efficiency
			Regulatory governance and political accountability
	Water Supply	Institutional and Regulatory Reforms	Decentralisation mechanism and monitoring and inspection mechanisms
		Public Private Participation	Private sector participation
	Telecom	Public Private Participation	Private sector participation
		Institutional and Regulatory Reforms	Impact accountability and regulatory Governance
	Public Transportation	Institutional and Regulatory Reforms	Decentralisation and regulation based reforms
Annamalai et al. (2013)	Electricity	Public Private Participation	Private sector participation through concessions, divestitures, leases, etc
	Telecom	Public Private Participation	Private sector participation through concessions, divestitures, leases, etc
	Water Supply	Public Private Participation	Private sector participation through concessions, divestitures, leases, etc
Annamalai et al. (2016)	Water Supply	Urban Planning Intervention	Public provision of water supply
			Service delivery and financial planning participation of local communities
	Sanitation	Urban Planning Intervention	Public provision of sanitation systems and services
			Community participation and resident participation
	Electricity	Urban Planning Intervention	Management practices and pricing methods
			Community participation
Arnold and Colford (2007)	Water Supply	Physical infrastructure investments	Technology based intervention
Bain et al. (2014)	Water Supply	Physical infrastructure interventions	Tubewell and borewells, protected well, rainwater harvesting
Bensch et al. (2016)	Electricity	Public Private Participation	Private sector involvement through privatisation and liberalisation
		Institutional and	Regulation on tariff and cost

Study	Sector	Intervention category	Intervention description
		Regulatory Reforms	
Birdthistle et al. (2011)	Sanitation	Physical infrastructure investments	Separate sex toilets
		Developmental and multilateral agencies	Knowledge management and training programs on sanitation infrastructure usage
Bouillon et al (2007)	Water Supply	Physical Infrastructure Investments	Expansion of water supply system
		Public Private Participation	Privatization of water services
	Sanitation	Physical Infrastructure Investments	Expansion of sewerage system
Clasen et al. (2010)	Sanitation	Physical infrastructure investments	Construction of sanitation and sewer systems
Clasen et al. (2015)	Water supply	Urban Planning	Piped water connections
			Chlorination, Flocculation and disinfection
		Physical infrastructure investment	Point of use filtrations systems
			Biosand systems, life straw, Solar water disinfection
Dangour et al. (2013)	Water Supply	Physical infrastructure investments	Filtration and chemical treatment technology
Fewtrell et al. (2005)	Sanitation	Physical Infrastructure Investments	Latrine installation
	Water Supply	Physical Infrastructure Investments	Household and standpipe connection
			Treatment at water source
	Infrastructure	Physical Infrastructure Investments	Multiple hygiene, water and sanitation intervention
Heijnen et al. (2004)	Road	Urban Planning intervention	Road infrastructure upgradation
	Sanitation	Urban Planning intervention	Urban planning intervention
Hepworth et al. (2013)	Water Supply	Urban Planning Intervention	Water resources management
Hine et al. (2016)	Road	Physical Infrastructure Investments	Extension of road network
Huges et al. (2013)	Water Supply	Physical Infrastructure Investments	Technology based water quality improvement investments
Hunter (2009)	Water Supply	Physical Infrastructure Investments	Technology based water quality improvement investments

Study	Sector	Intervention category	Intervention description
Knox et al. (2013)	Road	Physical infrastructure investments	Construction of new roads
	Electricity	Physical infrastructure investments	Upgradation of Electricity connections
	Telecom	Physical infrastructure investments	Upgradation of telecom connections
	Water Supply	Institutional and regulatory reforms	Policy level intervention
Molina et al (2016)	Infrastructure	Community monitoring interventions	Community Monitoring tools
Null et al. (2012)	Water Supply	Physical Infrastructure Investments	Technology based water quality improvement investments
Taylor et al. (2015)	Water Supply	Physical infrastructure investment	Technology based water quality improvement investments
		Urban planning intervention	Precaution based intervention
Turley et al. (2013)	Water Supply	Public private participation	Private players involvement in water connectivity
	Road	Urban planning intervention	Road construction and up gradation
	Combined infrastructure sector	Urban planning intervention	Slum upgradation
Waddington et al. (2009)	Water Supply	Physical infrastructure investments	Technology based water quality improvement investments
Watson et al. (2012)	Electricity	Institutional and regulatory reforms	Financial assistance for installing and maintaining renewable energy
			Policy on cost reflective tariffs
		Physical infrastructure investments	Off-grid electrification technologies and micro grid infrastructure
Wolf et al. (2014)	Water Supply	Physical Infrastructure Investments	Provision of improved community water supply
			Provision of piped water supply

Study	Sector	Intervention category	Intervention description
	Sanitation	Physical Infrastructure Investments	Provision of Improved Sanitation
			Provision of Sewer Connection
Wright et al. (2004)	Water Supply	Physical Infrastructure Investments	Infrastructure to prevent water contamination

Appendix J. Study wise list of impacts analyzed

Study	Sector	Impact	Impact description
Arnold and Colford (2007)	Water Supply	Health	Diarrhea reoccurrence
Birdthistle et al. (2011)	Sanitation	Education	Number of Enrollment, Attendance, Completion in schools
Bouillon et al (2007)	Water Supply	Health	Percentage change in child mortality
	Sanitation	Health	Percentage change in child mortality
Clasen et al. (2010)	Sanitation	Health	Diarrhea reoccurrence
			Year on Year mortality
Clasen et al. (2015)	Water Supply	Health	Number of Diarrhea cases
Dangour et al. (2013)	Water Supply	Health	Change in physical growth of children – weight for age
			Change in physical growth of children – height for age
			Change in physical growth of children – weight for height
Fewtrell et al. (2005)	Sanitation	Health	Change in incidence of illness
	Water Supply	Health	Change in incidence of illness
	Infrastructure	Health	Change in incidence of illness
Heijnen et al. (2004)	Sanitation	Health	Diarrhea reoccurrence
			Number of disease causing parasites
			Number of people affected with enteric infection
			Number of fetal deaths
			Birth defects and outcomes
Hine et al. (2016)	Road	Economy	Change in transport costs
		Economy	Change in traffic volumes
		Economy	Change in non-agricultural employment
		Economy	Change in income and consumption of agricultural products
		Health	Change in accessibility to health care services
		Economy	Change in agricultural output, values, inputs, cost , prices
		Education	Change in deliver of educational services
Knox et al. (2013)	Road	Economy	GDP – measures of change in rural or total GDP
			Income – measures of rural income, crop revenues and gross margins

Study	Sector	Impact	Impact description
			Prices – measures of process of agricultural outputs
		Quality of life	Employment – Labour productivity and labour wages
			Poverty – measures of number of people in pverty
	Electricity	Economy	GDP – measures of change in rural or total GDP
			Income – measures of rural income, crop revenues and gross margins
			Prices – measures of process of agricultural outputs
		Quality of life	Employment – Labour productivity and labour wages
			Poverty – measures of number of people in poverty
	Telecom	Economy	GDP – measures of change in rural or total GDP
			Income – measures of rural income, crop revenues and gross margins
			Prices – measures of process of agricultural outputs
		Quality of life	Employment – Labour productivity and labour wages
			Poverty – measures of number of people in poverty
	Water Supply	Economy	Productivity – measures of quantity of production crops and livestock
Molina et al (2016)	Infrastructure	Economy	Measure of decrease in corruption
		Health	Change in health issues
		Health	Change in physical quality of children – Weight for age
		Health	Change in year on year child mortality
		Education	Change in school enrolment
		Education	School dropout rate
		Time	Time interval to get services
Petrosino et al. (2012)	Road	Education	School attendance and enrolment
Turley et al. (2013)	Water Supply	Quality of life	Change in rate of employment
		Health	Number of cases of parasitic diseases
	Road	Quality of life	Change in rate of employment
		Health	Number of cases of parasitic diseases
	Combined infrastructure	Quality of life	Change in rate of employment

Study	Sector	Impact	Impact description
	sector		Risk for immigrants
		Health	Number of water bourne diseases
Waddington et al. (2009)	Sanitation	Health	Number of diarrhea cases
	Water Supply	Health	Number of diarrhea cases
Watson et al. (2012)	Electricity	Economy	Cost reflective tariffs
			Link to productive users
		Quality of life	Purchasing power of individuals
Wolf et al. (2014)	Water Supply	Health	Number of diarrhea cases
	Sanitation	Health	Number of diarrhea cases

List of abbreviations

3ie International Institute of Impact Evaluation

DARE Database of Abstracts of Reviews of Effects

DFID Department for International Development

ES Evidence Summary

EPPI Evidence for Policy and Practice Information

LMICs Low-Middle Income Countries

MDG Millennium Development Goals

NGOs Non-Governmental Organizations

OECD Organization for Economic Co-operation and Development

PICOS Population, Intervention, Comparison, Outcome and Study design

QOL Quality of Life

R4D Research for Development

RCT Randomized Control Trials

SDG Sustainable Development Goals

SR Systematic Review

UN United Nations