Policy Options for Water-Stressed States

(POWSS)

Building lessons from the Middle East and Southern Africa
into decision support for policy makers

Final Report
(pre-publication)

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Incorporating outline:

FoRWaRD decision support model
Meeting Food Requirements and Water Resources Development

Contents

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Introduction

Many regions of the world are facing a decline in the availability of natural resources in light of their rapidly increasing populations and the associated increased demand for food. Frequently this situation is depicted as a 'crisis' scenario, an account beloved of the media and the many global institutions which possess a stake in the water sector (see ODI, 2002). Although a problem undoubtedly exists and the need to identify those factors which contribute to 'water stress' is a real one, it is not necessarily the case that stress will inevitably lead to crisis and to the eventual outcome of major social conflict and/or famine. The experiences of a number of countries as far afield as Israel and Jordan in the Middle East and Zimbabwe and South Africa in southern Africa clearly support this view and show that it is possible for a country to overcome serious water stress. This research project investigates the way in which certain states have succeeded in overcoming serious water stress and studies the lessons that can be learnt from their experiences. It aims to show that from these lessons and experiences an effective system of thought can be constructed, which could then be utilised to inform and instruct decision makers in countries that find themselves entering the 'crunch-zone' of serious water stress.

Due to the shared nature of many resources, water problems often require solutions at levels higher than the nation or country. Water issues have both regional and global significance. Decisions made in one country frequently affect neighbouring countries: more than 260 of the world's major river systems are shared by two or more countries, and these systems account for over half of the total world freshwater supply. Within these catchment areas live upwards of half the world's population. Therefore 'getting it right' in terms of decisions which optimise the use of the resource base—land, water and human resources—is a vital feature of global human development. Embedded within decision making processes are difficult trade-offs between national rights, sovereignty over resources, security of economy and questions of social order. These are intrinsically complicated issues which demand decision making capacities that go beyond the hydrologist, agriculturalist and engineering communities. One of the key challenges therefore is to bring the politicians into the decision making process as early as possible. Without them—and their more informed capacity to choose strategically rational decisions—there will be little room for effective manoeuvre.

The amount of time available for politicians to get it right is increasingly limited as well. Demands being placed upon a diminishing resource base by rapid population growth in certain regions of the world mean that there are 'pockets' of urgency[1]. This report examines first the global context, where since 1950 renewable freshwater supply per person has fallen by 58% as the global population has risen from 2.5 billion to over 6 billion. The urgency, however, lies in specific areas of the world such as southern Africa where the tools for decision making are limited and where the regional vulnerability of large sections of the population is that much greater. The four countries examined in this report, coincidentally, cover the range of 'categories' of rich and poor countries, from high income to low income. The lessons vary, but the message remains remarkably consistent: planning future water development and options for addressing water stress demands consistently greater breadth in decision making capacity than has often been the case in the past. It also demands great political commitment to change, sometimes involving some painful political fallout.

Whereas the political fall-out can be highly visible when issues become media-driven, more often it is less visible and more long lasting, involving retrenchment of positions by communities with large vested interests in the status quo management position. In revealing some

[1] As currently projected The UN's medium-term fertility model puts the world's population at 9.4 billion by 2050 (half a billion lower than the 1994 UN estimates). According to this model the world's population would continue to grow until 2200 when it would stabilise at some 11 billion.

of the less visible political credit and debit involved in addressing ‘policy options’, this study hopes to aid in bringing a greater level of rationality to the consideration of the water ‘scarcity’ question. Too often the analysis is rooted in simple per capita amounts, from which huge assumptions are made and ideas extrapolated.

The study is divided into four parts. First, a theoretical and analytical framework is developed, which encompasses recent thinking from both northern and southern social scientists and sets out a broad analytical framework for the remainder of the study. The analysis is necessarily broad in scope to illustrate the key global shifts that have influenced policy in the different countries and which continue to have a profound impact on decision making at all levels.

Part two examines in detail the regional resource contexts in which the four countries are situated – Israel and Jordan in the Middle East, Zimbabwe and South Africa in southern Africa - outlining the histories of resource development, periods of social and physical scarcity and the broader policy contexts of changing approaches to resource development. This wider view helps to draw outcomes of the critical resource issues that are key to national level policy making, an important part of which is situating national dilemmas in the context of regional resource stress.

Part three details the national experience of the four countries. Looking at water availability, socio-economic issues, institutional environments and policy options, this section analyses the resource contexts in relation to wider developmental goals—including poverty reduction—and concludes with ‘balance sheets’ for resource availability and food needs for each state. This analysis begins the process of narrowing down the output to essential elements surrounding the concept of ‘virtual water’, central to understanding the output of the study.

Finally, the fourth part applies the analytical framework developed in the first part to the case study material and, from this analysis, develops a decision support model, named *FoRWaRD*, that aims to create the conditions for greater decision making capacity and for the identification of future resources constraints and policy options based on the development of scenarios. It is hoped that this decision support model can be piloted in one or two situations in the near future to assess its ease of use, complexity of data and capacity to enhance real-time decision making.

Along the way, the study has encountered two major regional research analysis and data gathering problems, namely in the form of the rapidly deteriorating situations in Israel/Palestine and in Zimbabwe. These conflicts have prevented the depth of data gathering originally anticipated (particularly in terms of access to key informants as originally envisaged in the proposal), but some measure of substitution by secondary sources has been achieved.

Chapter 1: Theoretical Framework

The global context

This chapter provides a context for the research within the international decision making environment. It is necessary to do this as global shifts in policy, led by major bilateral and multilateral banks and other emerging networks of professionals, have direct bearing on the policy environment within which decisions are made. In short, global processes provide a key parameter for national and sub-national decision making. For this reason it is important to examine the 'crisis' narratives at work and responses to them.

Water is not abundant and the proportion of available global freshwater is miniscule. The status quo will no doubt remain until the cost of desalinisation is economically feasible for use in the agricultural sector, a development probably decades away. Currently, however, three quarter's of the world's fresh water is trapped in ice sheets and glaciers. Less than 1% is free flowing on the surface and about 20% is stored underground. In some parts of the world, surface flows and groundwater resources are highly unevenly distributed and often difficult to access. So even countries with average high water availability can incorporate areas where water is a scarce resource.

Commonly, when referring to water scarcity or stress, an annual per capita availability of less than 1,600 m^3 is used. This amount includes all the requirements of an individual plus the water required to grow his/her food. Clearly this sum will depend on numerous factors, one being the person's diet. A major shift in the type of food eaten can have a huge impact on the required water and cost thereof. At its most extreme, 'absolute water scarcity' is said to exist where availability falls below 1,000 m^3. Clearly, however, the impact of this stress or scarcity—i.e. its tangible effects—depends on the nature of the economy in a given area. Principally, whether or not food production is *in situ*, nationally or locally, or whether foodstuffs are imported and the 'embedded' water used in production originated elsewhere. This is referred to as 'virtual water' and forms a central strand to this research. It is discussed in more detail in ensuing sections.

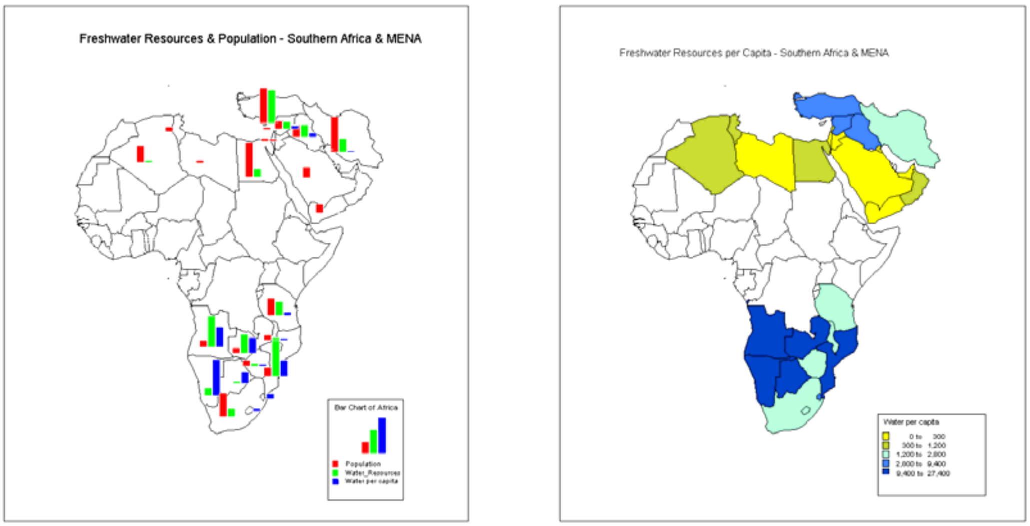
Currently some thirty countries, including South Africa and Zimbabwe, are considered water stressed and twenty others face absolute water scarcity (refer figure 1 below). These countries include Israel and Jordan, who fall well below the absolute scarcity threshold and are theoretically in serious difficulty. This research will show that in both the Middle Eastern countries, Israel and Jordan, and in the southern African states, South Africa and Zimbabwe, important processes exist which can be used to mitigate the stress and allow societies and economies to overcome structural challenges. However, in all four case studies there are factors which further complicate the already difficult situation. Firstly, rainfall variability is an ever present threat for states in both regions, forcing major restructuring in water usage with its associated socio-political impacts. Secondly, the populations of both regions are rapidly increasing with the resulting increase in demand for food and associated demand for water. These countries require the capacity to plan and manage access to the competitive volatile global and regional food markets.

In the future, competition for food staples will intensify further and global markets are expected to undergo a significant transformation. A report produced for the Second World Water Forum in The Hague (March 2000) by the International Water Management Institute (IWMI) concluded that by 2025, 33% of the world population, or two billion people, will be living in countries or regions with huge water deficits[2]. It is estimated that by 2025, nearly all the countries in the Middle East and North Africa will have reached absolute water scarcity. This situation will also apply to South Africa, large parts of India and China. These regions and countries will need to supplement their food requirements from other sources. IWMI views the problem in terms of

[2] Based on the UN medium population growth projections.

future water needs and predicts that by 2025, an additional 22% of primary water, mainly for irrigation, will be required to meet global food requirements. The International Food Policy Research Institute (IFPRI) is even more pessimistic as it foresees a doubling of food imports over the next twenty years. These predictions necessitate a serious political economic shift in societies and polities surrounding the contentious issue of food security and national sovereignty. Action will require more than just the improvement of water use efficiency or the production of 'new' water.

Figure 1: Current freshwater resources in southern Africa and MENA



The scenario presented by many experts working in these countries suggests a linear progression to an increasingly difficult situation. However, the progression is far more likely to be a convoluted line littered with peaks and troughs. Many of the deviants from the norm will be caused by a single key variable: climate variability. Major research findings indicate a process of global warming with potentially dramatic impacts on global climate patterns and localised weather systems. The key challenge will be to identify and understand how global shifts will change local rainfall patterns in vulnerable regions.

Over the last three decades, meteorological droughts in southern Africa and the Middle East have been of major significance, both economically and politically. During the 1980s and 1990s, droughts became potent 'policy vehicles' on the back of which major strategic decisions were made by communities and governments. Droughts not only force the individual to consider his or her own vulnerability but they also drive home the reality of water stress at the national level. To date, most models indicate a propensity towards more frequent 'extreme' weather events. If correct, these events will affect the precipitation levels in areas of global food insecurity. To what degree these areas will be affected is unclear and predictions vary according to which climate model is used. For example, forecasts for water-stressed countries for the year 2025, using the 'business as usual' scenario, vary from between 338 mm and 784 mm, depending on the model (see Arnell, 2000). Deciding which model provides the best strategy is difficult and policymakers are hampered by the science when trying to agree on which approach to employ – stick to the status quo, reallocate water to high value uses or pursue a low water based strategy. Computer generated scenarios do, however, contribute to the growing scientific knowledge on climate change and provide key additional parameters for decision makers contemplating future strategic options in national water policies.

Although the area of concern in this research is water for food production, it is necessary to include some analysis of the lower consumptive water sectors and place them within the global environment. This is because an inordinate amount of time in the decision-making process in countries within southern Africa and the Middle East is allocated to the industrial and domestic sectors. In addition, there is an increasing convergence between the various sectors and their water requirements. Management issues often overlap especially in terms of water quality and groundwater.

Currently some 1.2 billion people lack access to water and 3.3 billion have no effective sanitation, causing or contributing to the deaths of more than 3 million people each year from water-related diseases. It is estimated that by 2025, an additional 3.1 billion people will require access to water and 4.9 billion to sanitation[3]. This will present an increasing challenge to policy makers. Water deficits can have a serious impact on communities. Mortality rates and the loss of productive capacity brought on by endemic diseases have serious knock-on effects on a nation's productivity levels. In addition, chores such as collecting water from distant sources several times each day constrain household decision-making in a wide range of areas. Such time-wasting endeavours often come at the cost of the proper education of children. The impact of this in the long-term, both on the household and the wider society, is extremely negative.

Urbanisation is another related issue and one of paramount concern to future resource planners as cities grow more rapidly than rural areas. The provision of services to peri-urban areas and informal settlements in cities is an increasing social priority. Often the demands on urban provision come at a high price to rural areas. In sub-Saharan Africa 77% of the urban population receive services compared to 39% of populations within rural communities[4]. The disparity between the two areas highlights the links between urban and rural poverty and raises questions of resource allocation. In Zimbabwe, for example, the focus on urban service delivery has significant implications for rural provision which can contribute to a resource-poor environment. The effect of extensive urban drift has resulted in crucial reductions in agricultural activity and productivity. Response action to the 'crisis' described above centres on three key questions:

1) What should be done?
2) How should it be done?
3) How much will it cost?

In terms of addressing the third question, some experts estimate that an annual funding gap of US$180 billion exists for water provision. This figure is over and above the current expenditure level of approximately US$75 billion per annum and includes the cost of water required for the agricultural sector. Of the estimated amount, US$30 billion (compared to the US$14 billion spent currently each year) is required for water and sanitation. The Global Water Partnership (GWP) believe that 70% of the required funds should come from each country's 'private sector' (including the small-scale sectors). At present this sector provides only 4% of funds. The remaining 30% is expected to come from the international private sector. It is unfortunately, however, not simply a matter of the division of responsibility. In the first instance, it is difficult to determine who in fact is liable for the funding. For example, the term 'small-scale' private sector is often euphemistically applied to the communities themselves. A sector which may or may not be able to access funds, institutions or the capacity to manage resources effectively.

[3] Of the 3.1 billion who will require access to water, 0.7 billion will be rural dwellers and 2.4 billion will be urban. Of the 4.9 billion who will need access to sanitation, 2 billion will live in rural areas and 2.9 billion in cities.

[4] This compares to the global average of 90% urban-serviced areas and 62% rural-serviced areas.

The increasing focus on private financing reflects general global shifts in development, These were particularly driven during the 1980s by IMF and World Bank lending conditions and the ‘structural adjustments’ that economies were expected to make. In large they reflected the economic ideology of free-market capitalism and the reduced role of the state in public service provision. However, more recently there has been some scaling back of this ideological commitment to private sector development, not least because in many parts of Africa the conditions to entry and the development of a nascent private sector are too arduous.

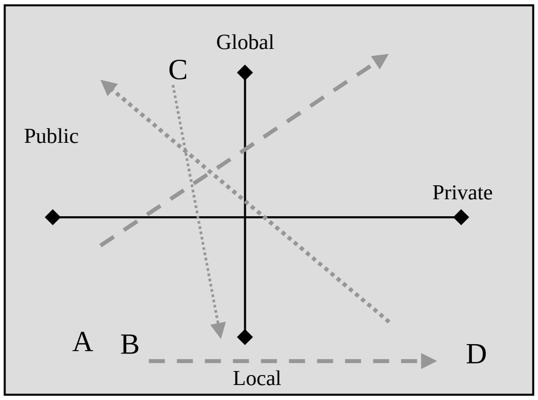
In addition to the private sector driven ‘economical efficient’ solutions to water problems, there has been a more qualitative focus on the policy options required to increase the efficient management of the resource. The Integrated Water Resources Management (IWRM) has advocated a cluster of ideas, central to which is the concept of the hydrological unit—be it basin, catchment or micro-catchment—as the basic starting point for water resource management. Within this hydrologically-bounded area, IWRM identifies the range of users *as stakeholders*, promotes effective governance, encourages cost recovery based on the notion of water as an economic good and sponsors bottom up planning. The IWRM approach is advocated by many southern African agencies and networks as it provides a significant parameter for government decision making on water resources management.

Policy development is not, however, a neutral space inhabited by benign practitioners and users but rather a hotly-contested arena. Within its sphere conflicting interests collide and new institutional forms sit uneasily with existing practices and processes. This factor is particularly important when considering parameters for effective transition within a state in terms of adaptation to change. It is imperative that the right policy is applied and the appropriate structures are put in place to facilitate implementation. In chapter four of this study a decision support tool is suggested which aims to assist in the formation of appropriate policy development. The aim is to provide a transparent method for governments to communicate policy to social groups. Two geographical regions which have recently either gone through sudden, dramatic changes or are currently in the process of sensitive political manoeuvring are the Middle East and southern Africa. The Israeli and Palestinian conflict, apartheid in South Africa and government policies on land reform in Zimbabwe provide examples of situations which can impede the ability of individuals to lead normal lives. Disruptions also constrain and shackle the decision making environment and sectors such as water often have limited options for addressing management issues.

When investigating water sector development there are also civil liberty approaches which challenge the relevance of perceived wisdoms. For example, emerging civil society groups in many developing nations take umbrage to the neo-capitalist belief that water should be treated first and foremost as an economic good[5]. In their opinion water issues intersect and cross-cut other narratives and address questions of human rights. While at present less influential to developing economies’ political processes than they are to northern development agendas, these budding expressions are nonetheless being increasingly addressed by southern political procedures. A few of these dominant concepts and their counter-concepts are plotted as ‘trajectories’ within decision making in the diagram below (refer figure 2). Although largely discursive this depiction illustrates certain aspects of the wider decision-making environment within which water-stressed states will need to address future ‘policy options’.

[5] Visit http://www.canadians.org/blueplanet/index2.html

Figure 2: Conceptualising change and capacity to change



Arrow **A** represents increasing global privatisation, particularly in urban service provision, shifting delivery from local public sector to global, private sector institutions. Arrow **B** represents a shift to more localized service provision, particularly in rural areas, where community management and financing represents a form of communal 'privatisation' of the resource. Often encouraged by donors and governments, this shift to demand-based approaches (including DRA) entails new forms of ownership and contractual 'obligations' by households and communities over supply structures and processes. Arrow **C** represents the growing influence of IWRM and subsidiarity, often to catchment levels.

Arrow **D** is the ideological 'counter-narrative' represented by advocates of both a public goods and rights-based approaches. The intersection of **C** with **A** and **B** depicts the increasing convergence between lower levels of water management and processes of water supply and sanitation development. This convergence is currently reflected in new policy approaches that highlight the linkages between water and livelihoods and wider poverty reduction approaches (see, for example, www.securewater.org).

In addition to understanding the context within which change takes place, it is important to know something of the nature of the actual processes of change. The following sub-section examines some of these issues from the perspective of recent thinking developed by both northern and southern policy practitioners. Questions asked include:

1) What are the key issues in understanding changes within increasingly resource-poor environments?
2) How can these be conceptualised?
3) What insights can this provide in terms of addressing the policy options facing water-stressed states?

The operation of processes and processes deemed important for mitigating future water stress (including the valuing of 'natural capital' such as water) have proven difficult in many water deficit regions. This reflects the difficulties in determining the cost of resource degradation. In other words, it is hard to establish an appropriate 'precautionary principle'. This principle focuses on economic value and is concerned with either avoiding reduction in stock or preventing reductions in the value of part of the natural capital stock. The precautionary principle has been increasing applied to water resources. A key way to avoid any reduction and/or degradation of the resource is to diversify the economy beyond the point at which it relies mainly or solely on stock exploitation in order to grow.

The Karshenas model (refer Figure 3a below) is an attempt to conceptualise the relationship between economic development and the use of natural capital such as water. This model is readily communicated and helps to explain and predict the nature of the political economy of water in the extreme political, economic and water deficit regions, such as the Middle East. Karshenas shows how development has been, to some extent, at the expense of natural capital. He recognises that two forms of disaster can arise from the mismanagement of a community's environmental capital: either:

1) **Ecological** – caused by progressive overuse of natural resources, or
2) **Economic** – caused by the community's decline into terminal poverty because of inadequate natural resources in the face of new demands (e.g. from rising populations), or the inability to manage the resources effectively.

The model shows how the development trajectory of an economy through time can be traced (highlighted in Figure 3b below). This is represented in the information space that is delineated by the axes. On the vertical axis the economic status of an economy is defined via an indicator such as GDP per capita, while the status of the economy's natural capital is defined on the horizontal axis. For both axes there are zones of unacceptable and unsustainable circumstances, namely the zone of unsustainable poverty and the zone of terminally degraded natural resources. In the Middle East no economy has entered the zone of unsustainable poverty, although the Palestinian communities have endured unacceptable political economies for decades. In the case of the Gaza Strip, a dangerous depletion of renewable natural resources has taken place over several decades (refer Figure 4 below).

The trajectory of Israel is an example of the capacity to respond to environmental and economic challenges, principally through rapid economic diversification. Feitelson (1998), describes how the Israeli process was largely facilitated by the decreasing importance of agriculture to the economy. By 1980 it contributed a mere 3% to GDP. Following the droughts of 1990/91, this reduced significance enabled the pricing of water to be used as a demand management instrument. The same challenge applies to the West Bank and Gaza Strip. There is a need to develop substitutes for highly water-consumptive agriculturally driven approaches. Change, however, is severely restricted by the wider political relationship between the nascent Palestinian state and Israel. Within the current set of circumstances it is difficult to conceive of development 'alternatives', particularly when urban centres—the key engines of industrial growth—are under such tight shackles. Although on a somewhat different basis, the southern African situation offers some tentative evidence that a trajectory similar to Israel's is emerging (Turton,1997; 1998).

Figure 3a: Conceptual model: Eco-environmental space: consequences of low-environmental capacity and 'over use' of environmental capital (Source: Karshenas 1994)

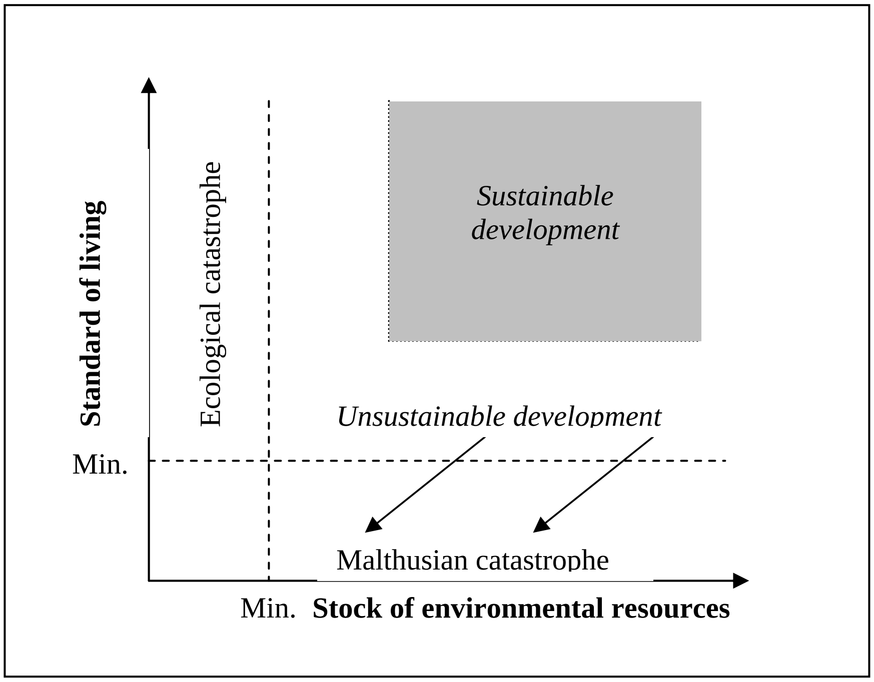


Figure 3b: Policies and practices: Common and 'precautionary' development trajectories

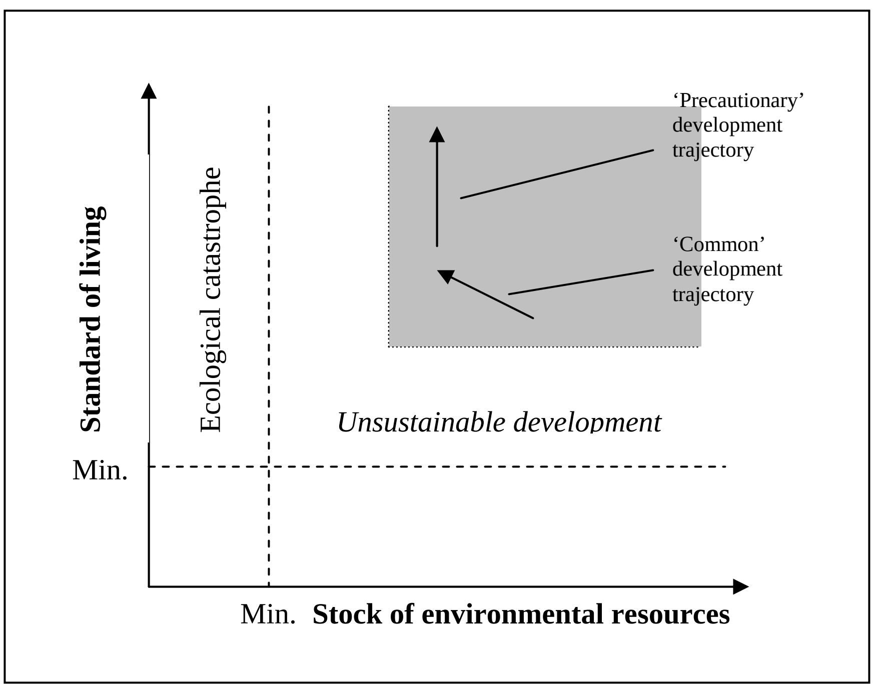
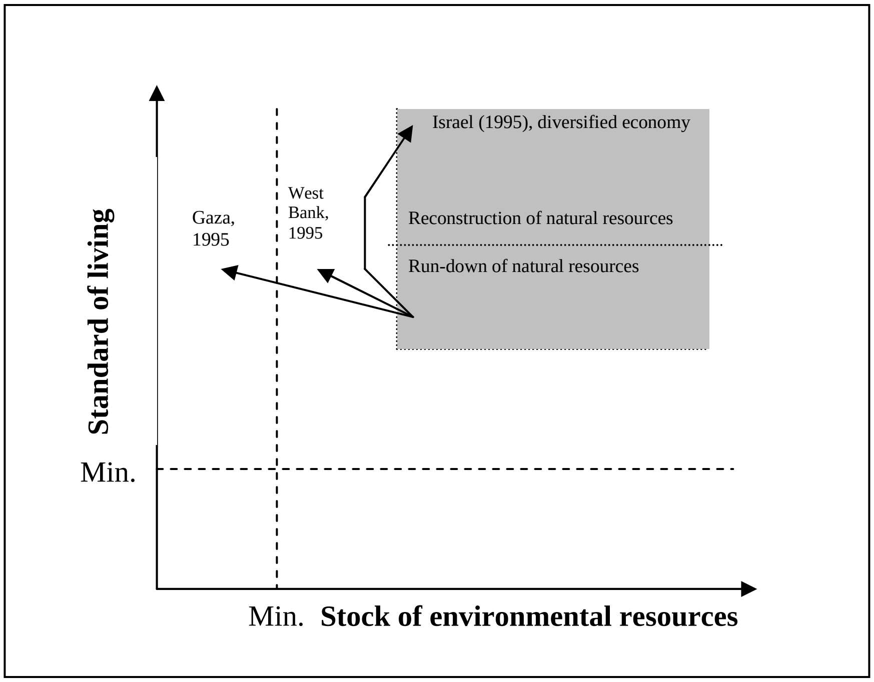


Figure 4: Empirical evidence from Israel, the West Bank and the Gaza Strip. Trajectories: 1947-1995

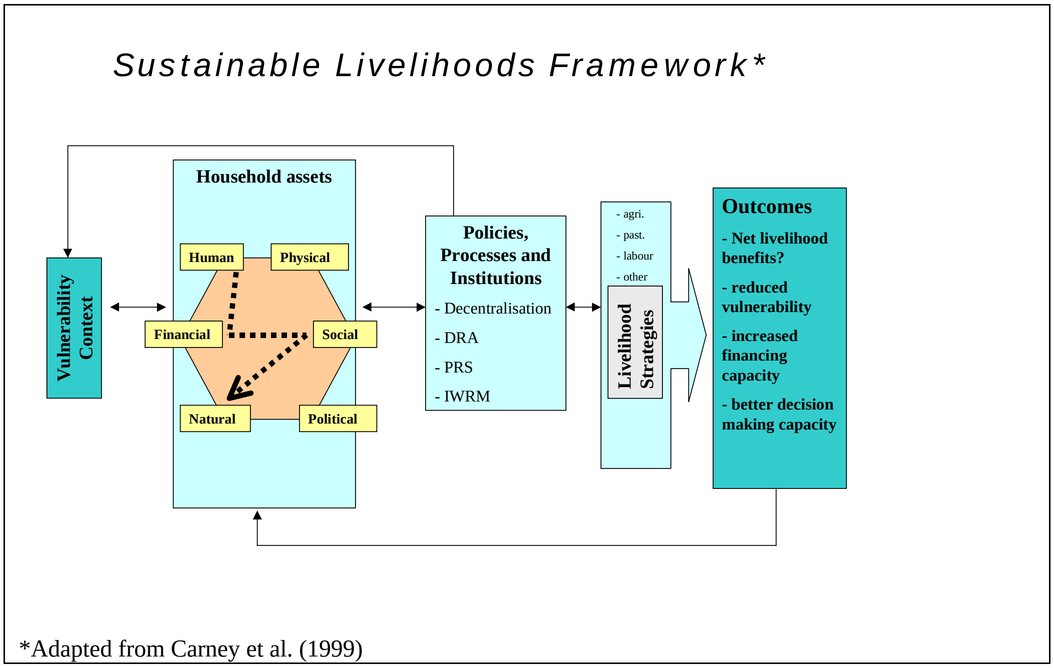


Broad modelling of macro-economic trajectories and natural capital helps countries who are adopting new policy options prioritise key issues. The capacity to adopt different trajectories is largely dependent on the 'change capacity' of a country; i.e. the capacity to adapt to the fluctuations of a resource over time. In effect this idea builds on the concept of coping strategies. This idea was previously employed to understand food security and, more recently, it informed on the theory of sustainable livelihoods (refer Figure 5 below) and the capacity of households to withstand external shocks. Success of application is based on the ability to access a range of assets. These include:

1) **Natural capital** including land and water.
2) **Human capital** including ingenuity.
3) **Financial capital** including the capacity to purchase 'entitlement' to other assets
4) **Physical capital** including the structures of access to resources, to markets and to other communities of knowledge and commerce
5) **Social capital** or the range of relations, networks and social regimes that enable and enhance the function of different livelihood strategies.

When extrapolated to the national level the capacity to manage change becomes central to the development of 'options' for addressing water scarcity. Clearly some capacities, for example, financial capacity, rely on income and using this option might, in the short term, reduce available financial assets. Managing change can also open up options previously unavailable to policymakers. Instead of using greater volumes of natural capital, water and land, to cultivate agriculture, governments could reallocate water to a more efficient sector and purchase the nation's food requirements from the global market. Important considerations are the sustainability of resource use and policies which result in poverty reduction. These issues are relevant at both the household and national levels.

Figure 5: Conceptual model of change, from household sustainable livelihoods framework



Institutional and policy forums are also necessary for effecting capacity change in resource use. The concept of 'adaptive capacity' developed by Ohlsson (1998; 1999), suggests that the mobilisation of social resources is required in combination with the existing natural capital to ensure adequate resource availability. In effect, this suggested mobilisation of increased social resources drives the arrows in Figures 3 and 4. This is particularly valid in the relatively complex 'return to a sustainable trajectory' in the Israeli case study. The stock of social resources, with a capacity to 'bend' otherwise unsustainable trajectories, can be called the 'adaptive capacity' of a given society. The lack of such a capacity represents what Ohlsson (1999: 161) terms the critical 'second order' scarcity. The first order scarcity refers to the scarcity of the resource itself.

Adapting to natural capital scarcity requires additional inputs of social and/or human capital until an equilibrium level is reached which allows the resource to be both managed sustainably and protected from future 'capture'. In addition, social and human capital impact on the development of policy options for water-stressed states. Allan and Karshenas (1996), suggest that societies with advanced political economies are able to implement demand management. As suggested above, this involves to a major extent the repositioning of agricultural water within the wider economy, to reflect, not only the relative importance of agriculture to the economy as a whole (which is frequently in decline i.e. an issue of allocative efficiency) but to increase the productive efficiency of the resource through maximising value added in agriculture. This could take the form of a switch from food products to higher value cut flowers at a time of very low world food staples.

Understanding the policy change and human and social capacity to adapt is critical: policy options that fail to contend with issues of adaptation are likely to fail and/or create local dispute. This requires that 'adaptive capacity' be understood within the concept of what is politically 'feasible', rather than, politically 'awkward', as a solution. Policy makers are working at the behest of politicians who want to remain attractive to the various political constituencies. In all country case studies there is a wide variation in the type of political system in operation. There is, however, regard paid by political leaders to constituents of interest through various mechanisms. Within governments political feasibility also exists at the level of institutional capacity which impacts on whether institutions are strong enough to address the demands placed upon them?

Part of the problem lies in overcoming the challenges to new policy options presented by constituencies of civil society. Southern Africa is replete with examples. Heyns (1997: 83) notes that Namibians traditionally viewed rainfall and water supplies as a gift from God This led to a resistance towards paying tariffs for water when they were introduced. Likewise, the introduction of pre-paid water meters in Zwelithle, Hermanus, in South Africa was viewed with suspicion and meters were frequently smashed, even though the community was disadvantaged as a result (Turton, 1999b).

If the capacity to adapt to change in an economy requires a major shift away from water use in agriculture, perhaps to free up water for stressed urban communities (e.g. Jordan/Israel). The question then asked is, where will the substitute agricultural production be found? Industrial and domestic needs are almost invariably achievable, rarely amounting to more than 10% of the national water demand. Water for food self-sufficiency is not, however, achievable as this would typically require approximately 90% of the economy's water for agriculture.

One of the key elements of the theoretical framework of this study is the concept of 'virtual water'. Countries that seek access to food staples on world or regional markets, or even from surplus producing regions within the country's borders, are effectively importers of 'virtual water'. This is the water that has gone into the manufacture of a given quantity of food during its production cycle. In other words, the amount of water that has been saved through purchasing rather than cultivating the food product. This key concept helps to explain the capacity of economies in regions such as MENA to ameliorate severe water deficits. At least 1,000 tonnes (cubic metres) of water is required to cultivate a tonne of wheat. The importation of the tonne means that this amount of water can be reallocated locally. Currently, the importer also wins in the sense that the tonne of wheat is frequently imported at half of its production cost[6]. Although desalination is fast making the concept of water 'deficits' less relevant (although this is largely relevant to countries with a seaboard and countries where the key areas of demand are not too far inland), at the moment the costs remain beyond the reach of most states.

An important theoretical development in the past decade has been the recognition of environmental priorities in the allocation of water. In the political economies of Europe and the US, environmental and economic priorities were recognised in the 1980s and 1990s, respectively (Allan, 2001). In southern Africa these environmental priorities have been reflected in new national water policy and laws (this is also evident in the two states under review in the current study). These environmental priorities increasingly constrain the availability of water for irrigation and further challenge the concept of water availability-based food self-sufficiency. The same is true in the Middle East where, for example, some local pressure groups are addressing agricultural use and water quality deterioration in the Jordan Valley, and challenging the transition of some wetlands areas to cultivation.

In regions with temperate and humid climates, most water for agriculture comes from the soil profile. Infiltrating the soil profile after periods of rainfall, water remains sufficiently long to enable seeds to germinate. Enough water is present to facilitate crop maturation for the 100 days or more of the growing season. Invariably, sufficient quantities are harvested for consumption. Only small volumes of freshwater from rivers and groundwater storage are used as supplements. In large areas of Europe and North America only 10% of freshwater resources are required for supplementary irrigation, representing less than 1% of the total national water budget. The high

[6] In the last two decades of the 20th Century, a tonne of wheat was available on the world market at about half of its production cost. Not since the end of the 19th Century has it been possible for Middle East wheat producers to get the crop to market at prices as low as those achieved by US producers (Lancaster, *et al*., 1999).

water availability in combination with highly intensive practices and technological innovation help to provide very high crop yields and in some instances production surpluses.

In both the Middle East and southern African Regions, however, soil water fed by infiltrated rainfall can be less than 5% of the national water budget. Freshwater taken from surface flows and storage and from groundwater aquifers comprise almost 90% of the water budget. When those managing the political economy decide to adopt a food self-sufficiency policy, the competition for water is serious. In the Middle East and southern Africa, it is the voices of rural communities, and particular constituencies within these communities, which use very high volumes of water needed for irrigated agriculture, that tend to dominate the water policy discourse. The trajectories they favour may neither be the most efficient for national development nor the best for achieving poverty reduction.

Understanding the poverty dimension

The above analysis has highlighted some of the key theoretical issues involved in deriving 'policy options' for water-stressed states. There is, however, in addition, a normative angle to the question, based on poverty reduction as an overarching policy goal. Factors surrounding this issue vary considerably between the states in the present study. This is because the case studies represent a full range of low- to high-income states. Clearly the issues for a high-income country such as Israel are widely different to those facing a low-income country like Zimbabwe. Nevertheless, there are complex issues of poverty interwoven within the Israeli experience, issues such as the relationship with the Palestinians, water use, and the economies of the Palestinian territories in relation to that of Israel.

How, why and where the 'poverty reduction' goal is placed within the hierarchy of food and water decision making will impact on the policy options pursued. Nearly all of southern Africa is classified as 'low-income and food-deficit', because countries of the region neither produce sufficient food to feed their populations, nor import sufficient quantities to fill the food gap. According to the UN Food and Agriculture Organisation (FAO) figures, some 800 million people worldwide remain chronically malnourished and the gap between production and market demand for cereals is anticipated to increase to 27 million tonnes by 2020.

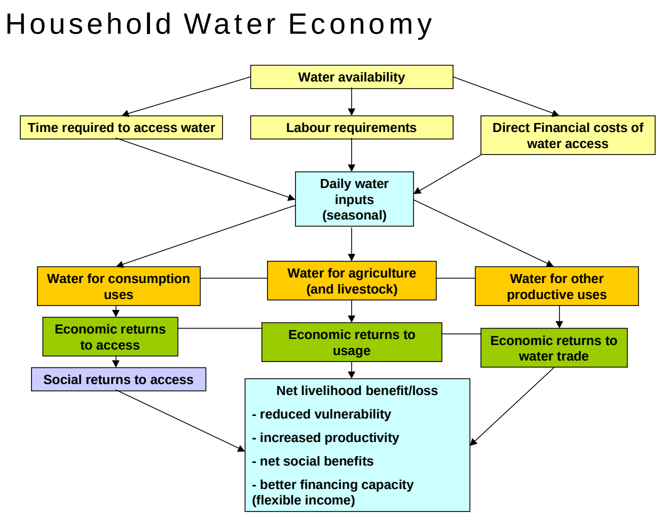
Achieving food security is obviously a primary consideration of poverty reduction approaches. However, as important perhaps is the capacity to provide a management regime for water resources which would enable poor communities and households to create both economic and social value from water use. These issues are particularly important because they address one of the key concerns of this study, namely the ability of governments and societies to achieve effective adaptation to increasing water-stress situations. In theory, therefore, it is necessary to create the conditions at the local level (household livelihood security) which will enable poor communities to take advantage of economic alternatives. This could be in the form of moves to greater industrial demand for wage labour, or engaging in small-scale trade and production in their own right. Hence, providing the 'livelihood' level of water effectively to households where it adds value and advantage to the economies of poor households, may in fact be more important than ensuring flows to agriculture.

An understanding of the household water economy, and its link to the adaptive capacities of households, is urgently required. Rural households, rather than the poor, are key components of policy options for water–stressed states. Much evidence points to the water and livelihoods situation of rural households as being a significant constraint to diversification of activities aimed at reducing vulnerability (for instance in poor rainfall years) and increasing long-term capacity.

The development of a comprehensive understanding of the water and livelihood relationships at the local level is a key facet in the development of an effective analytical framework for assessing the most appropriate policy options with which to address water stress. The *SecureWater* Assessment builds upon sustainable livelihoods approaches. This approach conceptualises vulnerability in terms of access to and returns to different livelihood *assets* (including natural (water), social and human capital). It assists in highlighting the ways in which policies, institutions and processes enable or constrain different livelihood strategies undertaken by poor households. This approach requires interveners to look systematically at how macro level policies and resulting institutions and decision-making processes translate into micro-level livelihood outcomes. The output of such an approach may suggest multiple entry points at both local and national levels for water-related interventions. These would strategically enhance local livelihoods and increase capacity to adapt to changes in future resource availability.

The basic structure of water demand for different livelihood activities can be usefully understood in terms of the *household water economy* (refer Fig. 5 below).

Figure 6: Household water economy

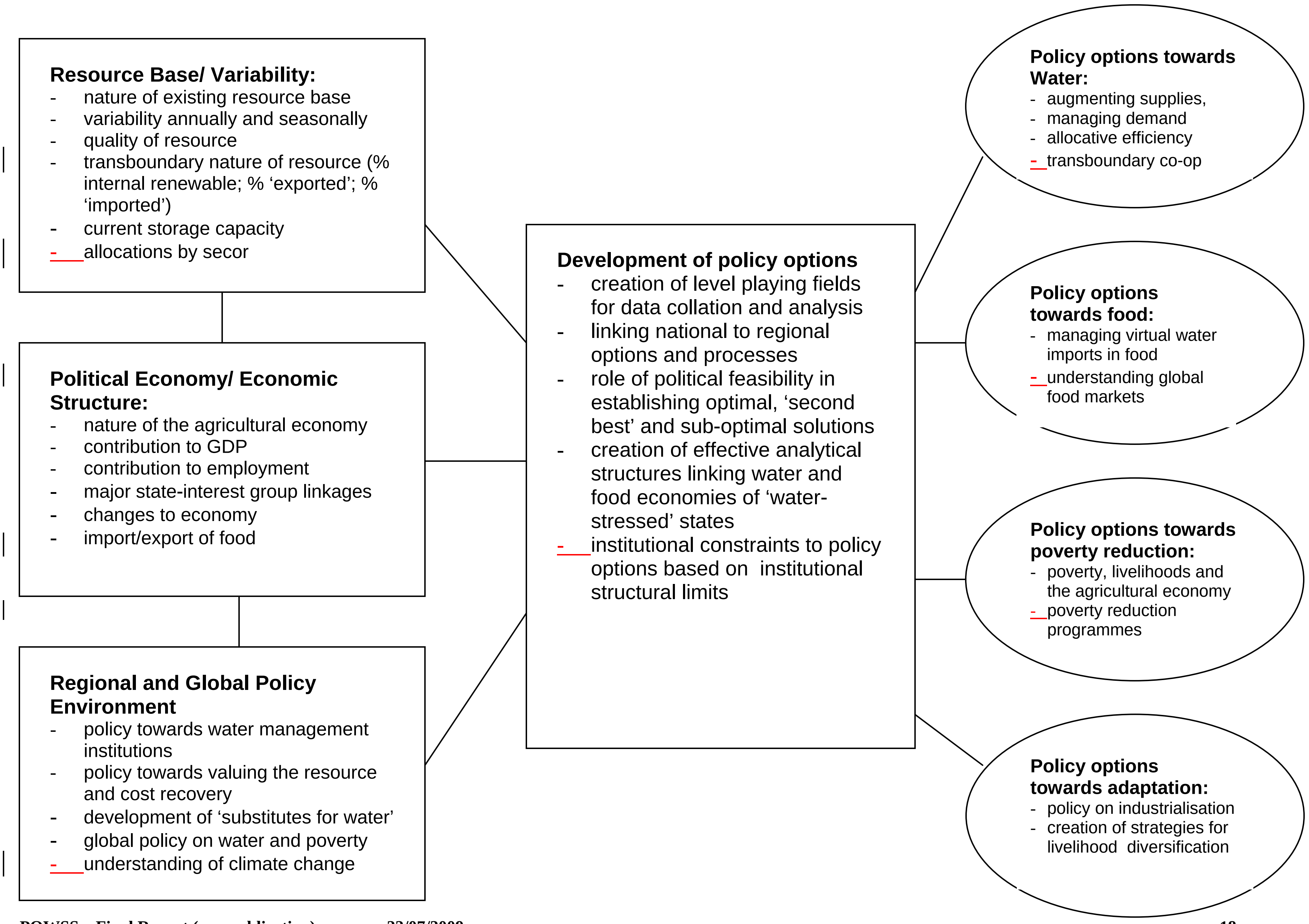


(SecureWater, 2002)

The need to centralise poverty reduction within the development of policy options has required important regional participation. Increasingly there is a move towards more integrated approaches to national decision making on transboundary resources. In southern Africa in particular, better coordinated policy on water resources can provide win-win development opportunities for all co-riparians, with a high potential for poverty reduction impacts. One of the key areas is the management of seasonal river flows on rivers from both the Zimbabwe and South African highlands. Many of these flow into neighbouring Mozambique where large poor communities inhabit lowland river valleys and flood plains.

Opportunities for integration of policy with water and regional poverty initiatives should also address the importance of livelihood diversification as the key to developing effective adaptive capacity. The search for win-win approaches for water-stressed states will enhance local-level livelihood capacity. In fact, these may, in the longer term, form an integral part of the process required by states to adapt and adjust to decreasing water availability.

Figure 7: An analytical framework



Chapter 2: Regional Resource Contexts

This chapter provides a context for the four countries under review. In order to better understand the circumstances experienced by each country it is important to consider the wider regional situation. Both environmental aspects and socio-economic factors are investigated.

The Middle East and North Africa

For the purposes of this study the Middle East and North Africa (MENA) region extends from Morocco to Afghanistan and from Turkey to Sudan. By the end of the 20^{th} century the region had approximately 300 million inhabitants and renewable freshwater resources were estimated at 200 billion cubic metres (bm^3) per annum (FAO 1997a; 1997b). Given that each individual requires more than 1,000 cubic metres (m^3) water every year, the region required approximately 50% more water than was available at the time.

MENA countries are encountering significant population growth and it is anticipated that by 2025, levels will exceed 600 million. Per capita water availability in the region varies from the extremely low 220 m^3 in Jordan and 330 m^3 in Palestine (refer below) to the 2,000 m^3 per capita available to inhabitants living in Iran and Turkey (World Water Council, 2001).

Grain imports have risen steadily from the 1970s onwards (FAO 1961-2000). By the year 2000, imports totalled 50 million tonnes. In terms of embedded water content this is equivalent to 50 billion m^3 water, which equals the amount of Nile freshwater allocated each year to Egypt under its 1959 Nile Waters Agreement with Sudan. The region imported 33% of its food requirements in 1995. This figure is likely to rise to 50% or more by 2025.

Until the end of the 1960s it was possible for states to mobilise ‘new water’, although over time this was done increasingly at the expense of environmental services. From the early 1970s, however, the region’s water needs have become so extensive that they could only be met by over-pumping the groundwater reservoirs and importing water-intensive commodities such as grain. Due to the existence of oil and gas reserves in the region, many countries (although not all) have developed strong oil-based economies. These states have been able to afford the purchase of advantageously priced grain commodities on the world market. This financial security has provided them with the necessary resource base to compensate for the ramifications of water deficiency and has given them an important set of decision-making parameters. At present MENA is the fastest-growing grain import market in the world. Iranian grain imports have recently eclipsed those of Japan, for years the world’s leading importer. Currently, Iran and Egypt import more than 40% of the grain consumed by their populations.

A significant issue in the region is the growing urban demand for water. Although at present the majority of people live in the countryside, it is expected that by 2025, the urban population will exceed the rural population in all MENA countries. This is likely to have important consequences for the patterns of water and food demand.

The four major rivers in MENA are the Euphrates, Tigris, Jordan and Nile. The management of these rivers on a cooperative basis is critical for the future development of riparian states and societies. Irrigation is already an important part of regional agriculture with yields in Egypt at 5.5 tonnes/ha compared with non-irrigated yields of 1.5 tonnes/ha elsewhere in the region (World Water Council, 2001). In the future, appropriate development of agriculture, specifically irrigation, will depend on effective and co-operative multi-state management. States will need to invest in irrigation systems, reform water management bodies and implement innovative agricultural production techniques in order to cope with the increasing demand for food.

There have been some advances in regional interaction and the recent Nile Basin Initiative illustrates the way in which national challenges to water stress can be supported by adding a regional dimension. Multi-state cooperation on the Nile has added strength to national capacities and increased the range of development options. The key concept has been benefit-sharing between states, which has replaced the previous system whereby each nation focused on its own water development strategies. Although there has been no real change in terms of legal entitlements, options for enhancing national benefits have been opened up under the umbrella of regional basin-wide agreements (refer Box 1 below).

Box 1: The Nile Basin Initiative

The Nile is the world's longest river flowing almost 6,700 km from its headwaters at the Kagera River in Burundi and Rwanda to its delta on the Mediterranean Sea in Egypt. The Nile Basin Initiative (NBI) launched in February 1999, is a regional partnership comprising the ten countries of the Nile basin who share a common goal for the long-term development and management of Nile waters. All ten countries – Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda - envisage sustainable socio-economic growth through the equitable utilisation of, and benefit from, Nile Basin resources (World Bank, 2002). More than 160 million people live within the boundaries of the Nile River Basin, while 300 million live in the ten countries that share the Nile waters. The region is typified by much poverty, instability, environmental degradation and frequent natural disasters. Several of the countries are ranked among the poorest in the world with less than US$250 per capita income. Given the rapid population growth in the region it is expected that any development within the basin will have important ramifications both on livelihoods and survival strategies.

Although only a transitional agreement until a permanent framework is in place, the NBI has launched a Strategic Action Programme to realise its aims and goals. The programme includes two subsidiary programmes:

1) Shared Vision Programme (SVP) – Building a foundation for cooperative action

It is the intention of the SVP to create an enabling environment for action on the ground through trust building and skills development. The SVP currently includes seven projects which build upon each other to form one coordinated programme. Four of the projects are concerned with thematic issues: environmental management, efficient agricultural water use, water resource planning and management and power trade. Three projects are facilitative in nature: one supports efforts to strengthen confidence building and stakeholder involvement, another is concerned with socio-economic development and benefit-sharing and the final one facilitates applied training.

2) Subsidiary Action Programme (SAP) – Seeking mutual benefits and investments on the ground

The SAP aims to deliver actual development projects to countries involved in partnership schemes. Two SAPs are currently in development. The Nile Equatorial Lakes Region Subsidiary Action Programme (NEL-SAP) includes the six southern basin countries and downstream riparians Egypt and Sudan. The Eastern Nile Subsidiary Action Programme (EN-SAP) includes three countries: Ethiopia, Sudan and Egypt.

An International Consortium for Cooperation on the Nile – ICCON was held in Geneva, Switzerland between 26 and 28 June 2002. ICCON provided a unique forum for the celebration of the commitment to a long-term partnership from the Nile Basin countries and the international community. Apart from state representatives, forty bilateral agencies, multi-lateral financial institutions, international organisations and NGOs attended. At the Consultative Group (CG) meeting more than US$100 million was promised in grant funds and investment.

Southern Africa

The southern African region (including eastern Africa) constitutes 4% of the world's arable land and is currently home to 300 million people (about 5% of the global population). Agriculture is very important to the region's economy and 88% of southern African water is utilised by this sector (Xie *et al*., 1992). However, given that the region withdraws only 4% of its total renewable water resources, compared to the world average of 8%, irrigation is underdeveloped (World Water Council, 2001). Although irrigation potential exists in many countries, two-thirds have developed less than 20% of their agricultural land[7].

At both regional and national levels, water resources in southern Africa are highly unevenly distributed. Variability is both temporal and spatial. The arid countries of southern

[7] Zimbabwe has only developed 30% of its irrigation potential compared to the 85% agricultural land under irrigation in South Africa.

Africa: South Africa, Namibia, Botswana, Swaziland, Lesotho and Zimbabwe have a combined population of approximately 60 million. Annual renewable freshwater resources in the arid southern African countries total 140 bm^3. Several countries, for example Namibia and Botswana, are poorly endowed with perennial rivers and have to rely either on rivers that rise outside their borders or on internal, unpredictable episodic and ephemeral rivers (Heyns *et al*., 1998; Pallett, 1997). In addition to limited resources, countries such as Namibia have problems accessing their water sources (FAO 1005a; 1995b). The more humid parts of southern Africa are Angola, Zambia, Malawi and Mozambique. The population total for these countries is 80 million and water resources are estimated at 630 bm^3 per annum.

Rainfall regimes are to a large extent dominated by the influence of the Indian Ocean. Patterns are largely seasonal and in many areas most precipitation occurs during a five to seven month wet season. There is a marked north-south trend in annual rainfall which encounters an easterly shift from the wet Indian Ocean coastline to the dry west (Falkenmark, 1989; Conley, 1995). The more humid eastern areas boast 800 mm annual precipitation, 80% falling mainly between October and March, while the Namib Desert in the west receives little to no annual rainfall (Calow, *et al*, 1996).

Following this marked rainfall pattern the river systems of southern Africa are also heavily seasonal in flow. For this reason a large number of dams have been constructed on many of the major rivers to store some of the annual flood and to generate hydropower. Given the political history of the region, many of these initiatives are unilateral (or bilateral) and only since the early 1990s have there been concerted efforts made at a regional level to address transboundary water management. The level of integration required is clearly evident as two or more countries in southern Africa share eight main river basins: the Congo, Zambezi, Limpopo, Okavango, Orange, Incomati, Ruvuma and Cunene.

The Zambezi and the Congo (the latter being on the northern periphery of the region but encompassing a significant swathe of Angola’s territory) are two of the largest river basin systems on the continent. To give an idea of scale, one hydropower scheme on the Congo alone could provide some 45,000 mega Watts of energy, sufficient to meet the entire current demand for electricity in southern Africa. The Zambezi River is another important regional resource reflected by the focus on its development by the Southern Africa Development Community (SADC). It accounts for more than 75% of the region's total mean annual runoff and drains some 40% of the land mass (Chenje & Johnson, 1996). Thirty large dams have already been constructed along the river, of which the Kariba Dam (between Zimbabwe and Zambia) at 160,000 million m^3 is the region’s largest. In recent years the management of these dams has been a point of concern for the downstream riparian Mozambique.

Other major rivers with key management structures include the Incomati between South Africa, Swaziland and Mozambique (with 10 dams totalling 12 million m^3), the Limpopo shared by Zimbabwe, Botswana, South Africa and Mozambique (with 43 dams and a storage capacity of 12 million m^3), the Save between Mozambique and Zimbabwe (with 20 dams supplying 2.6 million people) and the Orange River between Botswana, Lesotho, Namibia and South Africa, with 29 dams. New thinking on international river basin development is prompting major shifts in management of rivers, particularly given the context of the rising demand for water in countries.

To date transboundary initiatives such as ZACPLAN, OKACOM and the Incomati Basin Initiative, have not succeeded in resolving the major issues of allocation and management. It is hoped, however, that eventually these emerging institutional bodies will play an important future role in catchment management and help pave the way for a more inclusive and bottom-up approach. One of the key issues highlighted by this study is that policy options of water-stressed states must include also regional dimensions and strategies of water sharing.

Major southern African water projects often sit uneasily with the day to day requirements of communities. Governments support long-term programmes such as the expansion of irrigation, environmental projects and hydropower development, while many rural and urban households are more concerned with immediate survival. Communities access a variety of local water sources according to the different seasons but they depend to a large extent on groundwater resources. It is estimated that groundwater provides 60% of the water supply to communities in southern Africa. This is the result both of relative geographical availability and ease of access through shallow wells and other low-tech structures. In Botswana an estimated 80% of animals and humans rely on this resource (Chenje & Johnson 1996).

Appropriate groundwater management is hampered by a paucity of data on the resource base combined with a rapid increase in demand due to expanding rural and urban populations. Studies show average aquifer depths range from 30 m in the eastern part of the region to more than 100 m in the west. However, these are just average depths and systems exist which range from the shallow 20 m aquifers located in the east of southern Africa to the deep 200 m aquifers of Botswana and the 600 m systems located in western Namibia (Fruhling, 1996).

When considering groundwater extraction there are several factors which need to be taken into account. Firstly, most productive aquifers are frequently located in semi-arid or desert sub-regions, making both the development of the source and delivery of water to population centres a problem. Secondly, coastal aquifers located near densely populated regions are susceptible to over consumption and saltwater intrusion which renders the aquifers unusable in the long term. Thirdly, uncontrolled abstraction from deep wells, caused in large part by the rapid development of irrigation, can limit availability in any nearby shallow wells often the domain of the poorer communities and households.

In some instances the problem is one of restricted access rather than depletion of resource. Following successive years of poor rainfall, many parts of southern Africa suffered a 'groundwater drought' in 1992. According to Callow *et al.* (1996) well and borehole failure during droughts occur because of both increased demand on low-yielding sources and reduced aquifer recharge. It is suggested, however, that areas susceptible to groundwater drought will exhibit a combination of features which can help in their identification: hydro-geographical zones with low permeability, low yielding boreholes and wells and areas of high population demand. To date, the emphasis on wells and boreholes has detracted from the focus on the depletion of the groundwater resource base. Governmental policy and development directives must address the increasing stress on this water supply and take into consideration the various needs of all the stakeholders. In addition, given the intimate relationship between both groundwater and surface water, an holistic view of the total water supply is warranted.

Drought is another issue that urgently requires governmental scrutiny and action. In southern Africa they are significant not simply in terms of their effect on economic and social structures but also as events which can influence policy makers[8]. In South Africa, in particular, the last major drought occurred just prior to the democratisation process and 'policy space' was opened up enabling radical rethinking of water management priorities (Turton, 1999). In Zimbabwe, the drought experience has exposed the vulnerability of the national economy in times of stress and highlighted the fact that individual households can be mobilised to help mitigate the

[8] In addition to predictions of impending droughts and floods, policy makers desperately need information on long-term climatic shifts. The problem is the degree (or lack) of certainty surrounding current knowledge. Predicting rainfall change solely on the basis of rising temperatures is problematic for regions such as southern Africa as account needs to be taken of those events and atmospheric processes which affect 'extreme' weather, such as the El-Nino Southern Oscillation (ENSO). Only the broadest shifts are currently identified by climate change experts. These suggest that by the 2080s there will be an increase in rainfall in the equatorial areas of Africa and decreases in precipitation levels during the southern African December to February rainy season. Although these predictions relate to a time period far in the future, there is an urgent need to begin implementing mitigation strategies. This is especially pressing when considering the anticipated increase in population in the region and the associated higher demand for resources.

impact of these events. For example in 1992, 40% of Zimbabwe's population was affected by drought and the Gross National Product (GNP) fell by an estimated 12%. The slaughter and sale of 600,000 head of cattle provided temporary local employment and compensated for the acute drop in annual household maize production, from an average three tonnes per household in 1991 to less than half a tonne in 1992. The slaying and consumption of livestock offered an important coping mechanism for rural Zimbabweans at a time when the response from the government and agencies was inadequate (Waterkeyn, 1998 in Nicol, 1998). In terms of access to water, households played a key role in maintaining individual water points during the drought. In particular, upgraded family wells continued to provide water supplies in many areas. During this time only 10% of household wells failed compared to the 40% unproductive government-run wells. The well-deepening initiative taken by family members as the water table sank, combined with careful rationing of water use (which included giving up vegetable plots), allowed many communities access to sufficient amounts of water to survive.

Chapter 3: The resource environment in selected countries

This chapter investigates the water regime for each country case study and illustrates the particular conditions affecting the countries' freshwater environments and the related constraints. Each sub-section addresses a separate issue. The first is concerned with the natural conditions and overall water availability. The second looks at the socio-economic activities which drive the demand on resources, with relevant factors including population growth, economic expansion and basic rights. In the third sub-section institutional structures and bodies are investigated as all four countries have experienced assorted governmental restructuring with implications for water resource use. The final section addresses policy pertaining to national water resources and the way in which freshwater resources are managed by the various authorities and government officials.

The Jordan River Basin

Approximately 13.3 million people live in the Jordan River Basin which covers an area of 42,800 km^2 and is shared by Jordan, Israel, the West Bank, Syria, Egypt and Lebanon. Although the length and flow capacity of the Jordan River is relatively modest when compared to other rivers in the Middle East, the basin system is the largest surface water resource in the area. The region is beset with various challenges: political fragility due to conflict between countries, limited water resources (with the exception of Syria) and ever increasing population growth rates. Water is often regarded as a political tool in the region and has led to countries pursuing unilateral water policies and domestic resource management plans. The lack of a comprehensive water sharing strategy has not only led to a worsening of the overall water situation in the basin, but has also adversely impacted on wider regional development.

Joint regional management of the water resources and sound water agreements are urgently required. Although water has been perceived as a divisive issue, one which can undermine prospects for development, it also possesses an incentive for regional cooperation and can be viewed as an important instrument for peace among the riparian states. This research is concerned with two countries in the Jordan Basin: Jordan and Israel (including those Palestinian areas occupied by Israel). These countries have no other significant surface water sources and only limited groundwater reserves. Jordan receives half of its water requirements from the basin while Israel utilises the surface resource for 40% of its domestic water consumption. The following section addresses the complex issues facing each of these countries and the measures used to cope with water scarcity.

Jordan

Water availability

Jordan's lack of water availability is a fundamental feature of economic, political and social factors. Most urban Jordanians experience problems of water supply first-hand, with water supplied through the system only once a week in the summer months. Most of Jordan is situated on an arid plateau and receives little or no rainfall. Only 25% of the total area of Jordan is sufficiently humid for cultivation, which makes dependence on irrigation inevitable. Rainfall varies between 630 mm in the hills overlooking the Jordan Valley to as little as 200 mm elsewhere on the plateau.

Currently Jordan is one of the most water-scarce countries in the world. According to official figures, at the end of 1999, available water resources were estimated at 960 million m^3 per annum, leaving an annual water deficit of some 220 million m^3. Effective strategies are urgently required to address this situation.

Demands on the country's scarce resources are great, particularly from agriculture, which receives some 68% of all allocated water. The remaining water resources are allocated to the domestic sector (27%) and industry (5%). Jordan is rapidly exploiting much of its groundwater resources, situated mainly in the eastern desert. In the mid-1990s these sources provided some 60% of total supply. Some of these reserves are fossil aquifers and currently these sources are estimated to have a safe yield of some 275 million m^3 a year. At present 2,449 government and private wells access the important groundwater resources and regulation of abstraction and enforcement of licensing pose major challenges for the government.

Whereas agriculture consumes more than two-thirds of the country's available water, it contributes less than 10% of GDP and is shrinking further in importance. Currently the bulk of agricultural activity takes place in the Jordan Valley. The only rainfed agriculture possible is undertaken in the upland catchment of the River Jordan (accounting for some 90% of the cultivated area). Of the 36,000 ha of irrigated land in the Jordan Valley, approximately 28,000 ha are currently under cultivation. The remaining 8,000 ha lack sufficient water for development. Another factor impacting on cultivation is the high cost of irrigation, costing US$3,000 per ha. Additionally, each hectare requires 1.5 labourers, making cultivation in these areas economically unattractive [9].

Droughts in the 1980s and 1990s increased perceptions of Jordan's acute vulnerability within both governmental agencies and the wider society. The response included both supply- and demand-oriented strategies. The former is in some ways a less domestically-awkward response, although more internationally contentious, particularly where this involves joint ventures with neighbouring states. To date, construction activities have included the heightening of the King Talal Dam. Its reservoir capacity has been increased to 90 million m^3 and has provided supplementary irrigation flows to the East Ghor Canal at Adasiyah. Other projects include the Maqarin or 'al-Wahda' (Unity) Dam[10] and an associated hydropower station on the Yarmouk River in a joint venture with Syria. This is expected to provide additional storage of 225 million m^3, although how this would be apportioned remains a contentious issue. In mid-2000 bids were invited for the related US$205 million dam construction. During the 1990s there were also plans to increase storage capacity through raising the height of the Kafrein Dam thus increasing reservoir capacity from 4.3 million m^3 to 7.5 million m^3. By the mid 1990s, new dams were constructed at Walah, Karameh[11], Mjib and Tanur, creating a combined additional storage capacity of 115 million m^3.

On the demand side considerable emphasis has been placed on reforming irrigation in the Jordan Valley. Schemes have included the transfer of technology to enable increased drip methods and other less water-consuming forms of irrigation. The government aims to make savings in some areas of up to 20%. The importance of reforming water use in the agricultural sector is evident as farmers currently use some two-thirds of the country's total water supply. A 20% reduction in flows to agriculture could reduce demand on water by this sector by some 210 million m^3. This is roughly equivalent to the total current annual water deficit. One of the key challenges faced by policy makers and implementers is the shifting of preferences for cropping highly consumptive citrus varieties and bananas to less water intensive species. These crops are of high value to the individual farmers but their cultivation places a high opportunity cost on the rest of the economy. Other sectors, including agriculturalists farming lower valued produce, are

[9] Some 40,000 agricultural labourers in the valley are believed to have originated from Egypt. There are some suggestions that the figure could be as high as 75,000, as there are additional labourers who fled Iraq during the Gulf War.

[10] Possible sources of funding for the dam include the Arab Fund for Development (AFD), the Islamic Fund and the Abu Dhabi Fund.

[11] This dam was constructed with JD55 million provided by the AFD from 1993-1998.

forced to compensate for their water requirements through additional capture, production and/or exploitation.

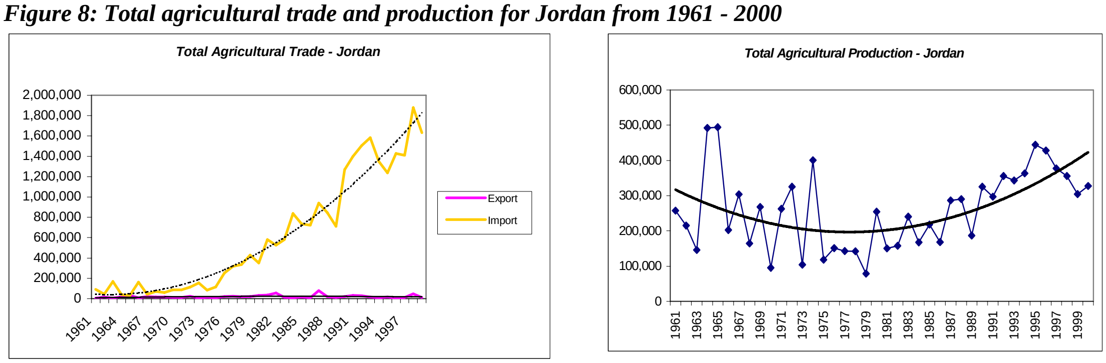
The highly contested Jordan River remains the focus for agricultural efforts and other water expansion programmes and most of the agricultural development budget is currently spent on its development. The river is fed by tributaries and springs along its length and flows roughly due north-south before finally discharging into the Dead Sea. Annual average discharge including that of the Yarmouk River, which feeds into the river south of the Sea of Galilee[12], is around 1.3 to 1.5 billion m^3. The first 96 km of the Jordan River flow through Israel and the remaining 152 km through Jordan. Key management challenges on the watercourse are capturing excess flows in years of high rainfall and regulating discharge effectively[13]. South of the Sea of Galilee the flow of the Jordan River is substantially reduced by the Israeli National Water Carrier off-take. Irrigation in and around the sea itself further reduces capacity. The southern drainage basin of the Jordan-Yarmouk (mainly in Jordan itself) supplies about 749 million m^3 of water.

<u>Socio-economic issues</u>

Given the highly charged political context of the region and the looming possibility of war in neighbouring Iraq, the socio-economic challenges facing Jordan go far beyond the issue of water and agriculture. Jordan is home to tens of thousands of Palestinian refugees and the Israel-Palestine conflict has had a permanent effect on the country's economy and society. One of its biggest impacts was the annexation by Israel of the West Bank of Jordan in 1967.

In addition to the precarious political climate in the region, there is also substantial meteorological variability. Years with poor rainfall figures can add further strain to the country's limited water assets. For example, between 1987 and 1990 flow in the Jordan River dropped by about 50% and levels in the Sea of Galilee, the key upstream source, reached an all-time low[14]. In 2001, however, the Jordan Basin countries experienced a major rainfall event which allowed the region's major aquifers to reach higher levels than those experienced in 1967.

Figure 8: Total agricultural trade and production for Jordan from 1961 - 2000



Jordan's population at the end of the1990s (East Bank only) reached 4.8 million with densities at 56.4 people km^2. Some 20% of this total lived in the capital Amman. The population

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[12] The Yarmouk River's annual average discharge is in the region of 467 million m^3. However, due to current Syrian use upstream this is more likely to be in the region of 270 million m^3, according to Jordanian water professionals.

[13] Although the Sea of Galilee receives some 800-910 million m^3 of flow each year (of which about 600 million m^3 comes from the Jordan and its tributaries), after evaporation this is reduced to only 610 million m^3. Its low operating capacity means that the sea cannot act as a useful international reservoir even if it was politically feasible to do so.

[14] In late 2000, the Sea of Galilee was said to have reached a level 80 m below the lowest point ever recorded. The lower the lake gets the greater the cost of pumping water up into the National Water Carrier.

of the Jordan Valley itself rose from 63,500 people in 1973 to approximately 280,000 in 2000. Even when taking this increase in population into account, the proportion of employment provided by agriculture has declined during this period. According to the Ministry of Labour, in 1992 (the last year for which official figures were available), agriculture provided only 7.3% of employment compared to 48.7% provided by the service sector[15].

<u>The institutional environment</u>

The institutional environment is dominated by issues of transboundary resources management between co-riparians and has witnessed a number of attempts at effecting transboundary management institutions over the years. This section is therefore pertinent to all the Jordan Basin riparians. (Note the following section on Israel and Palestine).

Management efforts preceded the creation of the State of Israel in 1948 but received renewed impetus as US foreign policy focused firmly on the region during the 1950s. The cause was championed by the then US Ambassador Johnston, who led the attempts to reach a comprehensive transboundary agreement termed the 'Johnston Plan'. It was, however, never fully implemented[16].

The 1956 Second Version of the Johnston Plan envisaged equitable water allocations for all co-riparian states based on separate national level development of water resources. Of the total estimated annual water availability of 1.29 billion m^3, Syria was to receive 10.3% (132 million m^3), Jordan 56% (720 million m^3), Israel 31% (400 million m^3) and Lebanon 2.7% (35 million m^3). This plan includes many features either currently incorporated in the Israeli-Jordan Peace Agreement, or under consideration for future inclusion. At the time, the political concerns of several riparians prevented final acceptance of the plan even though at one point states had been close to signing. The failure to reach a comprehensive approach to the river's development allowed the establishment of unilateral programmes during the 1950s and 1960s. This approach in effect set the benchmark for future development of the river. Following Israel's military victory in the Six Day War in June 1967 and its subsequent occupation of the West Bank of Transjordan and of the Golan Heights in Syria (including, critically, the remaining half of the Sea of Galilee), Israel extended its dominance over the region's water resources.

Not until the Oslo Peace Process between Israel and the Palestinians in the early 1990s did political relations warm sufficiently to enable further joint decision making on the river. Co-operation received a boost in 1994 when Israel and Jordan signed a peace treaty[17]. Pursuant to Clause 6 (and Annex II) of the treaty, there is recognition of the rights of both sides to the waters of the river, agreement on the principle of no harm and recognition that water sources for both sides are inadequate for their needs. Practical issues included water sharing, the timing of allocations and water quality issues. Under the treaty's provisions, Israel agreed to provide Jordan with *de facto* storage services for 20 million m^3 and both parties agreed to desalinate saline water diverted from the Sea of Galilee (although this body of water was deliberately not mentioned by name), of which Jordan was to receive 50%.

Nevertheless, problems with the agreement remained including, inevitably considering its bilateral nature, in failing to address Lebanese, Palestinian and Syrian claims. It also neglected to make provision for years of low rainfall levels thus preventing either party pursuing drastic unilateral action to ensure supply availability. A joint water committee was established whose

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[15] Figures are for Jordanian citizens only. Some regional officials claim that Palestinians came to Jordan with their 'water rights in their pockets', implying that some of the anticipated allocations of the river to Palestine should in fact be made to the eastern Ghor Canal instead.

[16] One informant, however, stated that this plan in fact had formed the basis for the Jordan-Israel water-sharing agreement.

[17] Shapland, 1997, 29.

role comprised day-to-day management issues, including implementing current arrangements and discussing and planning future activities. Efficient functioning of the committee has been affected by wider Arab-Israeli hostilities and by practical issues such as data sharing.

Several key projects under the auspices of ‘Peace Projects’ have arisen directly from the treaty between Israel and Jordan. These projects include regulation of the Yarmouk River, development of a desalination conveyor to urban Jordan, storage facilities on the Jordan River and in several side wadis and the Addasiyah Diversion Weir Project. The total estimated cost for these developments is in the region of US$582 million. Many of these projects are related to earlier proposals made under the Johnston Plan.

Jordan has also instigated bilateral projects with Syria. One of the most important of these projects is the construction of the al-Wahda (Unity) Dam[18]. Following the signing of an agreement in 1987, progress has advanced significantly, in spite of problems between the two countries following the outbreak of the Gulf War in 1991. The dam’s significance for Jordan is its ability to capture and regulate seasonal flows of the Yarmouk River. The total construction cost of the project was US$150 million and the anticipated yield to Jordan is expected to be between 80 and 150 million m^3 per annum.

Current and future co-operation on water resources is more problematic. The increasingly conflictual political environment has the ability to jeopardise future agreements on major water sharing issues. Projects such as the Al-Addasiyah Diversion Weir are now unlikely to take place[19]. Progress on a US$150 million joint desalination plant for brackish spring water between Israel and Jordan has also been frozen due to financing and siting issues (whoever hosts the plant has to deal with its substantial environmental implications). The plant was expected to provide 50 million m^3 drinking water to Jordan.

Various donor agencies, however, remain involved in major projects in the Jordan Basin. USAID, a key donor in the area, focuses on enhancing water sector institutions, increasing efficiency in use of water resources and improving the quality of wastewater. They have helped instigate a new financial accounting system for the Jordan Valley Authority. Public education programmes on water issues have been created and skills enhancement courses for technical staff are provided. USAID also liaise with other donors in the region. One such multi-donor collaboration involves the restructuring and rehabilitation of eighteen zones in the Amman water system. Although outwardly supportive of the projects and programmes underway in the basin, privately donors question the regional and national capacity of the countries concerned. (These questions are echoed in southern Africa. Refer sections below).

In terms of regional capacity, one of the most obvious concerns is the political pressures at play in the region. Volatile relations between the riparians are longstanding and it is difficult to foresee any change to the *status quo* in the short term. The structures of governments vary considerably in the Jordan Basin, as do the economies and societies. Such diversity is not specific to this region but when combined with the lack of political will, it impacts on regional innovation and progress. Donors perceive these factors as impediments to successful advancements. They are especially concerned that the individualistic nature of many of the governments hinder the ability to allocate donations and funds wisely and in the best interests of all parties. It must be noted, however, that some regional environmental watchdog groups do exist and these attempt to provide a mechanism for effective and fair regional water development[20].

Due to the spill-over effect, transboundary issues and regional capability reflect also, in part, national capacity. Given the links between farming interests in the Jordan Valley and

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[18] It had earlier been proposed under the Johnston Plan as the Maqarin Dam.

[19] The project would divert some 20 million m^3 of incremental water into the King Abdallah Canal with a total capital of US$30 million and recurrent costs of US$0.3 million (1996 prices quoted).

[20] Friends of the Earth Middle East, a consortium of Middle East environmental non-governmental organisations, is one example.

political elites in the government, conflicts within national institutions in terms of the management of state water are not uncommon. In Jordan, the political system ensures strong control by powerful civil society groups such as the Jordan Valley farmers. Similar political influence extends to control of the abstraction of water from aquifers and crop selection. These groups enjoy unregulated use of surface and groundwater, an acute problem in Jordan[21]. Although small in number, as a lobby group, these civil organisations enjoy significant influence. Many in the Jordanian water industry are concerned about the impact of this situation on the long-term national water resource.

The government of Jordan is actively involved in encouraging the wider participation of the civil society in its water issues. This goal forms part of the legislation and is chronicled in Jordan's Water Strategy (1997): 'the public shall be educated through various means about the value of water for them and the well being of the country'. Another aim of the Water Strategy is to back a public awareness campaign on groundwater. The campaign will complement an intended programme – a venture proposed by the Water Authority of Jordan and the Ministry - aimed at 'educating' farmers on the importance of groundwater protection and the promotion of wastewater reuse.

Policy options

Jordan faces acute water stress problems in coming years. The only realistic solution is to transfer water away from agriculture to ease pressure on domestic and industrial users. While desalination is regarded as a possible solution, it does have a number of limitations, one of which being that Jordan has an extremely short coastline to which the residual saline solution can be disposed.

Supply augmentation programmes may also not be sufficient to eliminate the projected deficits. Developments such as the al-Wahda Dam are expected to supply lower yields than originally anticipated. New figures for the project are 80 million m^3 water for Jordan and 10 million m^3 allocation to Syria. An additional, unexpected problem is protecting the quality of return flows from Syrian irrigation in the upper Yarmouk region (an application not originally part of the agreement between the two countries).

The critical issues across much of the country are maintaining water quality and managing wastewater use. To this end, future foreign donor input into the national water sector will focus on wastewater treatment and management. The Jordanian government has also shown its willingness to increase water efficiency by making improvements to national water bodies. The Water Authority of Jordan (responsible for groundwater) recently signed an agreement with the Jordan Valley Authority. The main aim of the partnership is to increase water management capacity within the Kingdom. Effective policy development at the national level is impeded, however, by the lack of key professional expertise in areas of policy and decision making. The country is undergoing a brain drain both at the national level, from the public to the private sector, and within the international arena. Educated and trained water professionals are often enticed by large salaries and perks to areas in the Gulf.

This loss of skilled manpower comes at a critical time for Jordan. Nationally, the water deficit has risen from 501 million m^3 in 1995 to 559 million m^3 in 2000. Government figures predict an anticipated deficit of 620 million m^3 for the year 2010. Remedies to alleviate the situation have been set out in Jordan's Water Development Strategy to 2011, published in 1997. The strategy itemises 61 projects with a projected cost of US$5 billion. Major projects under the strategy include the Three Dams Project which will provide water for the Dead Sea industrial and tourist projects and additional water for extending irrigation in the southern Jordan Valley. A second major project is the construction of a 325 km conduit which will allow 110 million m^3

[21] This is in spite of the fact that the government has laws regulating abstraction and the cultivation of highly water consumptive crops.

water to be brought from the Disi (fossil) Aquifer in southern Jordan to Amman. In concert with this supply augmentation, additional improvements to Amman's water supply (a city accounting for some 35% of the country's total water demand) are to be sought through the Greater Amman Water and Wastewater Project[22]. Overall, the projects are expected to raise water consumption from the 1,451 million m^3 required in 1995 to 1,720 million m^3 anticipated for 2010, 1,088 million m^3 of which (63%) will be used in agriculture.

This hefty allocation of water to agriculture is one of the fundamental problems facing water-scarce Jordan as the sector provides a mere 5-6% to GDP. Some donors, including USAID, have tried to encourage through conditionality the raising of tariffs on water, but there has been widespread resistance to this. Various mediums, including the media, have been employed to increase awareness within the general public to the acute water scarcity. Future external support will also, most likely, be dependent on increased tariffs. The current average price is some 15 fils per cubic metre but this would need to be raised significantly in order to reflect the real cost of agricultural water.

Policy options are being pursued also at the local level to address the current water limitations. Farmer irrigation efficiency is one area which is currently targeted. Problems exist particularly at the tertiary level where there is competition and allegations of water theft between farmers. Efforts are being made to establish small-scale water manager associations, each group to consist of 10 farmers. The aim is to facilitate better relationships between farmers and aid government programmes and interventions. Training will be provided on alternative irrigation techniques and advice on sensible crop selection will be given.

[22] Current losses to Amman's water supply are estimated to be as high as 50%. Figures for other urban areas are even higher, with loses at 80%.

Israel and Palestine

Water availability

In common with Jordan, Israel and Palestine (comprising the Occupied Territories of the West Bank and Gaza Strip), are severely water-stressed. For decades, water consumption has been in excess of natural water production capabilities. By 2000, the per capita resource potential for both Israel and Palestine was estimated at 250 m^3 and 115 m^3, respectively, placing these countries at the bottom end of the world water poverty scale.

The headwater of the Jordan River originates from three tributaries, the Dan, Baniyas and Hasbani. These three waterways merge in Israel north of the Sea of Galilee to form the upper Jordan River. Of these tributaries only the sources of the Dan originate within Israel proper. Both the Hasbani and Baniyas are located in areas which have been, or are currently, sites of political contention. The Hasbani springs are located in the southern part of Lebanon, an area previously situated within the Israeli security zone until June 2000. The Baniyas waters drain from the Golan Heights, a territory occupied by Israel since the 1967 war with Syria. South of the Sea of Galilee, the Jordan joins the Yarmuk River where it continues to flow in a south-westerly direction to the West Bank. However, on reaching the Palestinian territory the river is usually no more than a brackish muddy stream, due to intense extraction by the upstream riparians; Israel, Jordan and Syria[23].

Groundwater, also supported by the Jordan River Basin, is the principal water resource in the region. Israel and Palestine share two aquifer systems: the Mountain Aquifer (located under the hills of the West Bank) and the Coastal Aquifer (positioned under the coastal zone including an area covered by the Gaza Strip). One of the greatest challenges facing Israel has been the transfer of water from the wet north of the country to the southern cities and agricultural areas. To this end a key feature of the country's management system was the development of the National Water Carrier, in the 1960s, providing an annual capacity of 320 million m^3. Constructed amid considerable controversy and tension with neighbouring countries, this structure helps to supply the Negev desert area. Currently it provides water at a cost of some 25 US cents a cubic metre (approximately half the cost of desalinated water), although the price paid by farmers is just 15-20 US cents per cubic metre, i.e. they receive water with a substantial subsidy.

Palestinians have no direct access to the Jordan River under Israeli Occupation. In the Gaza Strip limited surface water places a huge demand on available groundwater[24]. This source of freshwater is, however, severely over-pumped. The result has been the lowering of the groundwater table below sea level and, in many areas of the aquifer, sea water intrusion and high salinity levels (Sabbah & Isaac, 1995). Rainfall figures for the West Bank are variable. In the relatively high altitude region, the range is between 600 and 800 mm per annum but levels fall to 200 mm in the eastern part of the Jordan Valley. In 1998/99 the Palestinian economy was severely affected by drought.

At present, many working in the Israeli water sector are concerned about the deteriorating quality of resources due to agricultural, industrial and demographic pressures (UNED, 1992). Intensive agricultural techniques combined with persisting water scarcity have resulted in degradation of the water quality in much of Israel. The Coastal Aquifer situated beneath almost one-third of the Israeli population provides water for much industrial and agricultural endeavours.

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[23] Shimon Peres once summed up the situation by declaring that "one can find more history than water in the Jordan River".

[24] The rapidly declining quality of Gaza's groundwater is a source of international concern. Irrigation of the important citrus crops in the Gaza Strip is seriously affected by raising salinity. The salinity of some groundwater is three times higher than the World Health Organisation's (WHO's) recommended safe levels.

Recent studies have found high levels of contaminants in the groundwater, including nitrates, fuels, heavy metals, chemical pollutants and toxic organic compounds.

Table 1: Total Israeli water availability and consumption over four decades

Israel	**1999**	**1998**	**1997**	**1996**	**1995**	**1990**	**1979/80**	**1969/70**	**1964/65**
Total water (mcm)	2,151	2,226	2,074	2,041	2,029	1,939	1,743	1,711	1,393
- Of which Kinneret	*94*	*376*	*386*	*386*	*371*	*153*	*273*	--	--
- Wells	*1,336*	*1,100*	*976*	*955*	*982*	*1,126*	--	--	--
Total Consumption (mcm)	2,073	2,166	2,008	2,013	1,983	1,804	1,700	1,564	1,329
- Of which agricultural	*1,264*	*1,365*	*1,264*	*1,285*	*1,275*	*1,216*	*1,235*	*1,249*	*1,075*
- Industrial	*127*	*129*	*123*	*124*	*120*	*106*	*90*	*75*	*55*
- Domestic	*682*	*672*	*621*	*604*	*588*	*482*	*375*	*240*	*199*

Source: Statistical Abstract of Israel, 2001 (No. 52). Central Bureau of Statistics (data from Israeli Water Commission)

The 1994 Peace Agreement reached with Jordan set out a bilateral agreement on sharing and managing water resources. It also facilitated discussions on other potential water sharing options, although their implementation will depend on the future stabilisation of political relations between the two countries. One of the proposed projects is the desalination plant in the Jordan Valley which is expected to provide approximately 50 million m^3 of water annually and will be shared equally between the two countries. The bilateral arrangement, which has had the benefit of restricting water conflicts to political rather than military affairs, has not been without its problems. For example, in 1999, spurred on by the extreme drought, Israel reduced the amount of water piped to Jordan by 60%. A quick sharp response came back from the Jordanians.

In Israel agriculture has been rapidly declining as a consumer of water, in part reflecting government policy to stem usage, but also resulting from the declining value of agriculture to the Israeli economy. Water consumption in Israel in 1999 reached 2,151 million m^3 of which 59% was used by agriculture, 32% by domestic users and 6% by industry. In the mid 1980s 70% of available water resources were allocated to agriculture (Deconinck, 2002).

The development of non-conventional water resources has been a priority for Israel and efforts have focused on various options including reclaimed wastewater effluents, intercepted runoff and desalination. In 1999, it was estimated that 300 million m^3 (25%) of the total amount of water supplied to irrigation was in the form of reclaimed sewage effluents, a figure expected to increase to 600 million m^3 by 2020 (The Ministry of National Infrastructures, Israel, 2002).

Several local and regional intercepted runoff schemes exist which divert storm flow from rivers into reservoirs. Currently, 40 million m^3 are intercepted and either pumped into the supply system or allowed to percolate into the underground aquifers. Experts estimate that a further 95 million m^3 water can be generated from storm water over the next few years.

A further key development has been the progress of proposals to develop desalination capacity. Although the grandiose Red Sea-Dead Sea Canal Project which was projected to provide 850 million m^3 of water per annum at a cost of US$4.5 billion has yet to be taken forward, other smaller desalination plans are currently under construction. In the long term, desalination is seen as the most economically viable guarantee of Israel's water security. Costs have fallen almost ten-fold since the late 1970s to around US$0.5 per cubic metre at current prices.

Socio-economic issues (Palestine)

In mid-2000, the population for the Occupied Territories was 3.2 million with an extremely high average population density recorded at 535 per km^2. Roughly two-thirds of the population live in the West Bank and a third in the Gaza Strip. However, the population pressure in the Gaza Strip is extremely severe as the territory occupies a mere 6% of the total land area.

The Palestinian economy was formerly tied to Israel's market through employment. Israeli construction in particular relied to a great extent on Palestinian casual labour. During the early 1990s 35% of the population in the West Bank and 45% of Gaza's workforce were employed in Israel. Since the Al-Aqsa *Intifada* in 2000[25] this economic relationship has been suspended.

Water is one of the most important factors constraining attempts to establish peace between the Israelis and Palestinians[26]. Israeli domestic water policy has a serious effect on populations living in the riparian states and especially on those living in the Occupied Territories. The major issues of poverty with respect to Israel and water use relate to the occupation of Palestinian lands since 1967. Palestinian territories face major problems of water usage, arising from both common problems of agricultural demand as well as the severe restrictions placed on available water by illegal Israeli settler communities.

The Palestinian economy is largely dependent on agriculture and its contribution in 1999, combined with fishing, was 9.5% of GDP. This sector employs 12.7% of the Palestinian labour force and consumes an estimated 70% of total available water. The development of agriculture is under severe constraints due in large part to the lack of investment in irrigation and the resulting barriers to productivity. Compared to the 45% of land under irrigation in Israel, only 4% of the total land area in the West Bank is irrigated.

The institutional environment

In 1959, Israel passed the Water Law (amended in 1971 and again in 1991). Under its remit water was defined as a national public good. This meant that all water, including waste, sewer and runoff was the property of the state. The law also provided for the creation of the Water Commission, a permanent body to oversee and allocate water rights. At the head of this body is the Water Commissioner whose role includes the supervision of the National Water Carrier and the development of water projects. The government at the time of creation determined that two-thirds of the Water Commission would be made up of 'public' representatives[27]. Members of the commission are supposed to reflect all the water consumers of Israel, however, the 'Agriculture Centre', the main lobbyist for the farm sector, are guaranteed 13 representatives. Initially, both the Water Law and Water Commissioner fell under the jurisdiction of the Department of Agriculture. Today, however, responsibility for both is shared by the Minister for Agriculture and the Minister for Infrastructure.

The official government body responsible for pumping and supplying 66% of Israel's water is Mekorot Ltd. This public corporation is also empowered to undertake the planning and development of water resources. Much of the distribution and supply of Mekorot's water takes place through the National Water Carrier. Much criticism has been levied at Mekorot. It has been accused of being a wasteful monopoly with no incentives to improve efficiency, cut costs or downsize (Plaut, 2000). The modus operandi has traditionally been to supply water at costs so low that they do not cover the actual costs of production. Each year the losses have been covered by heavy subsidies provided by the government.

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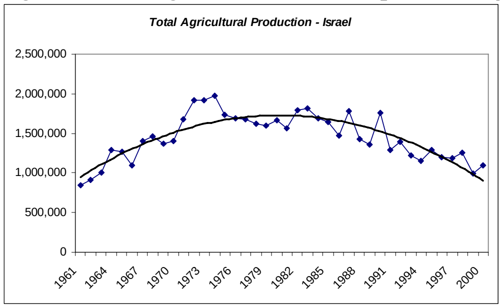
[25] So called because its origins lay in now Prime Minister Ariel Sharon's infamous visit to the Temple Mount (site of Al-Aqsa mosque) under heavy police guard, prompting violence that has subsequently spiralled out of control.

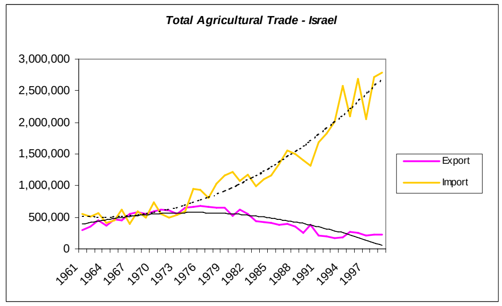
[26] the other four being Palestinian refugees, Jerusalem, Jewish settlements and the status of a future Palestinian entity (Deconinck, 2002).

[27] In total there are 39 commissioners.

Israel successfully managed the transition from a largely agricultural-based market in the 1950s to a hi-tech industrial economy in the 1990s. At the time of the shift the Israeli economy was ripe for innovative policy measures, acceptance of which would have been impossible in earlier decades. By the mid-1980s, Israeli agriculture consumed in excess of 70% of the country's available water but accounted for a mere 3% of GDP while employing a tiny proportion of the population. In contrast, industry and the services sectors utilised 5% of the economy's water while contributing 97% to GDP.

Figure 9: Total agricultural trade and production for Israel from 1961 - 2000





By 1986, the US government had also begun pressing for radical reforms to the Israeli economy and specifically to its water management policies. At the same time Israel's legislators were being heavily lobbied by environmentalists who criticised the Government's management of the Sea of Galilee and the Mountain Aquifer under the West Bank. The situation was further compounded by the fact that the eastern Mediterranean Region was experiencing a severe drought. A window of opportunity produced by this concurrence of factors combined with the required political sanction enabled a dramatic shift in allocation policy. The share of water to agriculture was reduced by 30%. In addition, the price of water to farmers was increased ,improving the economic returns on water (Arlosoroff, 1996).

After the occupation of the West Bank and Gaza Strip in 1967, a new water regime was implemented in the territories and authority over resources was shifted to the 'Civil Administration' and subjected to Israeli water legislation. Institutional control over Palestinian water affairs was finalised in 1982 when water management was transferred to Mekorot. Water supply to the Palestinian population is currently deemed extremely inadequate. For example, in the West Bank, locals receive only 20% of the resources which originate in the subterranean basin. Many Palestinian villagers do not have access to running water and most of the older established wells have dried up resulting in a reliance on distant wells and tank lorries. Several other factors have compounded the already difficult situation. The current Intifada and the associated siege of Palestinian towns and villages by the Israeli authorities have resulted in an exorbitant price for water deliveries. Also, much water is lost due to the collateral damage brought about by shelling and by the bulldozing of pipelines (UNDP, Focus, 2002 – refer references Deconinck, 2002).

In terms of institutional structures and support, the water requirements of nearby Jewish settlements, located in contested land areas, have been sustained by the Israeli authorities. This has led to a great deal of conflict between the settlers and the Palestinians. Water installations and wells built in the Jewish settlements have physically impacted on Palestinian access to water and have understandably caused frustration. The disparate distribution of resources has had various ramifications. For example, in the mid-1990s the entire Palestinian agricultural production was allocated 152 million m^3 of water annually by Israeli water institutes, compared to the 56 million m^3 allocated to the 120,000 Jewish settlers. Palestinian authorities accuse the Israelis of shifting their water shortages onto the Palestinian people. Israeli authorities deny accusations of a 'double water policy' for Palestinians and Jewish settlers. Figures quoted by the government show a 20%

increase in Palestinian water consumption under Israeli administration and they blame Palestinian mismanagement for supply problems. Ecological damages to the Mountain Aquifer have been attributed to over pumping and infiltration by those living under the Palestinian Authority (Plaut, 2000). However, Palestinians attribute any accusations of mismanagement to the fact that they lack the necessary financial means for investing in water development and blame the Israeli occupiers for preventing the establishment of appropriate institutions. The inequalities experienced by the Palestinians is highlighted by the available statistics: the average per capita water consumption for an individual living in the West Bank is 35 m^3 while it is 321 m^3 per capita for an Israeli living either in one of the settlements or in the country proper.

Policy options

In August 2000, the Water Commissioner submitted a Water Policy Plan to the Israeli government (implemented in August 2001), which set out a general framework for managing the water resources for the following twenty years. The Cabinet reconfirmed the contents of the document in April 2002 and approval was given for a transitional master plan for the water sector applicable until 2010. The main aim of the plan is to conserve and manage limited natural water resources in light of population growth and economic development.

The plan has already received some criticism, as calculations for allocations have been based on average rainfall and surface flow levels for the period (Deconinck, 2002). This is based on the presumption that enough good rainfall will occur to compensate for those years when natural water stores will not be recharged sufficiently. Given that extraction figures from the coastal aquifer between 1980 and 1996 indicate that for eleven of the sixteen years there existed a water deficit, doubts are cast on the reliability of averaging figures. In addition, all projections in the plan are based on the assumption that an average starting point was in existence when the policy initiatives were put into effect. Unfortunately, instead of the anticipated levels, five successive years of below average winter rainfall between 1998 and 2002 resulted in depleted underground and surface reservoirs and water resources at an unsustainable yield.

Actual freshwater consumption is expected to be 2,000 million m^3 by the year 2020. Currently, freshwater consumption levels of 1,785 million m^3 are beyond the sustainable yield of 1,555 million m^3. The deficit is currently being met through non-conventional water sources. In its water plan the government clearly states its preference for desalinisation to alleviate future pressures and sets out a timetable for the construction of plants. These include the decision announced in early 2000 to build the first desalination plant near Ashkelon that would produce some 50-100 million m^3 of desalinated water each year. It is projected that a new plant with a capacity of 50 million m^3 will be built every two and a half years.

Reducing the cost of desalinated water in an economy like Israel enables new policy—and political—space to be created. This is true in both economic and security terms, the latter an issue of critical importance to Israeli policy. Cheap desalinated water would reduce reliance on West Bank groundwater which would afford both financial and political advantages. For the peace-builders amongst Israel's political elites, it is reasoned that it is in Israel's interest to ensure that any future Palestinian state has sufficient water to survive. To this end, half the share of the mountain aquifer—some 200 million m^3 a year—would be sufficient for the West Bank's needs, at least for the next two decades. The resulting decrease in allocation to Israel could be met through desalinated water, the cost of which would be (at current costs) US$100 million, a fraction of Israel's GDP and about 1.5% of the annual import bill from the USA (Shuval, 2000). As mentioned above, water has been an important stumbling block to peace discussions between the Israelis and Palestinians. It is a firm belief held by many that any long lasting negotiations between the two will need to incorporate arrangements for the equitable distribution and management of water resources.

Another option identified for future consideration in relation to the water policy plan is treated sewage water. This water will be targeted mainly for use in irrigation and it is estimated that approximately 830 million m^3 should be available by 2020. One of the key policy directions is the increased emphasis being placed on the reuse of wastewater in agriculture.

As well as addressing supply issues, the government has been attempting to regulate demand, particularly from agriculture. The shift of water away from agriculture continues. In 2000, Israeli officials claimed to have moved half a billion m^3 water from agriculture to the municipal sector and to have cut off some 70% of freshwater supply to agriculture. This shift has caused major conflict with farmers who sometimes use their political clout to lobby for increased allocation of water and who have even taken it upon themselves to solicit water officials in person. Even with these reductions, however, a substantial amount of water is still being allocated to this sector. Although the proportion of agricultural exports has decreased in the last few decades, in absolute terms there has been an increase in exports. Figures quoted range from US$20 million in 1950 to US$666 million in 1991. The area under cultivation has risen from 408,000 acres in 1948 to 1.1 million acres in 1991. This is reflected in the fact that in 1999, 59% of water was still being allocated to agriculture.

No mention is made in the water policy report of any future plans for further reductions to agricultural water. It is clear that the position taken in the policy document is that of safeguarding agricultural productivity. It acknowledges the prominence of the sector within the economy and generally emphasises the government's unqualified support for agriculture. Some critics disapprove of the government's standpoint. Deconinck (2002), for example, argues that if the consumption of potable water was 880 million m^3 in 2002, an amount of 530 million m^3 high quality water supplemented by an additional 620 million m^3 will be required to maintain current productivity levels. In addition, local agricultural products sold outside Israel constitute an export of virtual water and an economic inefficiency. Other commentators go even further and state that Israeli water policy, especially in terms of allocation, has been an unmitigated disaster (Plaut, 2000). Due to government mismanagement and its wasteful, politicised administration, water policy has had a harmful impact on agricultural productivity and it is argued, has even led environmental destruction.

Even were the economy to become more dependent on economic activity and a reduction in agricultural use be realised, development in the industry sector would still require an increased input of water. The water plan document sets out the parameters for the future water requirements of the industrial sector. Economic development, combined with rising birth rates and continuing immigration, are together expected to increase by 60% the amount of water required in the year 2020.

Unlike the Israelis, who have been able to shift the basis of their economy to the service and industry sectors, agriculture will remain for now and in the foreseeable future, the only economic option available to the Palestinians. It requires low capital investment, the technology is easy to absorb and rural populations depend almost exclusively on this sector (Sabbah & Isaac, 1995). In addition, the present suspension of employment opportunities in Israel reinforces the importance of agriculture. However, even though the Palestinian economy is extremely reliant on agriculture (it provides in excess of 30% of national GDP), almost 60% of the food requirement is met through imports. A significant feature of the Palestinian economy is its reliance on international food aid hand-outs.

Although the current Israeli water policy plan does not include any allowance for Palestinians living in the Gaza Strip (this area is not covered by the Israeli National Water System), it does, however, include proposed transfers of water to those living in the West Bank. If implemented, this will raise the average level of water consumption from 35 m^3 to 7 0m^3 by the year 2020 resulting in an additional transfer of 115 million m^3. This allocation will not, however, provide sufficient capacity to meet demands. The projected water estimates for the agricultural sector are 304.5 million m^3 for 2010 and 415.2 million m^3 for 2020 (ibid). Even with a more equitable allocation of resources, those living in the West Bank will need to meet the deficit through treated wastewater. There are also suggestions that a restructuring of the sector is required with the introduction of brackish-water-tolerant crops and appropriate intensive agricultural techniques.

If a time comes when Palestinians are able to follow Israel's lead and shift to a more industrial based economy, adequate policies will then need to be implemented. Prior to the outbreak of the present Intifada, significant expansion plans were being contemplated for the industrial sector. Areas targeted for expansion were food, quarrying and textiles. Many believe that one of the advantages of creating an industrial base for the Palestinians is the opportunity it would provide for sustainable resource utilisation. Various innovative water conservation measures could be implemented early on in the process. These could include schemes for recycling water and processes for cooling and treating water onsite. Unfortunately, these policy developments have been put on hold in light of current circumstances.

Israel is the only country in this study that has demonstrated an ability to cope with its water deficit through social adaptive capacity. This has been facilitated by its diverse and strong economy. At present some estimates suggest that as much as 80% of all Israel's calorific intake is provided through the import of 'virtual water'. Trade in food provides a vital way around the current dilemma of water stress. Future policy options for Israel and Palestine are closely tied to the surrounding political climate. Currently there is little prospect of creative solutions to problems of water sharing between the two peoples—Israelis and Palestinians—and to wider processes and actions to address the growing water stress issue.

According to the GCI, the per capita water resource potentials in Israel and Palestine were 250 m^3 and 115 m^3 respectively and these were projected to decrease to 153 m^3 and 5 m^3 by the year 2020 due to population increases. Both averages fall well below the WHO standard of 500 m^3 for severe water stress but the situation for the Palestinians is substantively more acute[28]. As for desalinated water, 50 million m^3 water in this 'form' is currently being generated and the development of these operations is expected to increase substantially by 2020 (an estimated 395 million m^3 of desalinated water is required).

In the late 1990s, a number of poor rainfall years culminated in a drought emergency being declared in April 1999 and an official enforced reduction of 40% in freshwater allocations to agriculture. The drought that year severely impacted on Israel's already dwindling cereals production, contributing to a fall from 175,000 tonnes in 1998 to 159,000 tonnes in 1999. It was reported that by mid-1999 nearly all of the country's wheat crop had been destroyed by drought.

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[28] Some experts consider countries with a per capita water consumption rate below 1000 m3 per year to be water stressed.

South Africa

Water availablity

South Africa covers an area of 1,221 000 km^2. The majority of the country is semi-arid with variable rainfall and high evaporation rates which together result in low available runoff. Only 8.6% of rainfall is available as surface water, resulting in one of the lowest conversion rates in the world (Asmal, 1998). There is high spatial climatic variability with three major precipitation regimes: a narrow winter rainfall season along the western and south-western coasts, continuous rainfall throughout the year along the south coast and a summer rainfall region elsewhere. South Africa experiences an average rainfall of 497 mm per annum, a rate well below the world average of 860 mm (Walmsley, 1991). Nearly two-thirds of the country receives less than the national rainfall average and about a fifth receives less than 200 mm. It is important to note that successful dry-land farming requires 500 mm rainfall per annum.

The driest 70% of South Africa's land area, including the dry central plateau, contains only 11% of the exploitable water (Asmal, 1998). Much of the plateau drains into the Orange River system which flows towards the Atlantic seaboard. The Orange River catchment area incorporates 48% of the country yet contributes only 22% (12,057 million m^3) to annual runoff. The northern part of the plateau drains from the Northern Province into the Indian Ocean via the Limpopo River system. Rivers draining the eastern seaboard cover a mere 13% of the total land area but account for 43% of the runoff. Only one quarter of South Africa's rivers are perennial. However, due to the lack of inland reservoirs or permanent snow, features necessary to stabilise flow regimes, many are irregular and strongly seasonal (Asmal, 1998). Groundwater resources can yield an estimated 5,000 million m^3 a year, representing about 15% of surface runoff although this accounts for only 10% of total water use (de Villiers *et al.*,1996). Relative to global averages, groundwater reserves are also limited in South Africa. The demand for groundwater increased from 1,790 million m^3 a year in 1980 to approximately 2,000 million m^3 in 2002 and 78% of this resource is currently allocated to the irrigation sector (Basson *et al.*, 1997).

Demand for water does not coincide with the spatial distribution of the resource. The highly disproportionate water distribution forced the Apartheid government to undertake an extensive system of water transfers from the wet coastal strip to the highly populated and industrialised dry inland centres (DWAF, 1986). These schemes were implemented in order to facilitate industrial development (particularly mining) and also, to provide the rapidly expanding urban areas with sufficient water. Localised water deficits in centres of growth and expansion continue to be a problem in present day South Africa. Demand exceeds supply in many catchment areas and there is increasing pressure for supplementation from water rich areas (refer Lesotho Highlands Water Scheme below). By 2030 it is predicted that at least seven river basins will be in deficit and will not be able to meet their water budgets (Basson *et al.*, 1997).

Given the inadequate and erratic rainfall over South Africa, only 13% of the land surface is suitable for arable farming. According to World Bank statistics this ceiling was almost reached in 2000 when 11% of the total land area was under major cropping. Drought, however, has a major impact on the agricultural economy. Maize, the most important item in South African farming, is widely affected in drought years. Following the 1983/84 drought, maize production was at 3.4 million tonnes, down substantially from the 13.6 million tonnes crop in 1981/82. Further droughts in the late 1990s also resulted in significantly diminished output but by the year 2000, maize production began to improve and production levels were registered at 10.6 million tonnes. Real GDP in the agricultural sector declined by 3.1% in 1998 due to the drought conditions but it recovered by 1999 and grew by 4% in 2000.

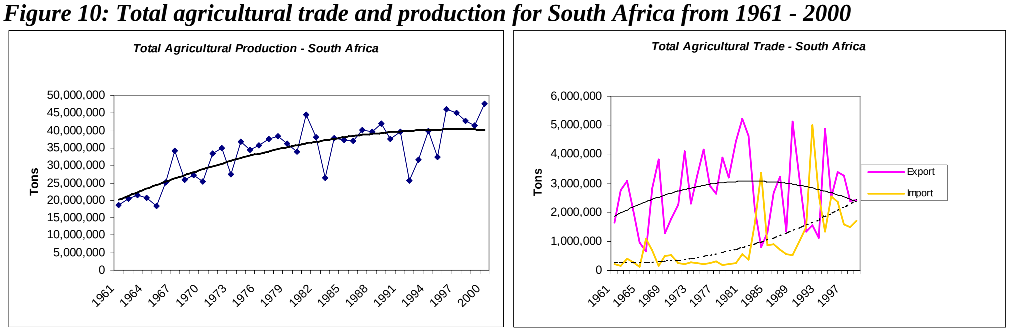
By the mid-1990s, irrigation accounted for 50% of total water use. Irrigated crops were grown on only 10% of the cultivated land but provided 35% of domestic foodstuffs and 85% of agricultural exports (DWAF, 1999). Private farmers and those supplied by Irrigation Boards farmed 80% of the total irrigated area (Villers, *et al*., 1996). Water rights under the Apartheid regime were linked to ownership of land skewing the distribution of water resources towards the white minority population.

It is obvious that the freshwater resources of South Africa are severely stressed (Davies *et al*., 1993). In addition, more than 50% of wetland areas have been lost to land-use practices and many floodplains have become less productive. Most of the country's major rivers are regulated and major dams are fully extended with a combined capacity of 50% of the total mean annual runoff (Asmal, 1998). Water scarcity is further exacerbated by the pollution of both surface water and groundwater resources. Typical pollutants affecting these supplies include agriculture runoff, domestic and commercial sewage, acid mine drainage and industrial effluents. It is extremely difficult to quantify the amount and type of pollutants entering the water systems (State of the Environment Report, 1999). However, there is an urgent need for water resource managers to devise strategies to alleviate this pressure on South African water sources.

<u>Socio-economic issues</u>

The population of South Africa was an estimated 44,810,000 in mid 2001. According to the 1996 census, 8.9% of the economically active population were engaged in agriculture. This figure represents a sharp decline from the 28% recorded for this sector in the 1970 census. The nature of the economy is changing fast. Official figures in 1999 placed manufacturing's contribution to GDP at 21%, compared to 6% for mining and quarrying and only 3.7% for agriculture. By contrast, the burgeoning services sector contributed two-thirds of GDP in that year representing one of the largest shares in Africa.

Figure 10: Total agricultural trade and production for South Africa from 1961 - 2000



Patterns of water use and management issues in terms of access to water are embedded in South Africa's political history. The principal focus of the Apartheid government was the bulk supply of water to the commercial farming sector and to various industries. This emphasis left between 12 and 14 million people without access to formal water supplies (DWAF, 1999). In addition, 21 million people out of the total population of 41 million had no formal sanitation. Unsurprisingly, most of these people lived in the former homeland areas where 75% of the population lived on a mere 13% of mostly water-scarce land.

According to Basson *et al*. (1997), the next thirty years will see an anticipated 51.7% increase in the demand for water. Given that current freshwater resources are almost fully-utilised, it is unlikely that future water resource demand will be sustainable with the present rates of economic development and projected population growth (State of the Environment Report, 1999). Many predict that water supplies will become a major constraint in the country's socio-economic progress (Asmal, 1998; Ohlsson, 1995; among others).

The institutional environment

In 1998, a new Act was legislated (the National Water Act 36 of 1998) which superseded the Water Act (No. 54) of 1956. Under the former legislation, the right to abstract water was principally riparian, and 'abstraction by riparian landowners was not subject to limits unless formally apportioned by a Water Court among different users of the same stream, or regulated by a government Water Control Area or an Irrigation Board' (Woodhouse and Hassan, 1999: 23). In addition, groundwater and surface water located on private land were the gratis property of the landowner. 'Homeland resources', by contrast, were communally owned and fell under the control of tribal authorities. The government provided block water allocation to each Homeland Administrators' Department of Agriculture. African farmers requiring water resources from their local Irrigation Boards were referred to the Department of Water Affairs and Forestry (DWAF), whose usual response was that there was no water available as it had already been allocated. They were expected to apply for additional resources from the already over-extended homeland allowance. In the white areas, the Irrigation Boards distributed water to their membership (mainly white commercial farmers) and levied management charges. Where these areas were supplied through government water works the boards were responsible for collecting tariffs on behalf of the government. The old Irrigation Boards were also responsible for water distribution within Government Water Control Areas—areas where the government had asserted control over all water abstraction.

The 1998 National Water Act falls under the authority of the Minister of Water Affairs and Forestry. In conjunction with the Water Services Act 108 of 1997, it is one of the most important pieces of legislation pertaining to water resources. The two acts effectively abolished riparian rights and the distinction between 'private' and 'public' water. Water was effectively nationalised and 'all water in the water cycle whether on land, underground, or in surface channels, falling on, flowing through or infiltrating between such systems became an 'indivisible national asset' over which the national government would act as custodian in the public interest' (DWAF, 1997). Another key aspect of the legislation was the establishment of a national water reserve that prioritised human and ecological flows over flows to agriculture or industry (Asmal, 1998). This provides for the rights of access to basic water supply and sanitation and the institutional structures essential to water provision (State of the Environment Report, 1999). In addition, the legislation saw a simplification of water resources management and the development of multiple stakeholder catchment management agencies. The two acts have brought principles of sustainability of use and equity of distribution into law. A third piece of legislation which affects water resources is the Minerals Act 50 of 1991. Although indirectly related, it has important implications for the water environment, specifically groundwater. The act requires that every operating and prospecting mine produce an Environmental Management Programme Report (EMPR).

Underlining the water reforms in South Africa during the 1990s was the major political aim of redistributing water to promote social efficiency between alternative and possibly competing demands. To this end, nineteen Water Management Areas (WMAs) were established, each governed by a Catchment Management Agency (CMA). The responsibility of the CMAs was to meet the demands for the resource while at the same time providing scope for greater public participation in management. At a subsidiary level, Water Users Associations (WUAs) were set up to promote further devolution of water management. It was determined that administration of water at the subsidiary level would need to recognise and address conflicting interests between users and that the principle of subsidiarity 'should not interfere with the need for a national perspective on water use' (Asmal, 1998: 145).

In keeping with similar activities in other southern Africa countries, there was an emphasis on extending management reach, essentially to achieve ‘a balance among the interests of water users, potential water users, local and provincial government and environmental interests groups’ (National Water Act (NWA), 1998, Section 81). Each CMA was to be financed through management charges payable by all water users in the catchments. The core functions of the CMAs were to:

1) Investigate and advise on the protection, use, development, conservation, management and control of water resources in a particular WMA;
2) Develop a catchment management strategy and
3) Coordinate the related activities of water management institutions within a particular WMA.

Unfortunately many CMAs are still in the process of being established and until they have been put in place the intended benefits of the scheme will not be realised.

Those operational WMAs with fledgling CMAs have experienced teething problems. A study of one of the early transitions to CMA management, carried out in the Komati River area, highlights the problems of legitimacy and the difficulty encountered when attempting to undertake the level of stakeholder involvement called for by the Water Act (Woodhouse and Hassan, 1999). Firstly, there is no clarification as to the extent of water available to farmers and all three providers - DWAF, the Irrigation Board and the Department of Agriculture – have avoided taking responsibility for this issue. Secondly, African farmers are concerned about dependency, including as the ‘junior’ members of the Irrigation Board, the dominance of the larger, white commercial farmers. Part of the problem in adapting the Irrigation Boards to reflect the multiplicity of stakeholders has been the existing finance structures which rely on member levies to pay for operational and maintenance costs. Many smaller farmers, however, cannot afford to contribute and this has implications for the distribution of power within boards. It also hampers the development of both capital works and effective administration.

Political challenges are also evident in terms of the development and distribution of water for domestic use. Prior to the 1994 White Paper on Community Water Supply and Sanitation, there was no ‘political mandate’ to provide a domestic water supply to households (Abrams, 1996). Under the new regimes basic water services are considered a human right. After 1994, DWAF became responsible for water and sanitation services in the former black homelands. This had previously been the responsibility of the Rural Service Councils (RSCs). Cost recovery for the mostly inadequate water provision under the RSCs was largely unsuccessful, not least because failure to pay water bills provided an effective outlet for political opposition. The 1994 White Paper has signalled a major shift in domestic water provision. The aim is to facilitate a move from a supply-led system to a community based demand-driven approach to water and sanitation. Water is to become an economic good and the user pays principle (for ongoing costs) is to be employed (Waddell, 2000). The Local Government Act makes the provision of water in the long-term the responsibility of local governments. They have until 2007 to provide all households with a water supply and at the same time ensure the successful maintenance of water bodies and systems. This is a heavy political commitment given the scale of the task.

Although the commitment to a demand-driven water policy appeared strong after the 1994 White Paper was published, there has since been a substantial shift in narrative back to a supply-driven, basic needs approach. The provision of free water to rural communities became a keen political slogan in late 2000. DWAF announced that it planned to provide 6,000 litres of free water to each rural household every month. This service was included in the ‘free basic amount of water, electricity and other municipal services’ which formed part of the African National Congress (ANC) council election manifesto. This promise has been greeted enthusiastically in the Mvula Trust (an NGO) literature, where it stated that:

'[The] Government's new policy on free basic services will help municipalities ensure that all citizens enjoy the socio-economic rights which our Constitution guarantees. It is a big step forward in the struggle against poverty. Ensuring a basic amount of services free to the poor also empowers municipalities to enforce payment from those who are less poor. In the past enforcing credit control measures has been hampered by opportunists using the plight of those who genuinely cannot afford to pay, to avoid paying themselves' (Mvula Trust, 2001).

Implementing a free basic service is extremely complicated. It will be difficult to ensure that those who consume more than the basic amount pay for the additional usage. The government will need to create effective metering, billing and credit control systems. This is not an easy task. For example, in areas where water is provided by public standpipes, metering is expensive in relation to the relatively small income that can be raised from this type of service. In such cases waiving all charges may make more sense.

South Africa has also been involved in various bilateral projects. By far the largest and most controversial has been the Lesotho Highlands Water Scheme. The project was agreed between South Africa and Lesotho in 1986. It involves the building of six dams on the upper reaches of the Senqu-Orange River and the establishment of 200 km of tunnels. Once all three main phases have been finalised in 2021, an anticipated 2,200 million m^3 of water will be transferred annually to the Ash River, a tributary of the Vaal River. The aim is to meet the water demands of Gauteng Province, South Africa's industrial heartland[29]. The project is likely to bring in R130 million a year to Lesotho's coffers based on sales of electricity and water to South Africa. In addition, it will enable Lesotho to become self-sufficient in power generation.

Policy options

The advent of democracy in South Africa in 1994 provided a window of opportunity for the new government to form policy which could promote sustainable development while providing basic rights for each citizen (State of the Environment Report, 1999). The updated Constitution has placed South Africa at the forefront of policy initiative for developing countries. An important policy aim is the protection of the environment and an elimination of resource abuse, inequity and the degradation of systems. Prior to 1994, resource allocation (including water) had served a narrow group of the population and selected sectoral interests. Current environmental policy seeks to redress the bias while encouraging the public to utilise resources sustainably. It encourages public input in policy and actively seeks consultation with civil society.

South Africa faces a number of major challenges to future water use and national food security. It is a highly rainfall dependent country within a highly variable region. Nevertheless, it has developed effective alternative strategies—principally through massive industrial and power development—which can help to ameliorate future agricultural demand for water.

Several options for increasing water supply are under investigation in South Africa. These include importing water from high flowing southern African rivers, e.g. the Okavango and the Zambezi. Also, although currently too expensive, desalination may be a viable future option. However, it is recognised that demand management has the potential to provide the best opportunity for dealing with water scarcity. Water pricing and the creation of a new culture of payment is considered a key factor in a demand management approach. Already a successful pricing programme is in place in Masekane, Cape Province.

Future water development policy must also ensure that the living standards of formerly disadvantaged communities are improved and must continue to provide efficient supplies to important urban centres and industrial areas. Key environmental flows are also a priority.

South African policy is also influenced by the international community. The country is signatory to various international conventions and agreements (State of the Environment Report,

[29] Formerly the Pretoria-Witwatersrand-Vereeniging (PWV) mining and industrial region.

1999). These have implications for national strategies, policies and implementation plans. Of increasing significance is the level of regional integration and cooperation in managing the numerous shared river basins (refer Table 1 below). This includes developing strategies that will support disadvantaged communities in South Africa while maintaining small-holder agriculture in neighbouring countries. Of the four countries under review, South Africa has the greatest responsibility to set relevant policy for management and allocation of water with neighbouring states.

Table 1: Committees and authorities responsible for river basin cooperation between South Africa and neighbouring states

Committees and Authorities	Countries involved
Tripartite Technical Committee	Mozambique, Swaziland, South Africa
Limpopo Basin Technical Committee	Botswana, Zimbabwe, Mozambique, South Africa
Trans-Caledon Tunnel Authority	Lesotho, South Africa
Komati Basin Water Authority	Swaziland, South Africa
Vioolsdrift Noordoewer Joint Irrigation Authority	Namibia, South Africa

Source: National State of the Environment Report (1999)

Zimbabwe

Water availability

In 1980, Zimbabwe emerged from the period of post-colonial domination by a white minority with the promise of rapid economic development for the majority black population. The post independent government inherited an economy heavily skewed towards commercial agriculture most of which was dominated by white farmers. Water policy, control and legislation had also been closely allied with the system of production. Since the late 1980s, however, a process of water reform has taken place, in part promoted by the effect on the economy of droughts in the 1980s and 1990s. During the late 1990s, the water reform process became entangled in the political issues surrounding wider developmental objectives. Most notable of these has been the question of land reform and the return of commercial farming areas to small-holder agriculture.

The country has a land area of 391,000 km^2. It ranges from a high plateau to several low river valleys with mountains in the eastern highlands. In common with much of the southern African region there is high rainfall variability. Most precipitation, about 90%, occurs between November and March. Any significant variation in pattern/location has enormous repercussions for the production of the country's staple food, maize ('mealie-meal'). The location of major maize production areas reflect the pattern of spatial precipitation, from an annual average of 1,400 mm in the eastern highlands to 800 mm in the north-eastern highveld and just 400 mm in the Limpopo Valley. The optimal, commercial production region is concentrated on the soil-rich, rain fed plateau. The 'lowveld' (the site of highly populated colonial and post-colonial communal lands) is an arid soil-poor environment unsuitable for extensive agricultural production. Given the relatively low cultivable potential of these areas (and in fact most of the country), the production of food on commercial farmland is especially important.

Major rivers on the border of the country are the Zambezi to the north, the Limpopo to the south and the Save to the east. According to the FAO, annual internal renewable water totals are approximately 14 billion m^3 of which 30% is currently utilized. Added to this is an annual groundwater potential in the region of 1-2 billion m^3. Although a small resource, this forms a disproportionately important source of water for poor rural communities in the drier lowveld.

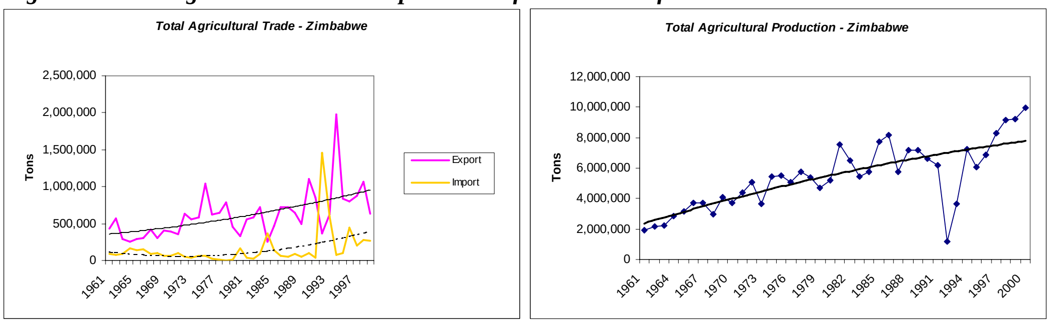
In contrast to South Africa, Zimbabwe is far more dependent on its agricultural sub-sector. Effective management of the country's water resources is therefore a key national requirement. Currently, agriculture utilises 80% of the total renewable water supply, with industry and mining commanding 5% and the remainder allocated to the domestic sector.

The development of supply structures is such that most of the water used in Zimbabwe comes from surface dams, of which 90% is allocated to agriculture. The construction of dams has largely served the commercial sector as well as providing water to major urban areas. Very little supply development in the past has explicitly sought to increase the agricultural potential of communal areas, with the possible exception of irrigation in the south-east lowveld where it was intended that people be resettled from higher density areas.

Socio-economic issues

Zimbabwe's socio-economic structure began to change rapidly during the period of this study. From an era of economic dominance by a small, largely white commercial farming elite, the economy has been radically restructured with a 'fast-track' land reform process. In effect this has dismantled the commercial farming sector and returned land to African smallholders. The process has been highly controversial and has received enormous media coverage both inside Zimbabwe and abroad. It is still too early to determine the effect of this situation on the long-term water-economy. At present, however, evidence suggests that it is having some impact on the efficient operation of new management institutions and on the effective environmental management of water and land. There has also been a reduced capacity in the generation of water revenues from the sale of permits and the levying of charges, most of which were previously obtained from the commercial sector.

Figure 11: Total agricultural trade and production for Zimbabwe from 1961 - 2000



Zimbabwe's population was officially estimated at 12.3 million in 1997. This figure is twice the size of the population of each of Israel and Jordan but only a quarter of South Africa's. Population growth estimates suggest that with the present growth rate of 3% the population will reach 15 million by 2006 and 20 million by 2016 (Moyo *et al*., 1993). The high growth rate combined with what is possibly a rapidly declining long-term food production scenario suggests two things: a) the demand for water will be substantially reduced in agriculture and b) production will increasingly depend on rainfall patterns. There is a possibility, therefore, of far greater vulnerability in the short to medium term. Although the current food crisis in Zimbabwe has been ascribed to drought by government officials, the food production deficit may be an indication of future structural problems. The two graphs in Figure 11 illustrate the impact of climate on the economy. In 1992, a severe rainfall deficit resulted in the substantial decline of agricultural production and an increased importation of food staples. The following season, however, the rains returned and a bumper crop ensued.

Figures for 2000 indicated that two-thirds of the total labour force and about a quarter of the formal sector labour force were engaged in agricultural activities. In contrast to the other three countries under review, Zimbabwe's agricultural employment figures of 16-17% have remained roughly the same since 1980. Maize is the most important food crop in Zimbabwe and in 1996 farmers produced some 2.6 million tonnes. The 1998 season produced only 1.42 million tonnes due to the effects of drought and the decline in the cropping area. The immediate impact of the land reform process on maize production is evident in the 2001 crop figure which was 1.5 million tonnes. This figure was 28% below the previous year and well below average in spite of the year's good rains. The decrease was attributed to the huge reduction (by more than half) in the area planted on large-scale commercial farms.

In 2000/2001 food imports amounted to 579,000 tonnes. The World Food Programme has described the government's ability to import maize as 'extremely limited' given the substantial decline in gold production and the reduced tobacco harvest (another factor of the rapid land return policy). This has led to a significant reduction in necessary foreign exchange earnings, much of which have been 'pre-committed' to other energy imports and international debt servicing. It has been suggested that Zimbabwe's economic situation and ability to feed itself has less to do with water availability and more to do with the changing structure of agriculture. Given that water management was closely tied to the colonial structure of agriculture, there were likely to be important consequences when the new land use and the commercial agricultural reforms were implemented. These issues are explored in more detail in the following section.

The institutional environment

The pre-independence Southern Rhodesian 1976 Water Act linked access to water with access to land. Ownership of land led to rights over water, both resources granted in perpetuity. Major water institutions of the time, including the Irrigation Department, existed mainly to support the extensive, white-dominated, large-scale commercial farming sector. Institutions were largely concerned with supply infrastructure such as dams. In communal areas, water structures and systems were used to open up development in the Zambezi, Limpopo and Save River Valleys. The 1998 Water Act which came into force in January 2000 adhered strictly to the prescriptions of international water policy. In particular, the Act reflected the global integrated water resources management paradigm. In terms of legislation, the Water Act led to the establishment of seven Catchment Councils. Each council was responsible for the management of a major catchment area, which it achieved through various lower-tiered Sub-Catchment Councils. Instrumental to the success of these new institutions was the Zimbabwe National Water Authority (ZINWA). A key element of this new authority was its financing structure. ZINWA was regarded as a commercial self-funded entity, responsible for its own operational costs and infrastructure charges. At the micro level the aim was to raise funds through Sub-Catchment Council levies and charges. Although the price of water was raised for some consumers, to meet the commercial operation criteria, it was anticipated that targeted subsidies to vulnerable groups could be implemented through the pricing mechanism. A national 'blend price' was fixed for water, which applied across all regions of the country regardless of relative water availability. Primary water use, that is water necessary for sustaining livelihoods, was provided free of charge. However, determining the precise definition of the term 'primary water' has posed various problems and has led to various conflicting interpretations. At the macro levelb ZINWA was expected to contract commercial loans for capital development (ZINWA, 2001).

Alongside the newly devolved water structure was an accompanying focus on widening stakeholder participation in management processes. This was considered a crucial part of the restitution process. The revised system dictated that all categories of users had to be represented. However, in reality, control remained with the large-scale, predominantly white commercial farming sector. This was partly by design and partly by default. Council meetings often took place in remote and inaccessible venues, out-of-the-way for those stakeholders coming from communal areas. In addition, the language barrier – most meetings were held in English - coupled with the problem of lack of technical knowledge, made real inclusion of all stakeholders somewhat difficult.

Regardless of these problems the Catchment Councils have an extremely wide remit of responsibility. These range from drawing up management plans for river systems, through approving applications and granting permits for water use, to regulating and supervising water utilisation. Additional functions include supervising the performance of Sub-Catchment Councils and resolving conflicts amongst users. Although the Catchment Councils have been assigned extensive local level responsibility, in effect they have been largely preoccupied with establishing systems of tariff collection and managing their own finances.

Future major challenges facing this institutional body include the management of the complex arrangement of supply constructions. These include irrigation systems, water transfers, dams and the many small reservoirs constructed by NGOs during and after the major droughts of the early 1990s.

The interface between the institution as a vehicle for management and the farmer as resource user occurs at the sub-catchment level. Each Sub-Catchment Council is tasked with supervising the exercise of permits (including those for groundwater use), monitoring flows, electing a representative to the Catchment Council, providing technical expertise, data collection, management planning and the collection of rates and fees. Difficulties in assuring local stakeholder involvement have also been encountered at this second-tier level. Appeals have been made for a further level of decision-making and Water User Associations (WUAs) have been suggested as a useful mechanism. In Mazowe District, where the initial Sub-Catchment Council pilot took place, a WUA was successfully employed to provide adequate, representative stakeholder decision-making.

Policy options

Following the establishment of Zimbabwe's independence, the government embarked on policies that sought greater rewards for the black majority population, most of whom were concentrated in the communal areas of the country. Initial efforts were focused on increasing the drinking water supply to households and little immediate attention was paid to the provision of water to farming. However, as the 1990s progressed, and particularly following the severe drought of 1992, there was renewed attention paid to the country's agricultural water 'inequity'. Demands were made for a change to the system based on riparian rights and resource rights granted in perpetuity. There was a push for a rights based system where access to water could be translated into time-bound permits.

Future augmentation of water supplies in Zimbabwe is constrained by the transboundary nature of the resource. Development on any Zimbabwean river system has implications for downstream users, a factor which places constraints on the country's own irrigation expansion options. In addition, there are fears that the government lacks the proper capacity for necessary water restructuring and reform. The current major agricultural transition has placed the commercial farming sector in jeopardy. The implications of the decline of this sector are as yet unknown. However, there will be large-scale effects on water management and demand management policy processes. On the one hand, managing water demand will become a more complex task as there will be many more smaller users. On the other hand, the transition to smaller farmsteads will likely result in a lower overall abstraction of water given the relatively low technical capacity of resettled farmers. The changes in land-use practices will also have possible environmental impacts within basin catchments. The worst case scenario includes predictions of increases in sediment load caused by rapid soil loss, as previous rangeland is ploughed and forest cover lost to firewood and construction materials for resettlement areas. While much of the discourse on environmental 'damage' is politically loaded, there is already anecdotal evidence that small and medium-scale dams are fast filling up and storage capacity is being lost. If true, then the impacts of such a scenario are most likely to be felt in poor rainfall years when demand and available supply are at variance in many areas.

Certainly Zimbabwe is an example of politicised decision making with respect to agricultural production, but as yet this has not filtered down to the catchment and sub-catchment levels. If the current situation remains the same, the demand for water is not likely to increase substantially, but the capacity to produce food internally will most likely be severely constrained. The future is beginning to look particularly bleak, with the number of available policy options increasingly limited.

Chapter 4: Supporting policy options for the Middle East and southern Africa

The policy options of water-stressed states are rooted firmly in the notion of political feasibility: whereas the resource base might dictate a particular set of development options—perhaps the gradual shift from agricultural to industrial use in a country such as Jordan—the political circumstances surrounding resource use might constrain the pursuit of such policy options.

There are important concepts emerging, such as 'virtual water', which enable a resource base and the value of that resource to particular political goals to be ascertained. These broad-based ideas allow decision makers to understand the existence of different macro-options in one decision making area, namely the allocation of the resource between sectors to reduce, say, sectoral water stress due to excessive water use in agriculture. The simple logic of alleviating stress at a national level through seeking often cheaper alternatives to domestic production of food on the world market has clearly worked in some of the countries under review in the current study. For example, Israel has succeeded in last few decades, as much out of necessity as policy choice, in reducing overall usage in agriculture.

Nevertheless, there are important concepts of development which tease such water management—and 'virtual water management' strategies—away from the simple economic choice between water in agriculture or higher value usage in industry. Certainly the issue of poverty elimination underscores the importance of agriculturally-based livelihoods in the contexts of, say, Zimbabwe in southern Africa or Palestine in the Middle East. In these countries, the realities of shifting water, or the pursuit of economic strategies which result in water demands being shifted between sectors, are tied to wider political imperatives and closely associated with land and land rights.

Policy options in water therefore have to be understood far more broadly than simply by sectoral policy alone, and an examination of the effects of agricultural policy on the environment, industry and urban development is required. The complex decision making processes requires the increasingly inclusive decision-support framework developed in the 'FoRWaRD' model described below. It also requires an understanding of change management issues and an appreciation of how different sectors can display different socially adaptive characteristics.

As the case of South Africa has shown—and Zimbabwe to a lesser extent—complex arrangements can be developed to help augment supplies and distribute scarce resources where there is effective institutional and social adaptive capacity. However, in the case of South Africa, the adaptive capacity was in fact largely 'partial', at least up until the end of the Apartheid era, because the nature of capacity and adaptation was fairly limited to a narrow section of society for whom the bulk of the changes sought to benefit. The complex arrangements enabling South Africa the ability to transfer water from Lesotho to the water-short Gauteng Province, were model institutions in the 'era of certainties' before the 1980s (Swngedouw 1999a; 1999b), but subsequent to the end of Apartheid, these arrangements have been viewed less enthusiastically. South Africa is an economy with the adaptive capacity to engineer interbasin water transfers. The country had the additional capacity to build institutions which could manage water in both an economically efficient manner and in a way which achieved environmental services goals. By the 1980s, the green movement had questioned the certainties underpinning the hydraulic mission of the state. The control of nature brought uncertainties rather than certainty (Reisner, 1984) and within these changed circumstances projects, such as the Lesotho Highlands Project (LHP), are being somewhat re-evaluated. The *FoRWaRD* Decision Support Model is a tool which can be useful in this endeavour, as it can help develop an understanding of the adaptive capacity of both potential projects and policy.

The rationale behind *FoRWaRD* is to: a) identify a range of options and b) provide the 'best fit' options to prevailing social, political and economic circumstance. The decision support model provides a bi-module approach to assessing the risks and opportunities associated with different policy options for water-stressed states. It examines a snapshot of the present food economy of a country from the perspective of current average production (as well as the extremes in exceptionally good and bad years), import, consumption and relative reliance on global food markets. It then examines major trends in food production through shifts in annual production, the significance of agricultural sector employment, the shifts in agricultural contribution to GDP and shifts in major imports of food staples. It also examines the major changes in national food consumption trends and relative importance of food aid to the economy.

In parallel, a 'water economy' module looks firstly at the production of water in average, good and bad years, the structure of consumption of water overall and by sector, the relative 'import' of water from neighbouring countries in terms of transboundary receipts (and the legal and political regimes surrounding this receipts), and the 'export' of water to neighbouring countries. It then looks in detail at the financing of the 'water deficit' (in average, bad and good years), through examining the origin and cost of 'imported virtual water', and it then assesses the relative cost of the virtual water to the overall import bill.

The model then provides a longitudinal analysis of trends which assesses supply augmentation trends, demand management trends, changes in relative abstractions by sector, trends in virtual water imports, the relative change in the 'cost' of the virtual water import bill and the nature of the 'water gap' over time—in particular, what is the main cause of the gap: rising consumption, declining supply or a combination of the two.

The third step in the model is the development of scenario building, though combining the two modules. This will create a picture of the projected trends as currently constituted in a 'status quo scenario'. It will then posit three scenarios based on increasing internal food production and reallocation of water to, greater efficiencies in and/or augmentation of supplies to agriculture, the external procurement approach involving increasing external procurement of water, and a 'combination' scenario where both greater resources are devoted to agriculture as well as to the procurement of water on the world markets.

The scenarios are then weighted against a number of factors, including political risk assessment, climatic risk assessment, and capacity assessment. This last form of assessment will address the existence of sufficient levels of adaptive capacity to enable the implementation of policy based on the scenarios presented. Following these forms of assessment the time planning requirements of different scenarios will be assessed, against which implications for assistance by external agencies can be addressed (i.e. in budget support, versus technical capacity building; or in technical assistance versus support to greater regional integration).

Lastly, and as a defining goal, the weighting of options against a set of poverty reduction criteria will help to establish the trade-offs involved in finding the 'best fit' for the macro economic criteria against those that provide greatest 'value-added' to poverty reduction goals (e.g. in seeking to achieve the Millennium Development Goals).

The idea would be that the model is as simple as presented below, with drop-down tables and charts under each category and links between, say, annual food production, and abstractions of water by sector, and been virtual water imports and employed labour force in agriculture. The linking of the categories would enable policy makers—and others—to visualise relationships that in many ways are often invisible. This in itself would assist in creating greater transparency in decision making and, in so doing, assisting in increasing the scope of political 'feasibility'.

One of the more difficult tasks of the model—and for policy makers more generally—is to link the 'big' water issue of water supply to agriculture, hydro-power and major policy questions of water supply and demand management to the 'small' water issues of local, domestic and 'household'-level livelihood supplies of water. This is certainly beyond the immediate scope of the model, but it can provide some guidance in thinking on supplies to sectors such as the livestock sector and/or the relative weight of livelihood needs within the wider consumption of water by the economy. At present global average personal consumption needs are in the region of

100 m^3 of water per person per year, although this is relatively high in the context of many currently water-stressed countries.

Appendices

Major River Basins in Southern Africa

River Basin	Area (sq km)	Length (km)	Riparians	
Congo	3,800,000	4,700	9	**Angola, Burundi, Cameroon, Central African Republic, Congo, DRC, Rwanda, Tanzania, Zambia**
Zambezi	1,300,000	2,650	8	**Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe**
Orange	850,000	2,300	4	**Botswana, Lesotho, Namibia, South Africa**
Okavango	570,000	1,100	4	**Angola, Botswana, Namibia, Zimbabwe**
Limpopo	415,000	1,750	4	**Botswana, Mozambique, South Africa, Zimbabwe**
Rovuma	155,000	800	2	**Mozambique, Tanzania**
Cunene	106,500	1,050,	2	**Angola, Namibia**
Cuvelai	100,000	430	2	**Angola, Namibia**
Save	92,500	740	2	**Mozambique, Zimbabwe**
Incomati	50,000	480	3	**Mozambique, South Africa, Swaziland**
Pungwe	32,500	300	2	**Mozambique, Zimbabwe**
Maputo	32,000	380	3	**Mozambique, South Africa, Swaziland**
Buzi	31,000	250	2	**Mozambique, Zimbabwe**
Umbeluzi	5,500	200	2	**Mozambique, Swaziland**

Zambezi River Basin Riparians

Country	Total Area (sq km)	Area in Basin	%	1998 Total Population	Population in Basin	%
Angola	1,246,700	145,000	11.6	13,168,000	487,200	3.7
Botswana	582,000	84,000	14.4	1,500,000	12,000	0.8
Malawi	118,484	110,390	93.2	11,407,000	9,821,400	86.1
Mozambique	799,380	140,000	17.5	20,791,000	3,991,870	19.2
Namibia	824,269	24,000	2.9	1,645,700	60,890	3.47
Tanzania	945,087	27,000	2.9	31,798,000	1,271,920	4.0
Zambia	752,614	540,000	71.6	10,037,400	7,046,250	70.2
Zimbabwe	390,759	251,410	64.3	12,552,000	9,050,000	72.1

Total	5,077,293	1,321,900	-	102,898,700	31,741,500	30.8

Source: ZACPRO 6 Sector Study 3, 1998

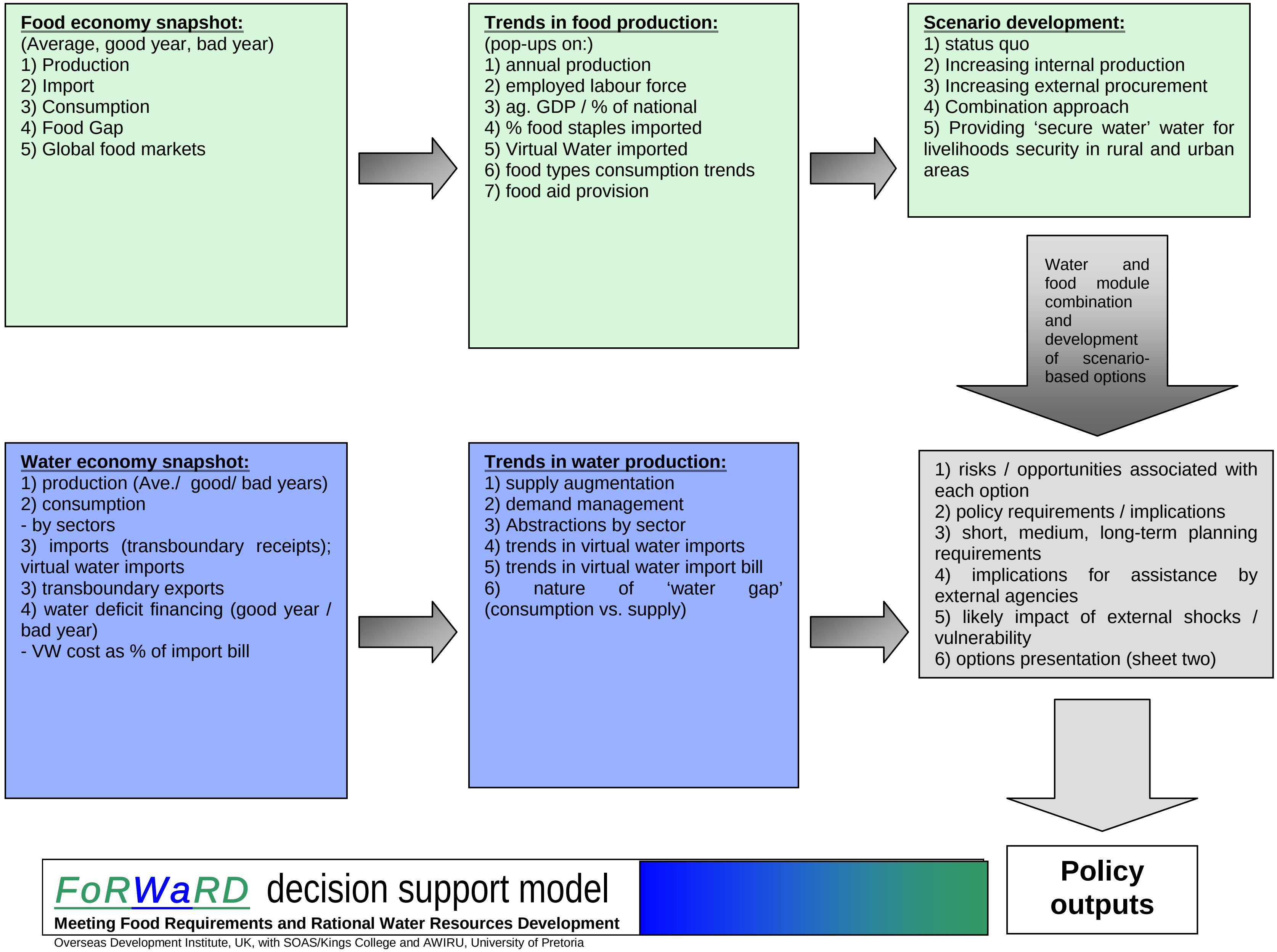
Water Resource Availability in southern Africa

Country	**Land area**	**Irrigated land**	**Annual internal renewable water resources per capita**	**Annual freshwater withdrawals**	
				As % of water resources 1980-99	Per capita (cu m) 1980-89
	823	0.9	333	38	166
South Africa	1,221	10.3	1,206[30]	18	410
Botswana	567	0.5	1,588	1	100
Malawi	94	1.7	1,678	2	20
Zimbabwe	387	7.0	1,776	5	138
Lesotho	30	0.9	2,551	1	31
Tanzania	884	5.0	2,998	1	36
Swaziland	17	35.8	5,275	4	408
Zambia	743	0.9	12,267	1	86
Mozambique	784	4.0	12,997	1	53
Angola	1,247	2.5	16,618	0	52
Average	--	13.5	5,390	6.5	136

(Source: Chenje, M. and Johnson, P. (eds) 1996).

30 Expected to fall to less than 700 m^3 per person by 2025 (World Resources Institute, 1992).

DECISION-SUPPORT MODEL (Version1.0)



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