Table of Contents:

2.6 Demand Prediction for the Central Areas of Namibia

2.6.1 Urban
2.6.2 Agriculture
2.6.3 Mining
2.6.4 Tourism
2.6.5 Summary
2.6.6 Discussion of Demand Predictions

2.7 WATER SUPPLY

2.7.1 Water Sources

2.7.1.1 Groundwater
2.7.1.2 Ephemeral Rivers
2.7.1.3 Perennial Rivers
2.7.1.4 Potential Water Sources

2.8 **Institutional Arrangements for Water Supply**

2.8.1 Local Authorities, The Ministry of Regional and Local Government and Urban Water Supply
2.8.2 Overview of Local Authority Institutional Arrangements
2.8.3 Namwater
2.8.4 The Department of Water Affairs.
2.8.5 Department of Agriculture and Rural Development

2.9 **The Costs of Water Supply**

2.9.1 Overview of Government expenditure in the Water Sector
2.9.2 Rural Water Supply
2.9.3 NamWater
2.9.4 Local Authorities

2.10 **Water Pricing: Tariffs and Fees**

2.10.1 NamWater
2.10.2 Local Authorities
2.10.3 Ministry of Agriculture Water and Rural Development
2.10.4 Economic Pricing of Water

2.11 Social Aspects of Water Supply

2.11.1 Water and Poverty
2.11.2 Willingness and Ability to Pay for Water
2.11.3 Summary

2.12 FUTURE WATER SUPPLY OPTIONS

2.12.1 The Future Cost of Water for Windhoek

2.12.1.1 The Kavango Option
2.12.1.2 Hardap Dam.
2.12.1.3 The Kunene Option
2.12.1.4 Tsumeb Aquifers
2.12.1.5 Summary

2.12.2 The Costs Unconventional Water Supply Options[1]

2.12.2.1 Reclamation of Wastewater for Direct Potable Use (Goreangab Reclamation Works and Extension).
2.12.2.2 Desalination
2.12.2.3 Artificial Groundwater Recharge.
2.12.2.4 Boreholes
2.12.2.5 Purified Effluent
2.12.2.6 Summary

2.12.3 Water Demand Management.

2.12.3.1.1 Water Demand Management in Namibia
2.12.3.1.2 Water Demand Management in Windhoek
2.12.3.1.3 Conclusion

2.13 SUSTAINABILITY

2.13.1 Sustainable Economic Development

2.13.1.1 The Capital Base
2.13.1.2 Substitutability
2.13.1.3 Critical Capital
2.13.1.4 Water as Critical Capital or Substitutable

2.13.2 Sustainable Development in Namibia

2.13.2.1 Policies and Legislation for Sustainability in the Water Sector
2.13.2.2 Groundwater in Namibia

3 Key Issues

3.1 EFFICIENCY

3.1.1 Institutions/Institutional Arrangements

3.1.1.1 NamWater
3.1.1.2 Local Authorities (Municipalities, Town Councils and Village Councils)
3.1.1.3 Department of Water Affairs
3.1.1.4 Community Based Management
3.1.1.5 Regulation

3.1.2 Pricing of Water

3.1.2.1 NamWater
3.1.2.2 Local Authorities
3.1.2.3 Irrigation
3.1.2.4 Transparency

3.1.3 Allocation of Water

3.1.3.1 Value Added and Water

3.1.3.2 Property Rights
3.1.3.3 Transferability of Water

1 Introduction

Water is often seen as the major constraint to sustainable economic development in Namibia. An average annual rainfall of 250mm coupled with high spatial variation and high variability both within and between years, makes Namibia's domestic water supply from groundwater and ephemeral rivers both scarce and uncertain. The more reliable border perennial rivers are far from the main centres of demand and would therefore require considerable investment to supply additional water. Other potential sources of supply, such as desalination, are also relatively expensive. The costs associated with the uncertainties of domestic water supply and future water supply developments limit the array of potential development opportunities in Namibia and consequently efforts to alleviate poverty and reduce income inequalities[2]. Furthermore, increasing demands for water in Namibia, largely driven by a 3% average annual population growth rate, mean that the limits of the current water resource base are being approached, and some groundwater aquifers are being used unsustainably.

Government budgets are also constrained, with government debt having risen to over 4% of GDP in 1999, and the debt/expenditure ratio is rising[3]. Clearly there is a strong case for reducing the strain on public finance that the water sector currently causes, thereby improving the sustainability of the water sector institutions and releasing government funds for wider developmental causes.

Given this situation several challenges for both the short and the long run present themselves to the water sector of Namibia.

- **Efficiency**: Ensuring the greatest economic development arises from the use of limited available water resources and that water supply is cost effective

- **Equity**: Ensuring water services are supplied in a socially equitable manner

- **Sustainability**: Ensuring water resources are managed and used in a manner that does not impinge unnecessarily on the well-being of future generations

For water to be managed and used in a way that meets these challenges it is clear that an integrated approach is required. The economic incentives that arise from the institutional arrangements in the water sector need to be conducive to these targets. Economic and social policy must also provide the correct economic incentives and focus for efficient, equitable and sustainable water resource use. The legal framework must provide a coherent basis upon which all the stakeholders in the water sector can act.

Changes to institutional arrangements, economic policy and legal framework can provide the "enabling environment" within which water utilities, managers and consumers act and the goals of efficiency, equity and sustainability can be achieved. In the words of Winpenny (1994):

> *"the enabling environment is a term that has arisen to describe the creation of the general conditions necessary for encouraging the more economically rational use of resources such as water"*.

All stakeholders in the water sector need to be aware of the effects of their actions on the nations water resources. Consumers need to make informed decisions about their water consumption in the face of prices that reflect the true economic costs and scarcity of water. The government should be aware of the dynamic effects of laws and macro-economic and social policy on the pattern of water resource use within the nation. Similarly, water utilities should be made aware of the economic impact of their policies on the consumer and the true economic costs of the potential future water supply options.

Several current initiatives can be cited from the Namibian water sector, which have begun to create an enabling environment for water users and suppliers. These include:

- the creation of the Namibian Water Corporation, the parastatal bulk water supply corporation, in 1998

[2] Namibia has one of the most unequal societies in the world according.
[3] Debt expenditure ratio is the local and external debt as a percentage of total government expenditure.

- the advocation of full cost recovery for water by the Water and Sanitation Policy of 1993 (WASP)

- the movement towards Community Based Management (CBM) for rural water supply

Each of these initiatives can help to create the conditions necessary for the more "economically rational" use of water resources and hence go some way to achieving the challenges set out above. However, given the current situation in many of Namibia's municipalities; where non-payment by water consumers including government institutions is common place, the overdraft of many of Namibia's groundwater resources, the lack of strict and coherent price regulation, and the absence of a national Water Demand Management (WDM) policy, to give but a few examples, it is clear that the current environment in the Namibian water sector is not wholly conducive to efficient, equitable and sustainable management.

Economics provides great insights into the management of scarce resources and the attainment of economic and social development targets. The Thematic Paper on the socio-economic aspects of the water sector will analyse the current situation in the Namibian water sector from an economic standpoint. The paper will reveal how the interdependent challenges of efficiency, equity and sustainability are being met, where there are obvious shortcomings, and the tools economic theory provides to address the sustainable management of Namibia's water resources.

An integrated approach will be taken in which the institutional arrangements and the resulting economic incentives to agents acting in the water sector will be addressed, water pricing policy will be investigated, and the objectives of sectoral development policies analysed. The successes and shortcomings of each facet of the water sector will be addressed from an economic perspective and recommendations made as to how these shortcomings can be overcome.

2 Current Situation Analysis

The current situation analysis of the Namibian water sector will address the two sides of the water balance: Demand and Supply. The current pattern of water demand, the factors which have shaped that demand and the implications for future demand growth will be discussed. On the supply side the water sources upon which Namibia is dependent are briefly outlined. The institutions that are responsible for water supply, their roles and the manner in which they interact are discussed and the shortcomings highlighted. The cost of water supply and the manner in which this cost is passed on to the consumers is explained and the social aspects of water supply are discussed.

The discussion will begin with a brief summary of the policy background of the water sector and will end with a discussion about the future water supply options for Namibia and the issue of sustainable economic development

2.1 WATER SECTOR POLICIES AND OBJECTIVES

A comprehensive analysis of all the relevant legislation is undertaken in the theme report on legislation and regulation. The following paragraphs merely highlight some of the economic, financial and social aspects of recent policy statements.

2.1.1 The Water and Sanitation Policy of 1993.

In September 1993, Cabinet approved the Water and Sanitation Policy (WASP) guidelines put forward by the interministerial WASP committee. The following overall long term sector policy was adopted:

- essential water supply and sanitation services should become available to all Namibians, and should be accessible at a **cost which is affordable** to the country as a whole;
- this equitable improvement of services should be achieved by the combined efforts of the government and the beneficiaries, based on community involvement, community participation and the acceptance of a mutual responsibility;
- communities should have the right with due regard for environmental needs and the resources available, to determine which solutions and service levels are acceptable to them. **Beneficiaries should contribute towards the cost of the services at increasing rates for standards of living exceeding the levels required for providing basic needs**; and
- an environmentally sustainable development and utilisation of the water resources of the country should be pursued in addressing the various needs.

According to "A digest of the water supply and sanitation sector policy of the Government of Namibia" a number of other objectives and strategies for the sector were endorsed by Cabinet including;

- recovery of at least operational and maintenance costs for rural water supply;
- a graduated tariff structure for urban water supply which would protect lifeline supply;
- a full cost recovery policy for commercial enterprises and industries;
- the approval of tariffs by the Minister in charge of water affairs;
- the ability to enforce payment;.
- that any assistance should be provided under a social security vote rather than a circumvention of the water revenue collection system; and
- that irrigation water is charged at an economic rate, any subsidy being determined by the value of the produce relative to its social economic benefits and appropriated by the Ministry of Agriculture.

It was also confirmed that the feasibility of establishing a bulk water supplier should be investigated and that a water supply and sanitation co-ordination committee (WASCO) should be established to act as a co-ordinating body.

2.1.2 WASCO

In June 1997, the Cabinet endorsed WASCO policies and principles with respect to the implementation of the community management and cost recovery aspects of the WASP. The five WASCO principles of community responsibility, national organisation structure, community organisation, implementation process and partnership are supported by a number of statements. From a financial perspective, the key statements are as follows:

- revenues from the provision of water supply services **shall cover operation and maintenance costs within five years starting in year 2 and full cost recovery within 10 years;**
- **revenues collected from water users will be managed by the collecting water point committee** who shall, in consultation with the community it serves, establish appropriate charges (which would include bulk water costs, where applicable), including a lifeline charge to satisfy basic needs of low income users. Regional and Central Government will provide subsidies, if required to supplement community cross subsidies, or to protect regional and national economic interest;
- a **disincentive tariff** will be applied to control what the community decides as excessive use of water and other natural resource;
- a **national compensation fund** shall be established to finance the provision of water for wildlife and pay for damage to water installation caused by wildlife. It is recommended that the fund be financed through **a tourist levy**;
- a **rural water supply development fund** should be established, funded initially by Government and Donors and eventually from interest and loan repayments, to finance the development of rural water supply.

It was further resolved that the Ministry of Agriculture, Water and Rural Development (MAWRD) be mandated to upgrade the existing rural water supply infrastructure to a condition acceptable to both the community and Government, prior to handing over the facilities to the communities.

2.1.3 The NamWater Act of 1997

In October 1997, the Namibia Water Corporation Act establishing NamWater was signed. NamWater is incorporated under the Companies Act as a public company and is wholly owned by the State. Its primary business is that of 'bulk water supply to customers, in sufficient quantities, of a quality suitable for the customers purposes, and by **cost effective**, environmentally sound and sustainable means'. The performance contract with the Government sets out the five year financial targets which it is expected to achieve. In order to fulfil these obligations it has the power to 'determine and levy, in consultation with the Minister, tariffs on a **full cost recovery basis** for water supplied.

2.1.4 The Local Authorities Act of 1992

The responsibilities of the Local Authorities are governed by the Local Authorities Act. Section 30 (1) states that Local authorities must:

a) supply water to the residents in its area for household, business or industrial purposes; and
b) provide, maintain and carry on a systems of sewerage and drainage for the benefit of the residents in its area.

In support of these services, the Local Authorities[4] are able to make their own regulations with respect to the above services, where no such regulations exist they must adopt the model regulations issued by the Ministry of Regional and Local Government and Housing (MRLGH). These regulations contain detailed guidelines on supplier - customer relationship and methods of operation . Under the Regional Councils Act (1992), regional councils are/will be responsible for rural water development. Sanitation, environmental and pollution policies and legislation are currently being developed, apart from the concept that the polluter pays, there is negligible reference to financial issues.

2.1.5 The Decentralisation Policy

[4] Local Authorities (la's) = municipalities, town and village councils

After the enactment of the Local Authorities and Regional Councils Acts in 1992, a policy review process began culminating in the Decentralisation Policy in 1998. The policy which was to be implemented from the 1st April 1998 states:

- decentralisation should be based on national ideas and values
- to extend , enhance and guarantee participatory democracy
- to ensure rapid sustainable development
- to transfer power to the regional councils and local authorities based on national ideas and values
- to improve capacity of regional and local government councils to plan , implement , manage and monitor

The decentralisation of expertise, decision making power and management responsibilities will, in theory, have a clear impact on the water sector and the institutions responsible for water supply.

2.2 WATER DEMAND

The pattern of water use in Namibia is a crucial component of the water management equation. Efficiency of water use within sectors and between sectors is the aim of effective water management. The way in which water is allocated and distributed between different water users governs the economic benefits that arise from water use and the social goals that the water sector hopes to achieve. The efficient allocation of water between sectors is critically important for sustainable economic development. Here the pattern of water use in Namibia and the economic significance of that pattern is described.

2.2.1 Water Demand in Namibia

Table 2.1 shows the demand for water by sector and the proportion of total consumption that each sector makes up. It is immediately clear that the agricultural sector's consumption makes up the majority of total consumption. Taking livestock and irrigation together, 64% of total water consumption occurs in this sector. Urban users, consisting of residential and commercial use, make up 24% of total consumption.

Table 2.1: Water consumption by sector (1996)

SECTOR	WATER CONSUMED PER ANNUM Mm^3	% OF TOTAL
Livestock	42.2	15.0
Irrigation	137.0	48.8
Urban – all inclusive	67.9	24.2
Rural domestic	13.1	4.7
Mines	20.0	7.1
Wildlife and Tourism	0.7	0.25
TOTAL	**280.9**	**100**

SOURCE: SOER Water 1999.

2.2.1.1 Agriculture

Livestock alone made up 15% of Namibia's total water consumption in 1996. It is worth noting that the consumption figures are estimates based on the requirements for livestock. The majority of water points from which livestock obtain their water are not metered and as such the exact extraction levels are not known with certainty.

Irrigation demands are also derived mostly from estimates based on the extent of irrigated land. In Namibia the assumption is that $16000m^3$/a/hectare are used for irrigation[5]. Groundwater and perennial river sources are in general not metered for irrigation.

In total the agricultural sector made up approximately 64% of Namibia's total water consumption in 1998, 75% of which was for irrigation. This compares to an estimated worldwide average of 69% (Pearce 1998).

2.2.1.2 Urban (inclusive)

Urban demand, including commercial and urban industrial demand, is more precisely known than agricultural demand because metering for billing purposes occurs at all bulk water supply points supplying urban areas. Demand by manufacturing commerce and industry makes up only approximately 5% of Namibia's total water demand at present.

[5] This is the latest assumption used for the issue of permits for irrigation by the DWA.

2.2.1.3 Rural (domestic)

The 5% of total consumption that domestic rural demands make up is again based on estimates of required/likely consumption levels since many of the rural water points are not metered. The Directorate of Rural Water Supply (DRWS) uses a figure of 15litres per capita per day for planning purposes based on survey information about desired levels of supply. Here rural means the communal areas of Namibia, which are supplied by the DRWS, largely from groundwater.

2.2.1.4 Mines

The mining sector demand, estimated as 7% of total consumption in 1998, is governed largely by the level of production, which is in turn determined by the market price of the mined product. This relationship has been noted at Rossing mine.

2.2.1.5 Wildlife and Tourism

Although currently only making up 0.25% of total consumption, the wildlife and tourism sector has been subject to significant growth since 1990. The sustainability of the tourism sector is partially dependent upon the availability of water in tourism zones.

As is the case in many sectors the exact consumption of the tourist and wildlife sector (Including Ecological requirements) is not known due in part to the lack of metering of abstraction from the perennial rivers and boreholes.

2.2.1.6 Unaccounted for Water

The figures shown in Table 2.1 attribute Namibia's total water consumption to the different sectors of society and the economy. However, within each sector there is considerable wastage, water loss and metering errors. Unaccounted for water is included in the figures, however it is worth noting the extent of this often unnecessary component of demand.

Unaccounted for water can occur for some of the following reasons:

- leaks
- inaccurate meters
- illegal connections
- administrative errors

In general unaccounted for water has been associated with urban water use, however similar losses can occur in all sectors, particularly in large irrigation schemes. **Table 2.2** gives an indication of the extent of unaccounted for water in Namibia's urban centres.

Table 2.2: Unaccounted for Water in Urban Centres.

Local Authority Area.	Total Water Production (Mm^3 1996/97)	Unaccounted for water[6] %
Arandis	**0.56**	**35.0+**
Gobabis	**0.48**	**7.7**
Grootfontein	**2.89**	**20.9**
Henties Bay	**0.36**	**9.0**
Karasburg	**0.23**	**18.0**
Karibib	**0.25**	**n/a**
Katima Mulilo	**2.22**	**35.0+**
Keetmanshoop	**1.65**	**17.0**
Khorixas	**1.10**	**58.0**
Luderitz	**0.83**	**22.0**
Mariental	**0.63**	**9.4**
Okahandja	**1.12**	**16.0**
Omaruru	**0.66**	**7.0**
Ondangwa	**0.87**	**35.0+**
Ongwediva	**1.13**	**35.0+**
Opuwo	**0.64**	**47**
Oshakati	**1.77**	**35.0+**
Otjiwarongo	**1.55**	**7.5**
Outjo	**0.64**	**7.7**
Rehoboth	**1.90**	**35.0+**
Rundu	**1.52**	**38.0**
Swakopmund	**2.79**	**12.0**
Tsumeb	**1.04**	**15.0**
Usakos	**0.12**	**31.1**
Walvis Bay	**4.52**	**14.5**
Windhoek	**13. 74**	**10.0**

SOURCE: IUCN Water Demand Management Namibia Country Study, 1999.

In a world-wide context 10% urban unaccounted for water is considered to be a reasonable target for good management. As such two things become apparent from the statistics in Table 2.2. Firstly Windhoek, which has a variety of water management techniques such as pipe monitoring and computerised billing, can act as a useful benchmark in Namibia. Secondly there is much room for improvement in many of Namibia's urban centres where unaccounted for water in the region of 30-40% is not uncommon.

2.2.1.7 Water Demand by Sector and Source

Table 2.3 brings together the demand for water for each sector of the Namibian economy, with the supply side by source in 1993. The economic sectors coincide with those used by the National Accounts. Table 2.3 only shows a snapshot of time for 1993. "All sources" is equal to the sum of groundwater, perennial rivers and ephemeral rivers. It is worth noting that in 1993, 56% of water was supplied by groundwater, 25% by perennial rivers and 19% by the ephemeral rivers.

[6] 35+ % Represents an estimate undertaken by the IUCN study.

Table 2.3: Use of Water by Sector and Source. (1993, in millions of m^3)

	All Sources			Groundwater			Perennial Rivers			Ephemeral Rivers		
	Total	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**
Agriculture	**146.2**	**35.2**	**111.1**	**69.1**	**5.6**	**63.4**	**48.9**	**1.9**	**47.1**	**28.3**	**27.7**	**0.6**
Livestock	39.1	7.5	31.6	36.5	5.6	30.8	2.6	1.9	0.8	0	*	0
Crops	107.1	27.7	79.5	32.6	0	32.6	46.3	0	46.3	28.3	27.7	0.6
Mining	**21.7**	**4.4**	**17.3**	**20.3**	**3.0**	**17.3**	**0.9**	**0.9**	**0**	**0.5**	**0.5**	**0**
Diamonds	13.6	0	13.6	13.6	0	13.6	0	0	0	0	0	0
Other Mining	8.1	4.4	3.7	6.7	3.0	3.7	0.9	0.9	0	0.5	0.5	0
M'facturing	**5.0**	**5.0**	**0**	**3.5**	**3.5**	**0**	**0.2**	**0.2**	**0**	**1.3**	**1.3**	**0**
Fish Processing	0.7	0.7	0	0.7	0.7	0	0	0	0	0	0	0
Other	4.3	4.3	0	2.8	2.8	0	0.2	0.2	0	1.3	1.3	0
Services	**5.2**	**5.0**	**0.2**	**3.6**	**3.4**	**0.2**	**0.2**	**0.2**	**0**	**1.5**	**1.4**	**0.1**
Households	**44.7**	**34.7**	**10.0**	**28.2**	**22.6**	**5.7**	**5.3**	**1.7**	**3.6**	**11.2**	**10.4**	**0.7**
Rural	10.0	0	10.0	5.7	0	5.7	3.6	0	3.6	0.7	0	0.7
Urban	34.7	34.7	0	22.6	22.6	0	1.7	1.7	0	10.4	10.4	0
Government	**2.3**	**2.3**	**0**	**1.5**	**1.5**	**0**	**0.1**	**0.1**	**0**	**0.7**	**0.7**	**0**

	All Sources			Groundwater			Perennial Rivers			Ephemeral Rivers		
	Total	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**
TOTAL	**225.1**	**86.6**	**138.5**	**126.2**	**39.6**	**86.6**	**55.7**	**5.0**	**50.7**	**43.3**	**42.0**	**1.4**

Adapted from G M Lange 1997.

2.3 The Namibian Economy, Value Added and Water Use

The demand for water is influenced by economic growth. The faster an economy grows the more pressure is likely to be placed upon water resources. Since 1990 Namibia's Gross Domestic Product (GDP) has grown at an average annual rate of 3.5% (CBS 1998)[7]. Since 1993 GDP has grown at an average rate of 2.6% per annum, whilst per capita income has **decreased** by 0.5%. For per capita incomes to improve requires economic growth in excess of population growth; approximately 3% on average. Economic growth in Namibia is not strong at present and is always vulnerable to climatic variability.

Namibia's GDP is dependent upon contributions from services (including tourism), mining, manufacturing (including fish and meat processing) and agriculture. Namibia is heavily dependent on natural resources, whilst much of the agricultural sector is dependent upon, and hence vulnerable to, rainfall.

The Namibian economy is relatively small and yet open with exports and imports of goods and services together averaging 112% of GDP from 1994 to 1996. Namibia's foreign exchange earnings are vulnerable to developments in the world market for minerals, whilst fish and tourism exports are dependent on the economic cycles in the overseas markets, mainly South Africa and Europe (WTO. 1997).

Water is often seen as the main constraint to economic development in Namibia. The scarcity of water, due to climatic variability and the increasing expense of supply augmentation, is certainly a constraint to certain economic sectors as expenses are frequently incurred in order to limit the risks of drought and use water more efficiently, whilst agricultural output is often severely affected by drought. Similarly the range of potential development activities is often limited by the scarcity of water. However, often the current costs of water supply make up only a small proportion of total costs for many industries (van der Merwe 1999).

Table 2.4: Value added per cubic metre of water by sector 1996

Economic Sector	Value added 1996 (millions of N$)	Water use 1996 (millions of cubic metres)[8]	Value added per cubic metre of water 1996 (N$/m^3)
Agriculture	**1,029**	**142.9**	**7.2**
Commercial	650	92.9	7.0
Subsistence	379	50.0	7.6
Mining	**1,654**	**25.2**	**65.6**
Diamond mining	1,169	13.6	86.0
Other mining	485	11.6	41.8
Manufacturing	**1,552**	**5.3**	**292.8**
Fish processing	354	0.5	708.0
Other manufacturing	1,198	4.8	249.6
Services	**3,215**	**5.5**	**574.5**
Hotels and Restaurants	226	1.2	188.3
Transportation	252	0.8	315.0
Other services	2737	3.5	782.0
Whole economy	**11, 796**	**231.2**	**51.0**

[7] GDP at Market Prices in constant 1990 prices.
[8] The figures for total consumption differ from those outlined above from DWA 1998 largely due to the differing underlying assumptions for water requirements in the agricultural sector.

Namibia's economy is vulnerable to domestic variability in rainfall and the changes in world prices for exports. Whilst the factors which affect the export markets are largely exogenous to Namibia, the pattern of domestic production should be shaped in order to maximise the economic contribution of these activities in the face of the natural constraints faced. Water availability is one of these constraints and as such it is sensible to address the pattern of current water demand in terms of the productivity of water in each sector in order to obtain some guidance as to optimal allocations of water.

Value added shows the contribution of an economic sector to GDP. Value added per m^3 relates this contribution to water usage. Value added per m^3 of water is a useful concept for considering the economic benefits derived from the use of water in different sectors of the economy. As such some notion of the **opportunity costs** of using water in different sectors is revealed and also an indication of the ability of these sectors to pay for water in the future. Calculations based on an analysis of the National Accounts for 1996 revealed the data shown in **Table 2.4** (G.M. Lange, CSO, 1996).

2.2.3 Agriculture

Growth in the agricultural sector has averaged 1.2% per annum since independence[9]. Since 1993 growth has averaged 2.8% per annum. This sector is strongly influenced by climatic conditions and as a result the contribution to GDP has varied from 6.8% to 12.3% since 1990 (WTO 1997) with low contributions in drought years. Since 1995 agricultural growth has barely kept pace with population growth. This can be attributed directly to the below average rainfall in Namibia over the past few years. As a result of low rainfall there was considerable de-stocking of livestock in 1996 which lead to a 60% drop in the number of cattle marketed in 1997. Cereal production has been affected similarly[10]. Growth in the agricultural sector is expected to be weak in the coming years, implying negative per capita growth (MAWRD 1999).

Due to the high usage of water in irrigation, and the generally low economic returns to agriculture as a whole, water is relatively unproductive in the agricultural sector compared to other sectors. Agriculture made up nearly 9% of GDP and approximately 62% of total water consumption in 1996. The value added per m^3 of water used is N$7.20. Agriculture also provided over 16% of visible exports, almost 90% of which comprised of cattle and small stock on the hoof. It is interesting to note that water used in subsistence agriculture is more productive than in the commercial sector. Furthermore in 1993 irrigation used 3 times as much water as livestock whilst producing output with a value only 2% that of livestock. These proportions are likely to be similar in 1996.

Since much of the water consumption in this sector is in the irrigation sector, the fluctuations in rainfall from one year to the next are unlikely to influence water consumption greatly.

2.3.2 Mining

Major users of water in the mining sector in 1996 include Rosh Pinah, Rossing, Navachab, Namib Lead and NamDeb. The value added per m^3 of water used is in the order of N$65. The sector as a whole made up between 7 and 10% of total water consumption[11] and over 14% of GDP in 1996. The mining industry contributes significantly to Namibia's foreign exchange earnings, making up 50% of the total export earnings, 2/3 of which comes from diamond mining.

Growth in the mining sector has fluctuated over the past few years. Since 1990 growth in the mining sector averaged 2.3% with high levels of growth in 1991 and 1994 and with negative growth in 1993. The contribution to GDP fluctuated similarly.

The mining industry has historically been forced to pay full cost recovery prices (operations maintenance and capital) for water, forcing many to employ recycling or use alternative inputs to freshwater. The value of output is also high. In combination these factors often lead to a high productivity and efficiency of fresh water use.

[9] Derived from the CBS figures of 1998.
[10] 1996/7 saw a record yield however.
[11] SOER 1999 and Lange/CSO1996 differ slightly.

2.3.3. Manufacturing

This sector includes the meat and fish processing industries which often have high levels of water consumption, e.g. NovaNam in Luderitz consumed 300,000m^3/a in 1997, and Meatco in Windhoek which consumed 185000m^3 in 1998 (van der Merwe, 1999). However, these processes generate considerable value added for the Namibian economy. In total the manufacturing sector made up 13% of GDP and less than 2.5% of total water consumption. Value added per m^3 is N$293.

Growth in the manufacturing sector has been stable since independence averaging 4.2% per annum since 1990 and 3.9% since 1993.

2.3.4 Services

The services sector is a major contributor to GDP. In 1995 the services sector made up 31.2% of GDP. Government services made up a further 28% of GDP in 1995. The services sector is also the biggest employer in the Namibian economy with the government being the biggest single employer.

Hotels and restaurants appear to be relatively water intensive compared to the rest of this sector, probably due to irrigation of gardens at many of the establishments. However, the high value added per cubic metre of water means that users will be able to pay the future cost of supply. The government sector is also a large consumer of water, and often the most inefficient consumer[12]. The government is not included in the value added calculations above.

2.3.5 Households

Although household output is not explicitly measured in the national accounts, the value of improved water supply to households can be very high. These values include reduced illness, reduced time spent collecting water and higher ability to work. Although no studies have been explicitly done for Namibia the values derived are expected to be quite high. The results of studies in other countries have shown that communities have been willing to pay up to 10% of their income on improved water supply (Aguilar and Sterner. 1995). Per capita income growth, one of the factors contributing to water demand growth, has been negative over the past few years.

2.3.6 Comparison of Namibia and the Republic of South Africa

For clarity and context it is worthwhile comparing similar statistics on value added for neighbouring countries. At present the information is only available for the Republic of South Africa as shown by **Table 2.5.**

It appears from Table 2.5 that Namibia generates greater value-added from its water use than does the Republic of South Africa in each of the broad economic sectors shown. At present it is not exactly clear why this should be, however it has been speculated that in the agricultural sector, South Africa's reliance on irrigation explains the wide disparity in value added per m^3. Further investigation is required in order to explain the disparities in the other sectors.

[12] Examples of the high levels of water usage in government institutions such as NDF, Ministry of Education, Ministry of works etc are numerous. Similarly examples of non payment for water use are common.

Table 2.5. Value-Added by Economic Activity in Namibia and South Africa, 1996.

SECTOR	Namibia Value Added (Rand/m^3)	RSA Value Added (Rand/m^3)
Agriculture	7	2
Mining	67	59
Trade and Services	575	403
Manufacturing	293	130
GDP (weighted average)	**51**	**27**

SOURCE: Namibia, unpublished work from the Namibian Natural Resource Accounting Programme, 1998. South Africa: Rashid Hassan, 1998 Forthcoming "Natural Resource Accounting as a Tool for Sustainable Macroeconomic Policy: Applications in Southern Africa" IUCN Policy Brief. 1999. (References include Lange and Hassan (2000)

2.3.7 Summary

Value added per m^3 of water is not a complete analysis of the value of water in particular uses nor the value of the sector in which water is being used[13]. For example, although agriculture has the lowest value added per m^3 it is estimated that 41% of the rural population is dependent on agriculture for their principle source of income (HIES 1997). Furthermore, over 45% of employment in Namibia is in the agricultural sector. However, it should be borne in mind that value added can be thought of as the sum of profits and wages, and as such this productivity measure does include the labour income generating aspects of the sectors mentioned.

The value added statistics are useful for comparing sectors and are instructive in determining the emphasis of future sectoral policies in the face of scarce water supplies. For example, since crop production (irrigation and rain-fed) has the lowest productivity of water, estimated at around N$0.2/$m^3$, irrigation is clearly a prime target for the reallocation or improved efficiency of water use, and hence reduced policy emphasis. Given the choice between promotion of irrigation and manufacturing in a given area with limited water supplies, manufacturing would be preferred on the basis of its contribution to GDP. It is clear however that there are other constraints facing Namibia, which inhibit economic development. These include: lack of skilled labour, limited manufacturing options, high transport costs and absence of markets. Subsequently, the variety of development options facing Namibia is constrained and often irrigation is seen as the only potential use for water in a given scenario[14]. In this case the emphasis must shift towards encouraging efficient water use and the growth of higher value crops in order to increase the income generating capacity of the constrained water.

The goal of sustainable economic development is more likely to be achieved if water usage in Namibia's economic sectors is guided by an approach that considers the economic productivity of water in different uses. Overall the contribution to economic growth and the productivity of water in each sector should be reflected in Namibia's sectoral development policies. The next section examines these policies.

2.4 Sectoral Economic Policies

One of the main determinants of the current pattern of water use in Namibia is the National Policy towards the different sectors of the economy. The Government's approach and level of assistance to sectors such as agriculture, tourism, and industry ultimately shape the growth of those sectors, which in turn shape the demands for water in those sectors. Similarly, policies, which address wider economic issues such as poverty alleviation, employment and trade, may also influence demands for water. Moreover, the specific policy concerning water supply to the different sectors will directly shape the water consumption decisions within that sector and guide allocations between the sectors. In sum the policy environment is a highly influential factor in creating an 'enabling environment' for the water sector. Any advances in policy in the water sector, such as charging cost recovery tariffs, can be

[13] Some commentators, Young (1996) for example, state that the value added approach to the valuation of water always leads to an over estimation of the real value of water. In essence, the value added of the particular sector is attributed only to water, whereas there are a variety of inputs contributing to value added. In this sense value added per cubic metre can be thought of as an upper value for water.

[14] An example of this might be the Orange River.

undone by weaknesses in sectoral policies such as import protection, taxes and subsidies on input and output prices etc.

The sectoral policies are dealt with in turn and their implications for current and future water usage described. The agriculture section receives more coverage than other sectors as it is a crucial water user.

2.4.1. Agricultural Sector Policy

The agricultural sector includes crop growth, both rain fed and irrigated, and livestock production. There are two agricultural sub-sectors: the communal-tenure farms and private-tenure/commercial farms, of which the former is situated in the communal areas of Namibia. The agricultural sector is economically important for the following reasons:

- It makes up approximately 8% of GDP. (commercial agriculture 5.4%, subsistence agriculture 3.6%)[15].
- Subsistence farming provides the principle source of income for 41% of all households in Namibia (Household Income and Expenditure Survey, 1997)
- An estimated 70% of the population derive at least part of their income from agriculture (WTO 1997).
- The sector is an important source of foreign exchange, providing more than 15% of visible export earnings during recent years.

It is important to make a clear distinction between livestock and crops in the agricultural sector, especially when considering water use. Although this sector uses over 60% of the water in Namibia, over 75% of this water is used in irrigation, which as stated above, has a very low contribution to GDP. It is clear therefore the policy orientation towards the agricultural sector as a whole, and particularly irrigation, will have a major influence upon Namibia's overall water usage whilst potentially offering the most obvious area for change.

Namibia's most recent policy statements regarding the agricultural sector have come from 3 main sources, the Water and Sanitation Policy of 1993, the First National Development Plan of 1994 and the National Agricultural Plan of 1995. **Box 2.1** shows the main facets of these policies.

The evolution of agricultural policy and planning with respect to the crops and irrigation is apparent from Box 2.1. There has been a systematic movement away from emphasis on food self-sufficiency[16] towards food security as a policy recommendation. Similarly recognition of the doctrine of comparative advantage emerges in NDP 1 and the National Agricultural Plan (NAP) of 1995. However, at the same time certain parts of agricultural policy, or water policy directed at agriculture, have remained constant, for example, the subsidisation of water for agriculture mentioned in the WASP 1993, has not been superseded, whilst the protection of domestic cereal producers still remains. The creation of employment and the promotion of sustainable livelihoods have been a feature of all three policy documents.

[15] This is an average since 1995. The actual contribution varies from one year to the next.

[16] Food self sufficiency refers to domestic production of basic grains to satisfy total domestic demand eradicating the need for imports. Food security means ensuring access, both physical and economic, to sufficient food supply without reference to the supplier.

Box 2.1 Government Policies in Agriculture.

i) Water and Sanitation Policy (WASP) of 1993:
The WASP prioritises water in the following way:

First Priority: Domestic purposes, including livestock watering for subsistence and economic farming
Second Priority: Water for economic activities such as mining, industry and irrigation (to be determined by the respective value in relation to the overall development objectives of the country)

The WASP states the irrigation sector should:

- improve sustainable national **food self-sufficiency** and security
- Promote improved nutrition and surplus production at household levels
- Support sustainable settlements
- Stimulate development of viable arable agriculture

The policy also makes provision for a 'special subsidy' to irrigation based on the socio-economic benefits derived from the project. There is no specific mention of the livestock sector other than the prioritisation.

ii) The First National Development Plan (1995-2000) of 1994:
NDP 1 prioritises water resource development and allocation as follows:

First Priority: domestic and livestock consumption
Second Priority: mining, industry and where suitable, for irrigation.

Policy objectives in NDP 1 were specified as

- Improve levels of household food security nationally with an ultimate goal of achieving **food self-sufficiency**
- Raise the value of agricultural exports and/or reduce the value of agricultural imports
- Create productive employment opportunities
- Increase the value added within the country to national agricultural output

There are specific targets relating to increasing employment, productivity and output in the subsistence livestock and crop sectors. An increase of irrigated land by 5000 hectares was also targeted alongside movements towards import parity pricing grain

iii) The National Agricultural Plan of 1995
The broad objectives of the National Agricultural Policy (NAP) are to:

- Achieve growth rates and stability in farm income, agricultural productivity and production levels that are higher than the population growth rate.
- To ensure food security and improve nutritional status.
- Pursue **food self-sufficiency** objectives only to the extent that it is financially rewarding and economically viable to do so.
- Create and sustain viable livelihood and employment opportunities in rural areas.
- Improve profitability in agriculture and increase investment in agriculture.
- Contribute to a balanced rural and regional development based on comparative advantage.

The emphasis of the policy is on ensuring participation of communities in strategies to improve farm incomes, employment levels etc whilst acknowledging the role of the government to create an enabling environment for sustainable agricultural development.

Food Self-sufficiency vs. Food Security

The policy of food self-sufficiency has been shown to be contrary to the Government's broad macro-economic development goals laid down in NDP 1 (DARD 1997). The goals of creating employment opportunities, sustained economic growth, a reduction in income inequalities and the alleviation of poverty are not addressed by a policy of self-sufficiency for the following reasons:

- **Labour Requirements**: cereals have the lowest labour requirements of all crops

- **Low Value:** cereals cannot be relied upon to generate sustained growth in farmer income's and therefore contribute towards poverty alleviation due to the low value of the crop.

There are several economic and natural resource constraints that make a policy of self-sufficiency unsustainable in the long run, undesirable economically and inefficient in its use of water. These constraints include:

- **Cheaper Imports**: Imports of basic grains are generally cheaper than grains produced in Namibia. E.g. It costs between N$1400 and 1200 per ton to produce maize in Namibia, whilst in the Republic of South Africa it costs N$800 (Heyns et al 1998)[17].

- **Storage costs**: The variability of Namibia's rain-fed grain production, due to variations in rainfall leads to surplus and deficit years. For self-sufficiency to be achieved will require the storage of grain in surplus years. This is estimated to add an extra 20% (N$176 per ton in 1997, or N$6.3million per annum in total) to production costs, costs which the government would have to bear.

- **Water**: Given population growth, self-sufficiency in basic grains would require over 500Mm^3/a by 2015, meaning the complete usage of Namibia's currently secured water resources[18]. This will require the development of highly costly water resources, the subsidisation thereof by the Government and international co-operation in the case of perennial rivers (WCE/Interconsult 1999). Similarly such a policy implies that water for grain production is given a priority over other uses.

- **Land**: In the future the lack of suitable irrigation land in Namibia would be a constraint to self-sufficiency since the cost of preparation and the added input requirement for crop production would be restrictively expensive (see feasibility study of Brukkaros Dam or Tandjieskoppe).

- **Environmental Concerns**: Namibia's soils are susceptible to over-use, wind erosion and subsequent loss of fertility. The prevention of this requires strict management and therefore high costs

Evidence from across Southern Africa tends to suggest that irrigating low value crops does not provide a sufficient return to capital, whilst the capital intensive nature of irrigation in Namibia tends to exacerbate income disparities. In a water scarce economy food self-sufficiency is not a sensible policy.

Agriculture and Trade

Namibia's trade policy, and the extent to which agriculture is protected, will have implications for the growth of the agricultural sector and subsequently the use of water. Namibia obtains on average two thirds of its annual cereal requirement from South Africa who is a net exporter of cereals. In essence Namibia's grain production is in direct competition with the world market and particularly South Africa. Livestock production in Namibia is largely exported to Europe and South Africa.

As a signatory of the World Trade Organisation (WTO), Namibia is committed to replace any quantitative import controls with tariffs. This will mean that the price that domestic producers receive will be equivalent to the *c.i.f.* price of maize landed at Walvis Bay, plus any tariff, plus transport costs

[17] There is some natural protection to Namibian crops in the form of high transport costs. This is only estimated to add in the region of N$200 per ton.

[18] Given that demands in other sectors increase concurrently.

to the mill[19]. In addition Namibia is party to the SADC free trade agreement, which hopes to dismantle quantitative restrictions, and within 8 years and have zero tariff protection.

Currently the Namibian Agronomic Board (NAB) does not comply with Namibia's commitments to the WTO. Namibian produced grain is given priority and import permits are only granted when the mills have bought the entire domestic grain production (DARD 1997). This results in an artificially high price for grain, since the price of grain is set at a level in excess of the true *c.i.f.* price. This artificially high price, estimated to be equivalent to an 8-10% rise, ultimately falls on the grain consumers and acts as a subsidy to those who can produce a surplus i.e. a few large-scale commercial producers and/or wealthier farmers. In the future the maximum price that farmers will be able to charge will be the import parity price (*c.i.f*).

This policy, quite apart from being contrary to the commitments made to the WTO, assists large-scale commercial farmers to persist in growing low value crops. Many of the maize growing areas are under irrigation where water is supplied from state dams, perennial border rivers or from groundwater. It is clear that the use of price support for basic grains can steer water away from more economically valuable crops, hence crowding out more economically rewarding activities. In reality no objections to this policy have been raised by regional WTO/SADC members. Nevertheless the WTO has estimated:

'under complete free trade, the maize production area (which includes marginal land) might have to be reduced by 65%' (WTO 1997).

Complete free trade would include the removal of the current NAB policy on grains and the removal of the South African Customs Union common external tariff, which provides degree of protection to Namibia from the world markets.[20]. It is not clear the extent to which water resources will be 'freed' as a result of this.

Trade in the livestock sector is not subject to intervention like that in the cereals sector. The only barriers to trade are based on quality and hygiene standards. The quality standards required for exports to European and South African markets are maintained by the Meat Board of Namibia through a licensing system for abattoirs whilst the price is generally set by the market (DARD 1997). A preferential quota system exists for exports of red meat to Europe under Lomė IV. The livestock market is more competitive in Namibia and as such the scope for policy changes to reduce economic distortions and to improve the efficiency of water use in this arena is small. There is general concern, especially in the beef industry, about the cessation of preferential access in 2000. Negotiations are currently underway to maintain the existing arrangement.

Lomė IV also provides preferential (duty-free) access for the export of 900 tonnes of seedless grapes (WTO 1997). Namibia's grape exports are currently in the region of 5300 tons, suggesting that preferential access provides only a small incentive to farmers.

Water Subsidies to Agriculture

There are a variety of subsidies given to agriculture. For communal farmers these include:

- interest subsidies on loans for the purchase of commercial farms
- interest subsidy on seasonal crop production
- price subsidies on fertilisers, improved varieties of pearl millet and maize (WTO 1997).

Fertilisers are subsidised to the NDC schemes at Etunda, Naute and along the Okavango River. There is also 100% GST exemption for all farmers registered for tax purposes on fertilisers, insecticides, fungicides and the like. Livestock and seed are also exempted. Losses made in farming ventures are deductible against tax on other enterprises. Other more indirect subsidies to agriculture have included the maintenance of roads. Many of these subsidies make the inputs into the farming process much cheaper to the private individual and are likely to encourage the expansion of the agricultural sector or the persistence of the current shape of the sector, and hence the use of water.

[19] This is Cost, Insurance, freight.

[20] Accepting that the other crops may be subject to some constraints of their own, as suggested in the agriculture and poverty section below.

The effects of these subsidies on overall agricultural growth could be negligible, and the survival of the industry in the face of free trade may require these and other measures; anti-dumping legislation for example. However, the existence of a policy to subsidise water to agriculture means that inefficient amounts of water will be used in existing agricultural endeavours. The issue of subsidised water is most apparent at the large irrigation schemes. For example, the full cost recovery price of water at Hardap dam is reckoned to be 14c/m^3 whilst the current charge levied upon farmers by the Ministry of Agriculture is N$333/ha. Given that the consumption of water is approximately 16000m^3/a/ha, this leads to a shortfall of N$1767/ha, and an overall annual subsidy to the project of N$4million per annum[21]. A similar situation is apparent at the Etunda irrigation scheme whilst along the border perennial rivers, although a similar charge is levied on a per hectare basis, there is no consideration made of the opportunity cost of the water. Where water is subsidised the value of water becomes capitalised in the price of land. This acts as a transfer of benefits from the owner of the resource to the land-owner and can be an inequitable outcome.

Subsidies such as those at Hardap provide incentives to farmers to use inefficient quantities of water, grow low value crops and use inefficient irrigation systems such as flood irrigation. The consequences of this overuse of water have included environmental damage such as salination of soils. Furthermore, such subsidies represent a recurrent cost to government and, since they encourage inefficient practices and environmental costs, seem to provide little benefit to society.

The Namibian Agronomic Board has stated:

> *'Presently, neither the actual nor the opportunity cost of water for agricultural irrigation is fully recovered. The irrigation of agricultural crops will in most cases be not sustainable, if full water costs are levied and have to be paid by producers. Only high value, low weight export crops will, over a longer period of time, be economically feasible to produce if water is supplied on a cost recovery basis to irrigation farmers'.* (NAB 1999).

In the livestock sector water is mostly obtained from groundwater on commercial and communal land. In addition to the free access to groundwater that some private farmers obtain as a right in accordance with the 1956 Water Act, there is concern that many commercial livestock farmers within communal areas have water subsidised through unlimited access to water points provided by the Directorate of Rural Water Supply. Similarly in the absence of information on the recharge and capacity of aquifers, little can be said about the sustainability of current livestock practices and water supply[22].

Agriculture and Poverty

The link between agriculture and poverty is pervasive. Most of Namibia's population (68%) lives in rural areas where dependency upon agriculture for income and food security is high. It has been found that across Namibia those households that rely most heavily upon subsistence agriculture also have the lowest incomes. Furthermore the poor seem to be 'trapped' in that the levels of income received from agriculture seem to be lower than 'non-poor' households (World Bank 1997).

However, agriculture in general makes only a small and limited contribution to average communal-tenure area household income. For example, less than 20% of household income is estimated as being derived from agriculture in former Ovambo region (with under 1% derived from crops), 16% in the Kavango and 34% in the Caprivi. The remainder comes from a range of non-farming activities, remittances of food and cash, pensions and formal sector employment (World Bank 1997).

Water is often considered to be the most crucial constraint to agricultural development in Namibia. As such past policies towards agricultural development, employment and poverty alleviation have manifested themselves in large-scale state irrigation schemes such as those at Etunda, Shadikongoro, Shitemo etc. which have attempted to overcome the otherwise variable water supply. These schemes, implemented partly in response to call for food security through self-sufficiency and favoured largely because of the ease of control, concentrated on growing low value crops such as maize whilst

[21] It should be mentioned that the DARD and NamWater disagree on the definition of full cost recovery, and more specifically the inclusion of capital costs in the tariff for water. This is discussed in detail in section 2.3.4.

[22] This is often more a question of the carrying capacity of the land, although the existence of water points can degrade the surrounding land and reduce the carrying capacity.

employing capital intensive technologies. As such many of the schemes have been deemed economically unviable and only able to support themselves with the aid of large government subsidies for both capital and recurrent costs. These schemes have lead to the inefficient and potentially unsustainable use of water resources as well as unsustainable government support.

There are many constraints to agricultural development in Namibia besides water. These constraints limit the ability of the poor rural households to break the poverty trap. The constraints include (World Bank 1997):

- Land quality
- Reduced availability of land due to indiscriminate fencing of communal areas
- Carrying capacity of land for livestock
- Labour at peak times
- Technology
- Weakly developed markets

NDP 1 put the constraints to agricultural development, and any associated poverty alleviation, in several broad categories:

- **Demographic**:

    - The fast increasing population in rural areas in recent years has meant that pressure on land has grown progressively and farmers are now compelled to cultivate the same piece of land continuously.
    - Women play pivotal role in the preparation and production of food and the welfare of the general household in rural areas, yet continue occupy a subordinate position in the social structure. For example, they have only restricted access to land and such agricultural services as credit facilities, veterinary extension and training, while other barriers exist to their social advancement.
    - Average levels of agricultural productivity are significantly below potential in most of the communal-tenure areas. That situation was mainly caused by the low-input low-output production systems, which result from a combination of environmental, historical technical and socio-economic factors.

- **Ecological**:

    - The fragile nature of ecosystems in the rural areas meant that it can easily be damaged; recovery is difficult and takes a long time. There is growing evidence of long-term deterioration in the ecological base.

- **Macro-Economic**

    - The level of budgetary support to the sector is low, having averaged between 3% and 4% of the total public expenditure in real terms since independence.
    - The repercussions at the farm level of the forthcoming implementation of changes in the regional and international trade regulations with SACU, COMESA, and the European Union is unclear and may affect the investment in the sector.

In combination these constraints have lead to low returns to land and labour, and a high level of vulnerability to external shocks. It is clear that all of the constraints will have to be addressed in order to encourage the development of the agricultural sector. Water is just one part of the spectrum of factors which constrain agricultural development and subsequent poverty alleviation in Namibia.

In the crop sector it is widely thought that large-scale irrigation is not the answer to the constraints imposed by low and variable rainfall and general unreliability of water supply. The currently uneconomic shape of many irrigation schemes as shown by the cost benefit analysis of the Etunda project, and the financial troubles encountered by many irrigators in Namibia, even in the absence of user charges for water, suggests several recommendations.

Future irrigation will have to:

- Combine low cost irrigation with high value crops in order to be viable
- Operate on a scale which does not result in a major draw-down of existing water resources

These recommendations are particularly important where irrigation is the only option for development in a particular area and where the sustainability of the water resource is paramount.

Other recommendations for the alleviation of poverty have focussed on improving extension services to farmers with the aim of introducing new techniques and changing the current low input/low output regimes. The introduction of peri-urban vegetable growth in order to replace imports, the production of cash crops such as cotton and oriental tobacco (which have been estimated to provide much higher earnings that millet) and the strengthening of the marketing and processing of millet, have all been suggested as potential poverty alleviation solutions through agricultural development (World Bank 1997). The removal of protection for domestically grown maize has also been cited as a poverty reduction measure since lower maize prices will benefit those who cannot grow enough maize for own consumption and those who spend the majority of their incomes on staple cereals, i.e. the poor.

Summary

The effect that government policy on irrigation and crops will have on the water sector is clear. If the targets of NDP 1 are taken as read, an extra 5000ha will be irrigated by 2000. This implies an additional 75Mm^3/a of water, an increase in Namibia's total water consumption of over 25%. This policy arose from a desire to achieve food self-sufficiency as a target in itself and may not be considered a priority in light of the NAP of 1995. There are strong economic arguments against pursuing a policy of self sufficiency in basic grains in Namibia.

The current protection of the Namibian maize growers offered through the prioritising of Namibian wheat and maize over potentially cheaper imports encourages the growth of low value maize crops and the low value use of water. It is not clear what the opportunity cost of this water is, i.e. what the water would otherwise be used for, but it seems likely that this current policy will offer incentives to use water in this way. Protection also encourages higher prices to consumers, the burden on which falls upon the poor.

The gradual compliance with the general trade agreements to which Namibia is party; WTO, SADC and SACU, will eventually see the removal of all protection and a movement away from cereals production and the use of water therefor, as competition from overseas or within SADC reduces cereal prices. As well as benefiting all consumers of cereals, and particularly the poor who spend a large proportion of their incomes (up to 60%) on food, compliance with trade policies could potentially reallocate water to higher value crops or sectors, or reduce groundwater overdrafts in certain areas such as the Karst.

A more direct impact on water usage comes from its implicit subsidisation. One of the major determining factors in the consumption of an input is its price. Where water is subsidised its use is likely to be highly inefficient. Where it is believed that significant social benefits arise from the existence of particular irrigation schemes, subsidisation should rather come in the form of explicit transfers whilst water is simultaneously charged at the economic cost (O+M and capital, externalities etc). There is an economic case for charging only the short-run marginal costs of supply (O+M) where current consumption is not believed to necessitate future capital investments and existing capital can be considered 'sunk'. In this situation the Government could make up the difference between financial costs (which may include a premium for existing capital) and the short-run marginal costs, provided it has been found to be a beneficial use of Government funds.

Lastly it is wrong to think that water is the only constraint to sustained growth in the agricultural sector. This implies that the alleviation of poverty and the development of agriculture in general are not likely to be achieved from the development of water sources alone. Furthermore the experience in many developing countries has revealed that large-scale irrigation enterprises are not the solution to poverty alleviation, food security and employment generation in rural areas.

2.4.2 Mining Sector Policy

Mining is a particularly important sector for the following reasons:

- Mining is the largest contributor to export earnings contributing 50% on average, 60% of which comes from diamond mining.
- On average mining contributes 15% of GDP.

The mining sector has always been made to pay cost recovery tariffs for water. This policy has been reiterated in the WASP where it is stated that industry should be charged cost recovery tariffs including operations, maintenance and capital costs. This policy, along with the circumstances under which many mines operate in Namibia, has meant that mining operations have always had incentives to use water efficiently. This incentive continues with the creation of NamWater, which must cost recover on all water schemes. Examples of efficiency improvements can be cited at Rossing Uranium and Navachab mine where recycling of waste water is undertaken, and at the Namdeb Oranjemund and Elizabeth Bay mines where seawater is used for industrial purposes (van der Merwe 1999)[23].

Namibia operates an open-door mining policy, with the aim of creating an enabling and competitive investment climate. The Minerals and Prospecting act of 1992 provides the legal framework for government intervention and the facilitation of mining development. The objectives of the sector include:

- Increase knowledge of Namibia's mineral resources through improved exploration efforts
- Develop new mines for exports and employment
- Local beneficiation of minerals
- Conduct all mining activities within a framework of minimal environmental damage

Furthermore the government intends to provide tax and other fiscal incentives to attract foreign investment in minerals. There is specific reference to strategies to account for and monitor environmental impacts

Water consumption in the future will be determined both by the Government's approach to new potential investors, world prices for minerals and the extent of the mineral reserves. Recent events have meant a downturn in the mining sector. For example the Haib copper mine on the Orange River has been currently put on hold due to the falling copper price. It was expected to use up to 60Mm^3/a. The Tsumeb copper mine closed in 1998 also due to low copper prices and rising costs. The future of Navachab gold mine is also in doubt in the face of current and expected future gold prices.

Environmental impact assessments are required for any mining development in Namibia. An assessment of the impact on water resources is just one of its components. Water consumption by this sector is determined more by these external factors than the policies of government it seems.

2.4.3 Manufacturing

Manufacturing has been shown to be one of the most productive sectors of the Namibian economy with respect to value added per m^3. The contribution to GDP in 1996, including the meat and fish processing industries was 12%.

Recent government policies with respect to the manufacturing sector are described in **Box 2.2**. The emphasis of these policies is upon the promotion of Small to Medium sized Enterprises (SME's), the promotion of production for the export market, the attraction of foreign investment and the protection of infant industries. In addition to the policies in Box 2.2 there are several other incentives offered to manufacturers such as tax breaks, cash incentives and concessional loans.

Export Processing Zones (EPZ's) are located in a variety of places throughout the country and have the capacity to be either 'fenced-in' or single factories which may locate anywhere in the country. It is

[23] Although the policy of supplying water free of charge in Oranjemund Town leaves somewhat to be desired.

expected that there will be a concentration of EPZ companies in Walvis Bay and certainly in the larger urban centres of Namibia.

The growth of water demands in urban areas, and particularly Walvis Bay will be increased should the EPZ and industrial parks development schemes be successful. The future costs of water in urban areas like Windhoek and Walvis Bay are increasing. The implementation of the desalination scheme on the coast, and the likelihood of supply augmentation in the central areas have high costs attached to them and may double the price of water. Water costs usually only make up 1-2% of the total costs to manufacturing enterprises and as such they are not likely to outweigh the incentives offered by the policies mentioned.

However in attracting companies to Namibia it is important that water is not used as a vehicle for incentives. In fact, as has occurred in the mining sector over the years, it is important that full cost recovery is applied to all businesses and manufacturers in order to provide sufficient incentives for firms to use water efficiently. In Walvis Bay for example the fish processing factories use seawater as an alternative to fresh water. Furthermore, given the small amount of total costs that water often makes up in the manufacturing sector, it has been recommended the application of particular yardstick standards for efficiency in certain industries may be appropriate (van der Merwe 1999). For example the specific consumption of water per litre of beer produced, or the amount of water used per head of cattle slaughtered can act as guidelines for water efficiency to new and existing enterprises. In Windhoek there are currently guidelines for new 'wet' industries, which encourage the use of efficient water usage.

Box 2.2. Examples of Current Government Policies towards Manufacturing

Export Processing Zone (EPZ) Act of 1995.

This initiative launched in 1995 and provides a variety of incentives to potential manufacturers to process goods for the export market. The incentives offered include:

- 0% corporation tax
- GST/AST exemption
- Stamp duties exemption
- 75% cash grant for wages and the formal on-the-job training during the start up phase.

Export Incentives 1993-1994.

- 25-75% of all marketing expenditure is tax deductible
- 80% exclusion of profits from exports in non meat and fish industries for income tax purposes
- a facility for the refund of 50% of direct costs of export promotion is available.

Small Business Enterprises Program.

A policy document 'Namibia: Policy and Programmes on Small Business Enterprises' (1997) calls for deregulation of the SME subsector, protection against unfair trade practices for infant industries under SACU, and the introduction of special SME investment incentives.

SOURCE: WTO 1997

The WASP policy states that rates for industrial and commercial enterprises should recover the full financial costs of supply and there seem to be no special dispensations for manufacturing. Furthermore the governments objectives for industry include (NDP 1):

- promoting efficient use of natural resources, including water
- ensuring that environmental issues are included during the planning of industrial development activities.

Furthermore industrial policies will:

- recognise that water is a scarce resource

- promote industries that use least water and assist water intensive industries to use water more effiicently in anticipation of price rises
- take water into account in zoning and locating industrial sites

These policy statements tend to suggest that environmental issues and the sustainability of water supply will not be sacrificed for the sake of attracting foreign investment or short term development whilst water resources will be considered in the planning process.

2.4.4 Tourism

Tourism is seen as a priority sector in Namibia. The Tourism white paper of 1994 describes the tourism development strategy as aimed at attracting high yielding quality tourism, thereby maximising the sectors contribution to GDP and minimising the negative impact on the fragile environment. The 1992 Tourism Development Plan predicted a four-fold increase in the real earnings in the tourism sector between 1992 and 2002, mainly as a result of the increase in foreign visitors. There are no trade barriers to tourism, it does not compete with other sectors and is seen to have strong linkages to other parts of the domestic economy.

The Ministry of Environment and Tourism (MET) sees the Governments role in the tourist sector as a co-ordinating role between private sector and government ministries. The wildlife resorts formerly under the control of the government have recently been parastatalised (April 1999) whilst the conservancy project of the MET promotes community based natural resource management, putting the emphasis of resource management in the hands of community.

At present the tourist industry uses little more than 1% of the entire water consumption of Namibia (Lange 1997). The increase in tourism will obviously affect this over time however the policy to attract few, high paying tourists rather than mass tourism, is likely to limit the extent to which water will be used unsustainably. However, given the high growth in this sector water usage is something that should be monitored over time.

Again no special recommendations are in place in the WASP for the subsidisation of water to tourism. However, many tourist lodges along the perennial rivers are implicitly subsidised in their water use, as are many tourist venues in rural areas.

2.4.5 Trade

Namibia's trade policy is seen as one of the most advanced in Southern Africa. Trade liberalisation and investment promotion constitutes key elements of Namibia's trade policy framework and development strategy. The main trade policy objectives include:

- Promotion and further liberalization of trade
- Expansion of exports and diversification in terms of both products and markets.
- Provision of tax-based incentives for manufacturing enterprises and traders.
- Support to small and medium-size enterprises (SME)
- Creation of an environment conducive to investment and growth.

The Namibian Government's central policy objective is to promote economic growth. Trade is seen as a crucial element in improving the standard of living of all Namibians. Regional and bilateral agreements and membership of economic organisations (SACU; SADC; COMESA; WTO; Lome Agreement Etc.) constitute important elements in the trade policy framework, aimed at promoting Namibia's participation in the world economy and increasing and improving market access for its exports.

The main exports from Namibia are minerals, fish and livestock. These exports are limited by environmental factors such as carrying capacity of land, mineral reserves, world prices etc and as such the connotations for water use are limited. However, the compliance with the various trade agreements to which Namibia is a signatory will reduce the level of protection given to the agricultural sector, i.e. cereals. Such compliance will have significant impact on the future shape of water demand in

Namibia, moving water production away from low value products towards a more diverse export base and perhaps moving water demand from rural areas to urban areas.

2.4.6 Drought Policy

Drought represents the extreme end of the rainfall variability. The rural areas and agricultural sector are in general most affected by the incidence of drought in Namibia. This includes much of Namibia's poor.

In the past it was believed that "droughts" were infrequent events, which warranted government relief assistance. Such assistance was costly, unstructured and inconsiderate of the long-term effects of drought assistance. The frequent involvement of the government in drought scenarios led to the perception amongst the population that the government bears the responsibility for risk management. In turn this has discouraged farmers, for example, from adopting risk minimising practices and as such led to the potentially unsustainable use of water both within and between sectors. The Namibia National Drought Policy and Strategy of 1997 cites four main short-comings of previous government policy towards drought labour:

- No adequate definition of drought
- The government has borne responsibility for risk management (discouraging the private sector)
- A number of drought programs have led to unsustainable farming practices e.g. fodder subsidy
- Food distribution programs have been inefficient, costly targeted and of limited impact on household food security.

In response the Policy draws a distinction between drought and the natural variability of rainfall that occurs in Namibia:

" human endeavour must adapt to [the] *reality* [of variable rainfall and aridity in Namibia]. *Drought on the other hand is a relative phenomenon which refers to exceptionally low rainfall conditions…. The rare occasions when conditions are so severe or protracted that they are beyond what can be reasonable be dealt with in terms of normal risk management practices, and when state intervention is considered justified, are to be known as* ***disaster droughts****"*

According to the Policy, government assistance will only occur on the declaration of a disaster drought. It is clear that the government has a responsibility to act in the event of a drought situation in order to maintain household food security and prevent loss of life. However, it is important that the risks of drought are borne efficiently by the government and do not provide bad incentives for private individuals. Similarly, those measures that are introduced by the government to combat drought should be efficient and effective. In view of this the National Drought Policy and Strategy recommends 8 objectives:

- ensure that household food security is not compromised by drought
- encourage and support farmers to adopt self-reliant approaches to drought risk
- preserve adequate reproductive capacity in livestock herds in affected areas during drought periods
- ensure the continuous supply of potable water to communities, and particularly to their livestock, schools and clinics
- minimise the degradation of the natural resource base during droughts
- enable rural inhabitants and the agricultural sector to recover quickly following drought
- ensure the health status of all Namibians is not threatened by the effects of drought
- finance drought relief programs efficiently and effectively by establishing an independent National Drought Fund

The drought policy has been in existence since 1997, however, few of the recommendations have been implemented and it appears that droughts in the future will be addressed by crisis measures rather than through preparatory behavioural changes.

2.4.7 Summary

In the sectors addressed above (Agriculture, Mining, Manufacturing, Tourism and Trade) the respective policies have different impacts on current and future water demand. The policies of Trade, Manufacturing, Mining and Tourism all seem to recognise the importance of limited government intervention and in some cases, (Manufacturing/Industry) specific reference is made to water resources as an important development consideration. In all of these sectors the WASP recommends the provision of water at full cost recovery price.

In agriculture however, the continued calls for food self-sufficiency, the subsidisation of water for irrigation, the protection given to Namibian maize growers and the other input subsidies towards irrigated agriculture can be detrimental to the long-term efficiency of water use.

2.5 Predicted Growth in Water Demand in Namibia[24]

This section describes the predicted growth in water consumption in Namibia as a whole and for the central areas of Namibia. The manner in which the predictions have been constructed is also discussed and potential inaccuracies highlighted.

2.5.2 Future Demands By Sector by Source

Table 2.6 shows the predicted water demands by sector and source in 2020. Given the lack of information about the available water from these sources it is difficult to make any predictions about whether the predicted growth in water demand can be sustained. However, the falling water levels in many of Namibia's groundwater aquifers suggests that many are currently being over pumped.

Table 2.6. Estimated Future Demand and Resource use in Mm^3/a (WCE/Interconsult 1999)

Sector	Perennial Rivers		Ephemeral Rivers		Groundwater		Total	
	1995	2020	1995	2020	1995	2020	1995	2020
Domestic	19	100	21	30	40	90	80	220
Livestock	4	10	Farm dams only		63	65	67	75
Mining	7	25	2	5	9	15	18	45
Irrigation	77	180	30	50	24	30	131	260
TOTAL	107	315	53	85	136	200	296	600

The sustainability and viability of each water source is discussed in Section 2.3. Future demand growth for the medium term, until 2012, is discussed below for each sector[25].

2.5.3 Urban

Urban residential demands are driven by several factors including underlying average population growth of 3%, rural-urban migration, which on average increases the population of urban centres by 5% per annum, income growth and other demographic changes.

Manufacturing usage is generally in urban areas. Demand in this sector is driven by several factors: the demand for the product, the relative price of water compared to other inputs, the availability and cost effectiveness of water saving devices.

In both cases, residential and commercial, the extent to which water demand management (see section 2.5.3) is advocated and practiced in urban centres will be a major determining factor of demand growth. The price of water, the awareness of water issues, the cost and availability of water saving devices (which can substitute for water usage) and the reduction of unaccounted for water will also influence demand growth. Very little is known about manufacturing use trends at present, since most manufacturers obtain their water from municipalities and information has not been extracted. Although manufacturing is not a major user of water at present the rapid growth that will occur in this sector if

[24] This section draws heavily on the State of Environment Report on Water (WCE/Interconsult 1999)
[25] Information on the sectoral predictions comes from a planning report entitled 'Water Demands in Namibia', DWA 1998.

Namibia's development strategies (which focus on increasing value added in manufacturing) are successful, may make it a major user of water in the future. In this sense pollution and wastewater disposal will become an issue in the future.

Growth in the manufacturing sector has been moderate since 1990. On the basis of current trends, by 2012 Urban demands are expected to have grown from 67Mm^3/a in 1996, to 109Mm^3/a.

2.5.3 Agriculture

Growth of the agricultural use of water by livestock is expected to fall off in the medium term as herd size levels off after recovery from previous droughts and adjusts to the grazing available. The demands of livestock as a whole are expected to rise at a rate of 1% from 37Mm^3/a in 1996. Long-term demands will be constrained by the carrying capacity of the land.

Irrigation currently uses a large proportion of total water. Irrigation demand growth is largely dependent on continued subsidies for large irrigation projects run by institutions like NDC. In these cases demand for water is easily under the control of the government. However there are significant new investments planned along the Orange River by both government and private sector. Other perennial rivers are subject to similar increases in the future. Ultimately the existence of suitable land and the prices of crops, as well as government policy govern irrigation water demand.

Agricultural demands are predicted to increase from 202Mm^3/a in 1996 to 284Mm^3/a in 2012.

2.5.4 Mining

Current mines are not expected to increase their water demands significantly. New mines will require currently unknown amounts of water. Future demands in the mining sector will depend entirely upon the extent of the mineral reserves and the profitability of the mining operations and hence the price of the minerals produced. Developments such as the Skorpion mine will increase water usage in this sector. The Haib copper mine remains a potential investment for the future. These two developments represent the largest potential increase in water demand, requiring 0.8Mm^3/a and up to 60Mm^3/a respectively from the Orange River.

NamDeb Oranjemund and Elizabeth Bay mine use salt water for their industrial processes. Similarly, Rossing mine and Navachab mine engage in recycling of water. This has been the result of cost recovery strategies for water in the mining sector. This raises the issue of alternative inputs for water and water saving devices and the extent to which these practices may influence water use in the future.

Water requirements in the mining sector are predicted to increase from 18Mm^3/a in 1996 in line with future developments and closures. Mining demands are estimated increase to around 30Mm^3/a in 2012 based on current expectations.

2.5.5 Rural

Rural water usage has several components. Domestic usage is expected to increase from the 1996 level of 13Mm^3/a to 21Mm^3/a in 2012, at a rate of 3% per annum. These estimates are based on an assumed consumption of 30 litres per day and estimated population growth of 3% per annum. Other rural uses include livestock and irrigation uses. These are included in the livestock and irrigation prediction. However, it is worth noting the livestock use for the communal areas is estimated as being 21Mm^3/a in 1996 and subject to 1% growth, constrained by carrying capacity. This includes cattle, sheep, goats, pigs and poultry.

2.5.6 Tourism

Although minor at present tourism demands are expected to increase in the future at a rate of 5%. Tourism is one of the fastest growing economic sectors in Namibia. This will have knock on effects on the rest of the economy. In the short to medium term, tourism is expected to grow at about 10% a year. Tourism demand is expected to increase from 0.74Mm^3/a in 1996, to 1.6Mm^3/a in 2012. Demand for water in the tourist sector will be limited in some areas by tourist carrying capacity. However, in some

areas, for example along the Okavango River, water demands may rise as the demand for, or number of, tourist lodges grows.

2.5.7 Total

In total the Namibian water demands are expected to increase from the current level of 302Mm^3/a to approximately 450Mm^3/a in 2012. This represents an average growth rate of 2.2%[26]. The predictions are heavily dependent on the assumptions made about future irrigation potential, this being one of the major components of total water use.

Nevertheless the total domestic assured yield in Namibia has been quoted as being 500 Mm^3/a (Day 1998). At this rate of growth the domestic water resources will be fully used by 2017.

2.6 Demand Prediction for the Central Areas of Namibia

The Central Areas of Namibia contains the majority of the service, industry and manufacturing in Namibia. It also contains the capital Windhoek, which due to its geographical position requires water from a variety of different sources. Currently existing developed sources are almost fully utilised and emergency measures have been investigated focussing largely on the transfer of water from the Okavango River. For this reason this area has been the focus of the Central Areas Water Master Plan (CAWMP) of 1993 and 1995 and the Okavango Pipeline Feasibility study of 1997. In each study sectoral demand projections were made in order to estimate the time at which consumption of water would use all of the currently developed sources, and this information was made to determine when new developments must take place. The demand projections were extrapolated into the future using assumptions about the main drivers of demand, population growth, economic growth etc. The implied growth rates have been used to extrapolate the demand projections further into the future. The comparison of the three projections can be seen in **Figure 2.1**.

CAWMP 1993 represents phase 1, CAWMP 1995 represents the interim phase. The projections shown here represent the middle/medium projections contained in each[27]. STUDY refers to the Okavango Pipeline Feasibility study projections. WDM represents a hypothetical Water Demand Management effect. The assumed affect is one of a growth rate reduced by 25% compared to that implied in the STUDY scenario. This is a plausible effect of Water Demand Management.

In referring to the demand growth in each sector reference is made to the Okavango Pipeline Feasibility Study of 1997, This is the latest projection, starting in 1995/6.

2.6.3 Urban

The urban water demand growth rate was based on expected population growth in urban centres which was based on the population estimates of the local authorities or the 1991 census. The towns included in the Okavango Feasibility Study were Windhoek, Okahandja, Karibib, Otjiwarongo, Otavi, Tsumeb, Grootfontein, and a number of minor urban centres. The population growth in these urban centres has been at a rate of approximately 5% per annum, ranging from about 2.65% in Tsumeb to 7% in Otjiwarongo. Windhoek has been assumed to grow at a rate of 4.35%. This projection contains a WDM effect based on assumed gains that could be made in Windhoek, Okahandja, Otjiwarongo, Grootfontein and Tsumeb. The commercial, industrial and residential water demands are all considered urban. An initial demand of 27 Mm^3/a is assumed to grow at a rate reflecting the assumptions for each urban centre.

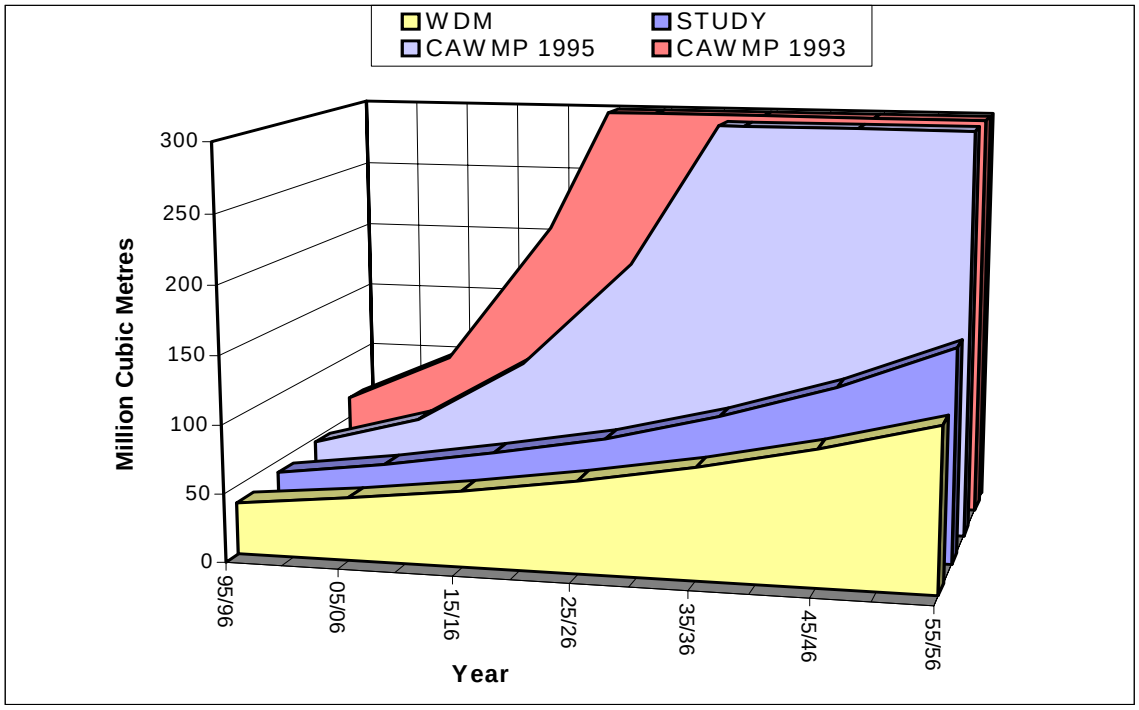
Also included in the STUDY demand projection are government centres; Omatjenne experimental farm, Osona Military Base and Windhoek International Airport. Small rural villages and small consumers were also included. Their combined initial water demand amounts to 0.9 Mm^3/a, and is assumed to grow at a rate of 4% pa.

[26] Assuming exponential growth.
[27] Each study had a low, medium and high prediction.

2.6.4 Agriculture

The agricultural sector included in the projection includes irrigation and stock watering. Irrigation is limited to Kombat mine, water abstraction permit holders in the central areas, other commercial farming and Oshikoto and Guinas lakes. An initial demand of 2,25Mm^3/a is assumed to grow at a rate of 4% per annum. Stock watering is constrained in the long-run by the carrying capacity of the land. There has been little growth in this sector. As such an initial demand of 2 Mm^3/a is assumed to grow at 0.5%.

Figure 2.1. Comparison of Water Demand Projections.



2.6.5 Mining

The mines included in this aspect of the water demand projection are Tsumeb, Kombat, Okaruso, Navachab and Otjihase. An initial demand of 3.5 Mm^3/a is assumed to grow at a rate of 1% per annum[28].

2.6.6 Tourism

The water consumption of the resorts in the central areas has remained largely constant over time. However a growth rate of 2% pa is assumed reflecting the general growth in the tourist industry in Namibia. An initial demand of 0.153 Mm^3/a is used.

2.6.7 Summary

The WDM projection takes into account the reduced consumption that has occurred in Windhoek. Consumption was reduced by approximately 3.5 Mm^3, from nearly 18 Mm^3 in 1996 to approximately 14 Mm^3 in 1997/8. The WDM projection also reduces the rate at which demand grows by 15% from 2.3% pa to 1.9% pa. This reflects the potential for water demand management to change the pattern of demand through economic, technical, legislative and public awareness techniques in all sectors. As such the effect on growth is a speculative projection. For the WDM scenario an initial total demand of

[28] It should be noted that many of these mines are now closed, either permanently or temporarily. Mining water demand growth may indeed be less than this prediction suggests.

38 Mm^3 and a growth rate of 1.92% pa is assumed. This compares with the STUDY scenario which assumes an initial demand of approximately 41 Mm^3 and an average growth rate of 2.3%[29].

2.6.6 Discussions of Demand Predictions

Figure 2.1 is a useful explanatory tool for the understanding of the shortcomings of demand projections such as those for Namibia in Section 2.2.4. It can be seen from Figure 2.1 that there has been a wide disparity between the water demand projections made in different reports for the central areas of Namibia. Each report tells us something different about the time at which new water infrastructure may become necessary. For example, given that currently available water resources in the central areas are said to be 52Mm^3/a, the CAWMP 1993 predicted full utilization of these resources by 1990/1, the CAWMP 1995 by 1997/8, and the STUDY by 2006/7. It is obvious that certain factors have been overlooked in the projection methodology since even in 1999, water supply is maintained to an increased population in the central areas from the same level of water resource development. The predictions of the two CAWMP reports have already been proven wrong.

The omissions of the CAMWP reports included:

- The effects of Water Demand Management in Windhoek.
- The general effects of increasing prices as a result of cost recovery policies. (e.g. the use of more efficient technologies, recycling, and consumer demand response)
- The effects of unpredictable droughts.
- Other economic factors: the price of produce, export market potential etc.

The Okavango Feasibility Study included the estimated effects of the implementation of WDM techniques such as block tariff structures, water efficient technologies and general awareness campaigns. However, the effects of price increases on demand resulting from cost recovery were not included in the STUDY projection. Furthermore the effects of the increased cost of developing water resources, such as the Okavango pipeline or groundwater, which would ultimately be reflected in the price to consumers, were not included. The absence of price responses makes the STUDY demand projection "price constrained". The WDM projection is also price constrained in this sense, although it attempts to account for the dynamic effect of other WDM techniques. Including estimations of the Price Elasticity of Demand in future projections will increase their accuracy and provide information about the economic benefits of water supply, thus providing greater insights into the timing and scale of investments required.

Other economic factors should be considered. For example, in response to price increases/cost recovery, industries and residential consumers may be encouraged to invest further in water saving devices and hence a greater efficiency in water usage will result. The use of recycling will also allow some consumers to use more water than they consume from primary water resources.

Furthermore, demands for water vary with income. As such if a country or a region has significantly increasing income levels, these should be incorporated in the demand projection. This has not been the case in Namibia of late, however dynamic effects such as this are often ignored. There are constraints to water demand growth in particular sectors. For example, in the agricultural sector there are constraints to the extent of irrigable land and the carrying capacity of the land for cattle. It is not inconceivable that similar constraints exist in other sectors of the economy. These constraints are not directly included in projections such as those in Figure 2.1 or section 2.2.3.1. Constraints such as these are incompatible with constant growth assumptions.

[29] The growth rates were extrapolated exponentially.

2.7 WATER SUPPLY

On the other side of the water equation is water supply. For Namibia's water resources to be used in the most efficient and sustainable manner requires efficiency and sustainability in supply and sensible management policies. The generally high cost of water in Namibia means that those institutions responsible for water supply need to be run in the most efficient manner in order for the extent to which water is a constraint to be minimised. Furthermore, consumers of water need to be presented with proper economic signals in order to make rational and socially beneficial decisions with respect to water consumption.

The water sources and the manner in which they are supplied is presented here.

2.7.1 Water Sources

Water supply by source is discussed briefly in the strategic water resources theme paper and as such will only be touched upon for illustrative purposes in the socio-economic and financial report.

There are three main primary sources from which Namibia obtains it water. The proportions in which these sources supply water to consumers in Namibia are shown in **Figure 2.2**. In the year in which the figure was compiled it can be seen that the majority of water, 51% derived from groundwater, whilst the remainder came from the internal ephemeral rivers, 23% and the border perennial rivers, 26%. It is clear however that these proportions will vary from one year to the next dependent upon the quantity of rain in a given year and the consequent flows of the ephemeral rivers. On average approximately 60% of Namibia's water derives from groundwater, the ephemeral and perennial rivers make up the remainder.

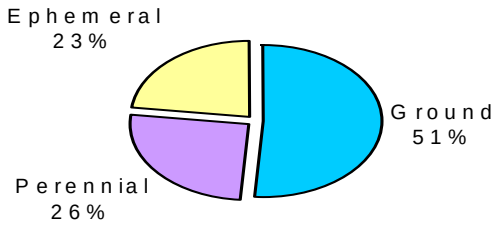


Figure 2.2. The Water Sources of Namibia

2.7.1.1 Groundwater

The main groundwater aquifers and their estimated stored reserve and abstraction rates are shown in **Table 2.7**. In addition to the aquifers that supply to the mainly urban and commercial farming areas, the communal areas of Namibia are largely dependent (57%, Lange 1997) upon groundwater contained in a variety of other aquifers.

Groundwater has both renewable and non-renewable qualities. Most groundwater in Namibia is subject to recharge, making it a renewable resource. 'Fossil' water, such as the Koichab pan near Luderitz, is not subject to significant recharge and as such the use of this water can be considered as mining. The implications for sustainable economic development are slightly different for each type of groundwater. This issue is discussed in detail in Section 2.5.

Table 2.7: Stored Reserves and Abstraction from Major Aquifers

AQUIFER	STORED RESERVE Mm^3	ABSTRACTION Mm^3/a	CONSUMER
Grootfontein (karst)	1 162	1-6 (Kombat-3) (Berg Aukas-3)	Grootfontein, ENWC
Otjiwarongo (marble)	55.0	1.7	Otjiwarongo
Omaruru delta (alluvial)	55.77	7.4	Central west coast
Kuiseb (alluvial)	39.34 (649)	5.0	Central west coast
Windhoek wellfield	n/a	0.5 – 5.0[1]	Windhoek
Koichab pan (alluvial)	150	0.08	Luderitz
Tsumeb aquifer (Karst)	1 400	2.0	Tsumeb
Platveld	99.0	0	To be investigated
Stampriet artesian basin (sandstone)	n/a	9.44	Irrigation

Windhoek Wellfield: Depending upon status of dams supplying Windhoek
Kuiseb (Alluvial) Combined abstraction from Omaruru and Kuiseb delta aquifers
Source: NamWater

Groundwater abstraction is largely controlled by the DWA through the monitoring of specified groundwater control zones. Permits for groundwater abstraction are issued by the Directorate of Resource management and the conditions of the permit require monthly readings of abstraction to be sent to the DWA to monitor compliance with the abstraction stipulated therein. Permits are issued to all groundwater users including NamWater, Municipalities and private farmers. In general there is no metering of private boreholes and as such there is little knowledge of the sustainability of abstraction. There is accumulating evidence that many of Namibia's aquifers are being depleted with water levels falling over time (DWA).

2.7.1.2 Ephemeral Rivers

The rivers that have their source in the interior of Namibia are ephemeral and only flow for short lengths of time after good rains. Run-off from rainfall is also affected by many factors and good rains do not always produce good run-off. Run-off depends on the characteristics of the rain (e.g. intense storm or soft drizzle), the condition of the catchment (sandy or rocky for example), and the density of the vegetation.

Due to the erratic rainfall conditions, the flow in the ephemeral rivers is irregular and unreliable. The potential of the surface water sources is therefore very limited and the water can only be used when harnessed in storage impoundments. It is estimated that the sustainable safe yield from the surface water reservoirs which could be developed on the ephemeral rivers is at least 200 Mm^3/a and twelve major storage dams have been constructed in Namibia to utilize much of this potential. The storage capacity of these impoundments is about 600 Mm^3, but the 95% assured yield is only 80 Mm^3/a. This is an indication of the low efficiency of surface water storage in the arid environment of Namibia (SOER Water). The major dams on the ephemeral rivers are shown in **Table 2.8**.

In sum, the ephemeral rivers supply on average 25% of Namibia's water through the large dams mentioned above and the many smaller farm dams. However the ephemeral rivers also provide essential natural resources for the livelihoods of communities and the abundant and diverse wildlife that exist within their catchments[30].

[30] See "Namibia's Ephemeral Rivers" a DRFN publication.

Table 2.8: Dams constructed on Ephemeral Rivers

DAM	CAPACITY Mm^3	3 MEAN ANNUAL RUN-OFF Mm^3/a	95% ASSURED[1] YIELD Mm^3/a
Von Bach	48.56	19.0	6.5
Swakoppoort	63.49	19.7[2]	4.5
Omatako	43.50	33.40	2.0
Hardap	294.59	188.8	50.0
Oanob	34.51	14.2	4.2
Naute	83.58	46.2	12.0
Otjivero	17.60	7.4	0.7
Omdel	41.29	14.0	0.5
Friedenau	6.72	1.55	0.5
Dreihuk	15.49	4.76	0
Goreangab	3.62		1.05
Viljoen Dams (Gobabis)	1.65	1.43	0.25

Source: NamiWater-19999

[1] Single reservoir analysis
ownstream of von Bach

2.7.1.3 Perennial Rivers

The border perennial rivers of Namibia are the Orange to the south, the Kunene in the north east, the Okavango, the Kwando-Linyanti-Chobe and the Zambezi Rivers in the North East. Riparian communities obtain their water from these rivers, as do urban centres such as Katima Mulilo on the Zambezi and Rundu on the Okavango.

These border rivers are shared water resources and as such significant abstraction from these rivers requires the consent of the relevant basin states. Such agreements only exist on the Kunene River, where the treaty with the King of Portugal of 1929 today allows Namibia to abstract $6m^3/s$, and more recently the Orange River where an agreement soon to be signed with the Republic of South Africa will allow Namibia to abstract up to $110Mm^3/a$.

Perennial rivers supplied 26% of Namibia's water in 1998. The Mean Annual Runoff (MAR) of the Perennial rivers is shown in **Table 2.9**. It is this yield that must be shared between the basin states and the associated environmental needs.

Table 2.9. The Mean Annual Runoff of Namibia's Perennial Border Rivers

Perennial rivers:	MEAN ANNUAL RUNOFF Mm^3/a
Kunene	5 053
Okavango – at Rundu	5 000
Okavango – at Mukwe	9 500
Kwando	1 000
Zambezi – at Katima Mulilo	40 000
Orange – at Noordoewer	11 000

(DWA Information)

3.1.1.4 Potential Water Sources

Apart from the Kunene and the Orange Rivers the potential of the perennial rivers to supply water to Namibia in the future is unknown in the absence of basin state agreements. Due to the absence of precise data, the sustainable yield of groundwater in Namibia is also uncertain. The potential of the ephemeral rivers is determined largely by the potential for further dam sites. Despite these uncertainties

estimates have been made of the assured (sustainable) yield of Namibia's domestic water resources. In addition to these estimates the secured supply from the border rivers is shown in **Table 2.10**.

Table 2.10. Potential Water Supply

SOURCE/RESOURCE		POTENTIAL YIELD – Mm^3/a
Ground water		300
Dams on ephemeral rivers		200
Perennial Rivers (secured)	Orange River	110
	Kunene	190
Unconventional sources		7
	TOTAL	**807**

SOURCE: Heyns et al 1998.

Namibia currently consumes approximately $290Mm^3/a$. Table 2.10 says nothing however, about the expense involved in bringing the potential supply from each source into fruition at the places where it is demanded and should not be interpreted as a sign of abundance of water in Namibia. For example, water from the Orange River is to be charged to the Namibia by the Republic of South Africa at a rate of $0.56cents/m^3$. It is unknown whether demand is strong enough at this price for the total quantity available to be economically used whilst the possibility of transferring water from the Orange River to other Urban settlements in Namibia has been all but ruled out as restrictively expensive. Similarly the feasibility study into the Brukkaros Dam revealed that the project was un-viable as a source for irrigation, and its distance from significant demand centres makes it unlikely to be a viable supply augmentation source.

2.8 Institutional Arrangements for Water Supply

There are several institutions that are involved in the supply of water. This section outlines the role of these institutions, the current institutional arrangement within the different arenas of the water sector and analyses the implication of these arrangements for the management of water resources.

2.8.1 Local Authorities, The Ministry of Regional and Local Government and Urban Water Supply

The institutions dealing with water supply to urban areas are as follows:

- Local Authorities
- Ministry of Regional and Local Government and Housing
- NamWater
- Ministry of Agriculture Water and Rural Development.

There is no one specific arrangement that characterises all urban water supply scenarios in Namibia. The IUCN Water Demand Management Namibia Country Study described four separate arrangements, which differ in the interaction of the Local Authorities with the other institutions that are involved in urban water supply. These so-called 'Cases' are described in turn. Cases 1-4 are shown diagrammatically in **Box 2.3**.

Case 1*: Non-Independent Local Authorities*
In Case 1, the Local Authority (LA) is responsible for the reticulation of water to its consumers, broadly classified as Residents, Government Offices and Private Businesses. The LA is also responsible for billing and the collection of revenues arising from water consumption. These responsibilities derive from the Local Authorities Act of 1992. Revenues collected currently go to the state fund from where the Ministry of Regional and Local Government and Housing (MRLGH) receives its budget and centrally pays NamWater for the bulk water.

In this case the LA's have soft budget constraints since the payment of water is divorced from revenue collection. Incentives to manage water through the issuing of appropriate tariffs and diligent billing and collection are minimal as a result. Revenues collected do not benefit the LA, balancing the water budget is not a priority, whilst the cost of unaccounted for water is not felt by the custodians of the water reticulation. In terms of **Box 2.3** it is likely that **A** will not equal **B**. This has obvious financial

implications for cost recovery, and economic implications for productive and allocative efficiency of water use and supply.

***Case 2**: Local Authorities with Own Budget*
The general situation is now reflected by Case 2. There has been a move towards decentralization with many of the Local Governments becoming responsible for their own budgets, including water revenues and expenditures. Water bills are sent directly from Namwater to the LA in question, from where the money is transferred from the account associated with the LA back to Namwater[31]. The LA should feel the pinch of water costs.

The trend towards decentralization is a move in the right direction for the management of the water supplies. It makes the local authority in question more accountable for the water expenditures and receipts, and hence more likely to take an interest in balancing the budget by collecting revenues, monitoring leakages, and dealing with non-payers.

However, Case 2 LA's are still dependent upon the MRLGH for transfers, as shown in Box 2.3, in order to balance their accounts. At present transfers are often specifically to pay off growing water debts to NamWater. In the long run this does not encourage LA's to balance their water accounts and similarly poor incentives arise as in Case 1.

[31] MRLGH indicate that it is they that transfer the money to Namwater but from the account associated with the LG in question, indicating a centralized componant to this process. Namwater has informed me that certain LG have not paid their bills which seems to suggest the arrangement described in the text.

BOX 2.3 . Institutional Arrangements for Local Authorities and MRLGH in Urban Water Supply.

Key:

Water Supplied: ——→

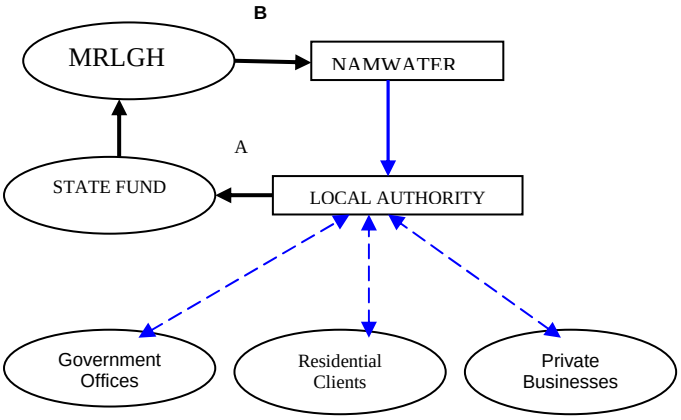
Payment: ——→

Partial Cost Consideration: - - - →

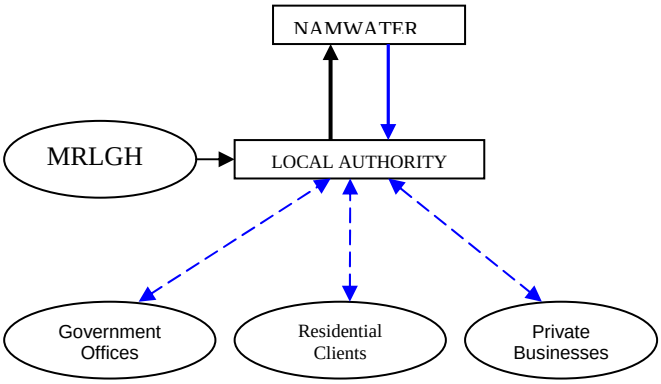
Partial payment /Water Supply: ←- - -→

Monitoring: ●- - - -●

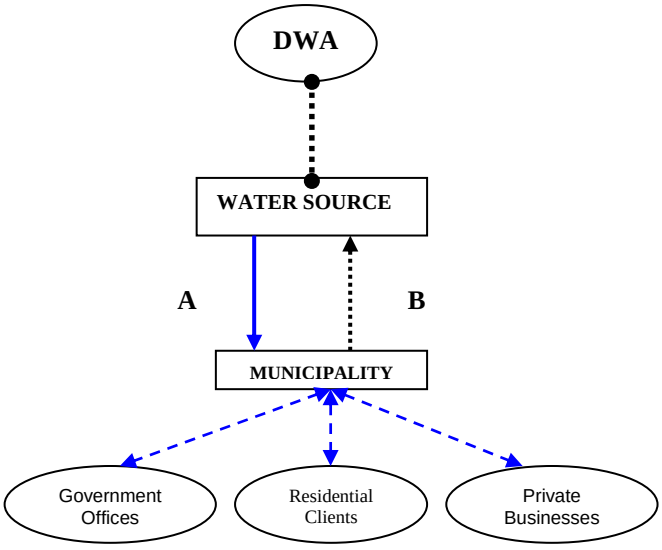
Case 1. Non-Independent Local Authorities



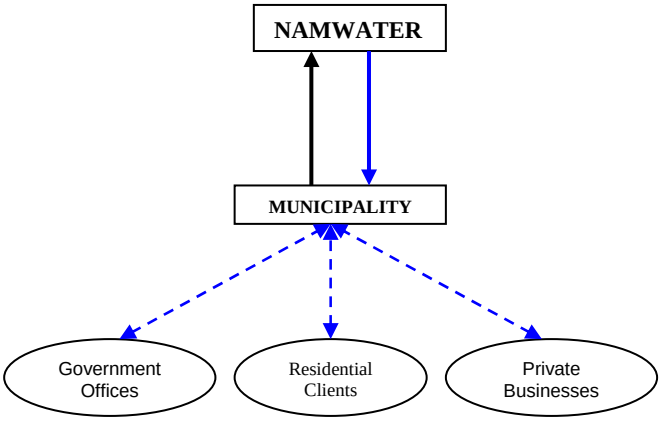
Case 2. Independent Loal Authorities



Case 3. Municipality with Own Water Source



Case 4 NamWater Supplies Municipality



***Case 3**: Municipalities with Own Water Source*
Municipalities have distinctly separate budgets and must raise their own revenue in order to sustain the services for which they are responsible. There are several examples of Municipalities that control their own water source, i.e. groundwater. Responsibility for tariff setting, billing, collection of revenues and control of the water resource is with the municipality. The water supply and payment occurs as shown in Box 2.3. Case 3 municipalities have some of the lowest volumetric tariffs in Namibia.

Since the municipality has the responsibility for the groundwater resource, and is independent from the government financial backing, there is every incentive for cost recovery to occur and action to be taken against those who do not pay. Evidence from the municipality of Outjo suggests that tariffs are based on the operations and maintenance costs only, which, although implying that the tariffs relate to the costs of water supply, do not account for capital costs and take no account of the costs of future capital, the "user cost" of groundwater. The financial implications of this system may not be severe since budgets are often balanced by revenue from other sources, such as electricity. However, not charging the full cost of water supply can have adverse economic effects, including inefficient consumption and inefficient timing of future water investments.

The water level in the boreholes at Outjo has been consistently falling suggesting that further investment will be required in the future, i.e. more boreholes will have to be drilled. The abstraction of groundwater is monitored by the Department of Water Affairs (DWA) and regulated by quotas in the form of permits that limit abstraction. This is the only manner in which the possible external effects; e.g. environmental linkages, draw down of private borehole etc, are controlled. In fact these factors are little understood and the level of recharge in many aquifers, and hence the implications for the sustainability of current groundwater use, is unknown.

***Case 4**: NamWater Supplies Municipality.*
Case 4 is essentially the same scenario that the LA's would hope to achieve in their fully decentralized state. The municipality pays Namwater from its own budget. The budget is independent from government funds and made up from fees charged for water, electricity and other municipal services. Again the responsibility for tariff setting and collection remains with the municipality, and the need for payment of water bills is a high priority due to the potential for the water supply to be cut off by Namwater and the opportunity costs of lost revenue. There are strong incentives to set tariffs in accordance with the costs of reticulation in order fully account for the water consumption. These municipalities theoretically have a "hard" budget constraint.

In reality the difference between Case 2 and Case 4 is marginal and there have been incidents of indebted municipalities receiving funds from MRLGH in order to cover their costs. Currently Rehoboth serves as an example of an indebted municipality, owing N$5.4million to NamWater. As of yet the MRLGH has not stepped in. However, good examples of the managerial perspective that arises from this institutional arrangement are Windhoek, Swakopmund and Walvis Bay.

2.8.2 Overview of Local Authority Institutional Arrangements

The problems associated with Cases 1-4 are clear. The financing of water supply and the interaction between the different water supply institutions in Case 1 and 2, are not conducive to providing good incentives for efficiency in water supply. The failure of economic incentives for the local authority and consumers in Case 1 and 2 is clear and illustrated by the fact that:

- unaccounted for water remains high
- tariffs are not set to cover full cost of reticulation
- payment is not enforced

These three aspects arise partly because the LA either does not benefit from addressing these points or does not directly lose from not undertaking them as a direct result of "soft" budget constraints. As a result of these factors productive and dynamic efficiency in service provision is lessened whilst allocative efficiency in consumption is not likely to be achieved. Rehoboth is currently indebted to the tune of N$5.4million as a result of a combination of these factors. Furthermore the bulk water supplier supplies economically inefficient quantities of water under these circumstances.

Whilst similar problems arise in Case 3 and 4, the incentives to cost recover are greater due to fiscal autonomy, and consumption of water is therefore likely to be more efficient. In all Cases the question arises of the overall incentives for efficient provision of water services and the ability of the local authorities to cost recover on inefficient systems.

Unaccounted for Water

Unaccounted for water in Case 2 towns is shown in **Table 2.11**. These figures should be viewed in light of a figure of 10% for Windhoek. In general the accounting and metering procedure in Case 1 towns and villages did not allow an estimation of unaccounted for water.

Table 2.11. Unaccounted for Water in a Selection of Case 2 Towns (1998).

Towns	Unaccounted for water %
Luderitz	**22.0**
Ondangwa	**35.0+**
Ongwediva	**35.0+**
Khorixas	**58**
Opuwo	**41**
Oshakati	**35.0+**
Rehoboth	**35.0+**

SOURCE: IUCN Water Demand Management Namibia Country Study (1999)

As an illustration of the comparative effectiveness of the more decentralised Case 4 arrangement **Table 2.12** shows that the level of unaccounted for water associated with this arrangement is in general much lower than in Case 2 towns. The IUCN WDM study found that the level of appropriate expertise in the more centralised institutional arrangement of Case 1 and 2 was often much lower. This will clearly impact on the effective monitoring and maintenance of the reticulation system.

Table 2.12. Unaccounted for Water in a Selection of Case 4 Municipalities (1998).

Municipalities	Unaccounted for water %
Gobabis	**7.7**
Grootfontein	**20.9**
Henties Bay	**9.0**
Karasburg	**18.0**
Keetmanshoop	**17.0**
Mariental	**9.4**
Otjiwarongo	**7.5**
Swakopmund	**12.0**
Tsumeb	**15.0**
Walvis Bay	**14.5**
Windhoek	**10.0**

SOURCE: IUCN Water Demand Management Namibia Country Study (1998)

Tariff Setting

It is shown in **Annex C** that the manner in which tariffs are set differs between the Cases outlined above. A uniform 10% increase is used in Case 1 whilst some level of autonomy is achieved in Case 4. It is also clear that the Case 3 municipalities have the lowest tariffs of all, illustrating the concerns raised above about the absence of capital, user and external cost in the price in these areas. This could lead to excessive and potentially unsustainable use of groundwater[32].

[32] The low tariffs in Case 3 indicates that these LA's are not abusing monopoly power through price discrimination.

In general it seems clear that a more conducive set of institutional arrangements is found in Case 3 and 4 municipalities. These municipalities do have an incentive to cost recover since they are financially independent. This in turn leads to an incentive to maintain the reticulation system, whilst paying attention to tariff setting. Tariffs are discussed further below in Section 2.3.4.2.

Incentives for Efficiency

The reticulation of water to urban consumers is subject to considerable economies of scale, has sunk costs, and requires a high degree of co-ordination. Water has also been seen historically as a "public good" which serves wider public goals. For these reasons, governmental provision of these services has been seen as the most appropriate means of service provision. Local Authorities essentially hold a "natural monopoly" position over the provision of urban water supply[33].

Local authorities are guided by the Water and Sanitation Policy and the Local Authorities Act in providing water services. As such, where a private monopoly water supplier may exploit its monopoly position through price discrimination and profit making, the local authority must charge tariffs which reflect only the costs of supply whilst simultaneously addressing social needs. However, even with the WASP as a guideline, local authorities have few incentives for improving efficiency in the absence of external pressures to improve performance, such as competition[34]. Some local authorities make a considerable profit on water sales. The incentives to reduce costs are still unclear however.

The councilors of local authorities are chosen in local elections, which occur on average every 5 years. The workers of the LA i.e. those responsible for the water reticulation, accounting and maintenance etc, normally remain in place in the event of a change of councilors. As such the incentives for dynamic productive efficiency are reduced due to the lack of competition a) for the jobs of local authority technocrats and b) the right to supply water. Inversely, it could also be stated that the lack of profit motive within the LA's is also a constraint to the dynamic productive efficiency of these water supply institutions. There are no direct rewards to the local authorities from cost reduction and efficiency improvements other than the existence of "reserve funds". Revenues collected in excess of costs are placed in a reserve fund, which is used for future projects[35].

Where there are high sunk costs of infrastructure, government involvement is often seen as necessary. However, public and private sector involvement in water reticulation is common where competition in the private sector may be introduced through tendering for the right to operate. In the case of "natural monopoly", efficiency in water supply has been achieved in many countries through the threat of loss of contract. It is clear that in the water sector some regulation, e.g. regulation of prices or monitoring of service targets, is required in order to ensure the social objectives associated with water provision are achieved. However, this need not preclude the efficiency gains that may be reaped from the involvement of the private sector and competition.

2.8.3 NamWater

The Namibian Water Corporation (NamWater) is responsible for the supply of bulk water to urban centres, certain mining projects and a few rural areas (the pipeline in the Northern Communal Areas for example)

The corporatisation of bulk water supply has attempted to enforce market-like pressures by cutting off access to subsidies from government, and essentially introducing the threat of bankruptcy. There are several crucial factors to consider when considering the incentives for the efficient production of water by NamWater:

[33] A natural monopoly exists when the benefits of service provision are optimally provided by a single, profit maximising, supplier, rather than multiple suppliers. This occurs mainly where there are significant economies of scale.

[34] It is also worth noting that not all Local Authorities have proclaimed the Model Water regulations contained in the Local Authorities Act, and derived from the WASP.

[35] Depending upon what the reserve funds are used for they may create incentives for efficiency in the LA's. If they are used to increase the wages of the managers, town clerks etc then incentives may be high. However, this would reinforce the case for regulation of prices.

- NamWater has issued shares to the Government valued equal to the audited value of existing capital, N$903 million (1997 prices)

- NamWater is a non-profit organisation

- NamWater is run on a commercial basis aims to recover all costs associated with bulk water supply (capital, operation and maintenance, overheads etc)

Ownership of the assets is divorced from management; the Government maintains ownership as a shareholder whilst NamWater manages these assets on the Government's behalf. A board of directors made up of government officials and members of the private sector acts as overseers to corporate policies and decisions. This new arrangement, which started formally in 1998, intends to improve the efficiency of bulk water supply and the quality of service.

Theoretically, the divorce of ownership from management could lead to a principle/agent problem, (the objectives of the managers are not the same as the objectives of the owners, a situation hampered by asymmetric information i.e. the managers know more than the owners) which in turn could lead to inefficient outcomes. The principle/agent problem usually refers to a situation where the owner's desire for profit maximisation is not fulfilled due to the differing objectives of the management. In the case of NamWater this situation is potentially reversed. NamWater is a non-profit organisation, based on the NamWater Act, therefore the government is not concerned with profit maximising and receives no dividends on its shares. The incentives for efficiency improvements are not necessarily enhanced by the government's role. One example of this might be the political influencing of tariff setting discussed in section 2.3.4.

NamWater is responsible for maintaining the value of the shares issued to the government, and this acts as the main rationale for charging depreciation costs on existing capital, despite these being essentially 'sunk' costs in economic terms. This issue is discussed further in section 2.3.4.

The absence of a profit motive theoretically reduces the incentives for dynamic productive efficiency in NamWater. The gains from improved efficiency would not necessarily accrue to the company in the absence of the ability to make a profit. Similarly, the absence of distinct regulation means that there is no external monitoring of the quality of service provision. This is not to say that internal incentives for efficiency improvements and monitoring of quality of service do not exist. There are a number of examples of these internal measures:

- Costs of investments are gauged against international norms
- Annual salary bonuses are based on efficiency improvements within different departments
- Salaries have been reviewed 3 times since 1997 and compared with equivalent private sector posts

Service standards are monitored by:

- Customer complaint/satisfaction monitoring
- Standards for unaccounted for water etc

These are potentially good efficiency incentives and service provision monitoring techniques. Currently the NamWater Act stipulates that NamWater has a responsibility to provide water at affordable prices in a sustainable manner. The current non-profit status acts as a form of regulation, removing to a great extent NamWater's ability to exploit its natural monopoly position. However, this status could be stifling the incentives for dynamic productive efficiency.

2.8.4 The Department of Water Affairs.

The Directorate of Resource Management

The directorate of Resource Management contains 5 divisions: Law Administration, Planning, Water Environment, Hydrology and Geo-Hydrology. Their roles have been discussed in the institutional theme report. Briefly Hydrology Division deals with surface water, Geo-hydrology deals with groundwater, Planning deals with countrywide planning and international waters, Water Environment

deals with environmental protection and pollution control while Law Administration deals with permits for water use and advises on legal matters with respect to water use.

In sum the Directorate of Resource Management's functions are:

- To advise the Minister on technical matters to give effect to the provisions of the Water Act.
- Render the service of a national water data centre for Namibia by collecting, publishing and supplying water related data and information.
- Investigate and assess the water resource potential of the country on a national and regional scale.
- Negotiate with neighbouring states to obtain access to shared water resources.
- Initiate the proclamation of water control areas.
- Licence the utilisation of particular water resources.
- Licence wastewater disposal.
- Monitor compliance with licence conditions.
- Monitor the quality of water that is supplied to consumers.
- Monitor and investigate pollution of water resources.
- Provide a small multi-disciplinary secretariat for the Water Supply and Sanitation Coordinating Committee as per the WASP report and the proposed Water Resources Board to be established by the new water legislation.

There are informational and administrative constraints that currently preclude the management of water resources by the Directorate of Resource Management in a manner that would coincide with an economically rigorous approach. The charging for water on a per hectare basis and the lack of knowledge about recharge of aquifers and the like, exemplify this. This dearth of data and monitoring power is discussed more thoroughly in the Strategic Water Resources theme paper.

The Directorate of Rural Water Supply (DRWS)
The DRWS is responsible for the supply of water to the communal areas of Namibia. The current move towards Community Based Management of communal water points through the creation of Water Point Committees is a new initiative which aims to shift the responsibility of maintaining water supply from the Government to the communities themselves.

This change in management approach is participatory and capacity building in nature. The DRWS is training community members in the necessary skills to enable maintenance of the water points within the community whilst the communities are monitored and assisted by regional extension officers.

The change in the institutional arrangements could be described as changing the prevailing property rights regime from an open access scenario, in which water users were free to use water points at any time for no charge, to a common property resource. The internalising of the O&M costs of a water point may evoke the more efficient use of water resources, hence improving the sustainability of the water source. Furthermore, once capital investments are under the control of the community, it is possible that more efficient, demand driven and appropriate.

The Community Based Management Strategy was officially launched in August 1997. The implementation plan was as follows:

Phase 1: Capacity building phase	one year	intensive capacity building at RWS and for communities
Phase 2: O & M phase	five years	intend to hand over O & M responsibilities
Phase 3: Cost recovery/final ownership	four years	

Although the project has now been in operation for over eighteen months, phase 1 objectives have not been reached and it is realised that many of the desired outputs were overly ambitious. In particular it has been delayed by:

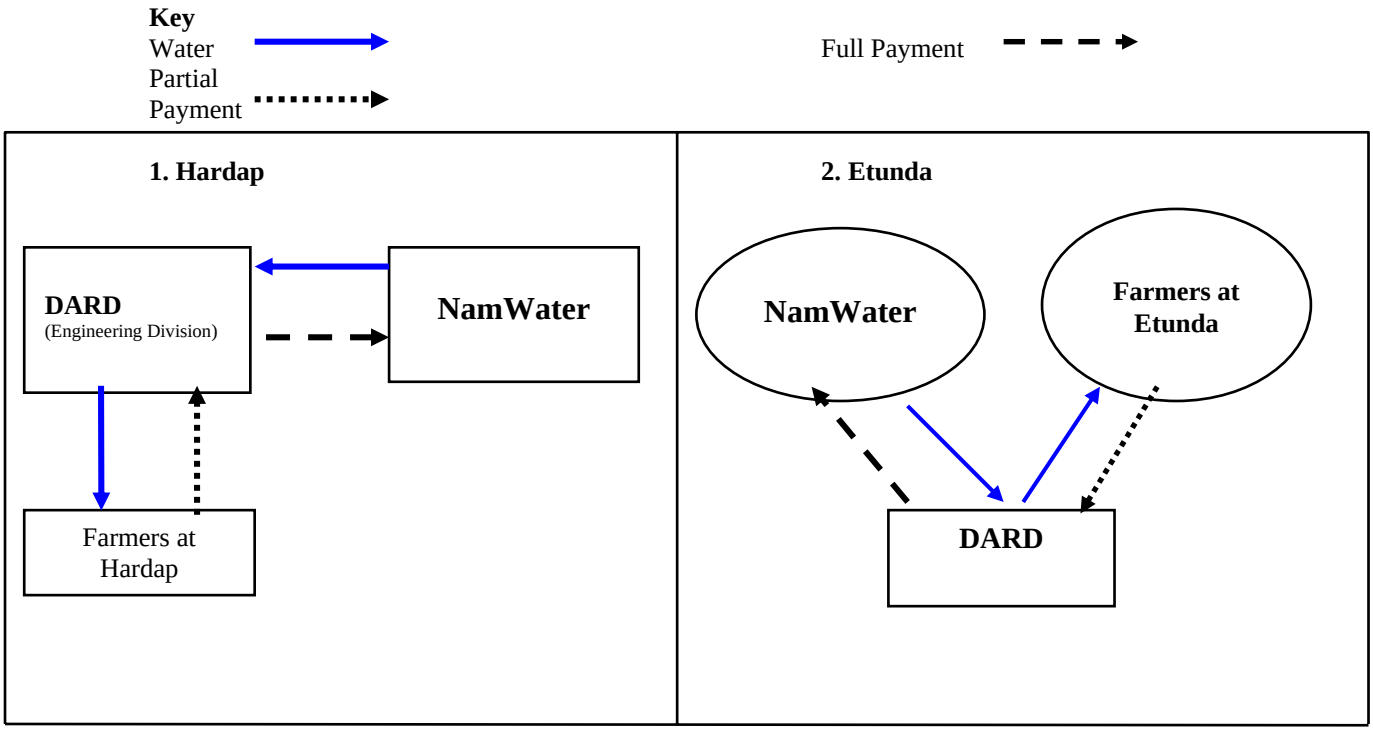
- underestimation of rehabilitation requirements to meet the agreed "handover" terms and the consequent financial implications;

- limitations in capital funding, with available funding being spent on ongoing "extension of service" projects;
- limitations in capacity within RWS to implement the strategy and insufficient redirection of available funds to facilitate it; and
- limited experience of community participatory approaches and a consequent underestimation of the time and resources required for successful handover.

2.8.5 Department of Agriculture and Rural Development

The DARD is responsible for extension of services to various irrigation schemes in Namibia. The modalities of the various irrigation schemes are set out in **Annex D**. Currently the Department of Agriculture and Rural Development (DARD) acts as an intermediary in the supply of water to certain large scale irrigation schemes in Namibia. Examples include the irrigation schemes at Hardap Dam and Etunda. In both cases water is supplied by NamWater to the scheme, however payment for water by the farmers at the scheme is via the DARD, engineering division. This relationship is shown diagrammatically in **Box 2.4**.

Box 2.4. Examples of the Institutional Arrangements for Water Supply in the Irrigation Sector



The involvement of the DARD as an intermediary in the payment for water is purely as a vehicle for implicit subsidies to irrigation however. Subsidising water is reserved in general for social benefits that arise in the consumption of water, such as health benefits, which imply water is a merit good. Such subsidies should always be explicit. Water used in irrigation is clearly not a merit good and as such subsidies cause inefficient use of water in both the short and long term. The involvement of these intermediary institutions in this role is questionable.

It is envisaged that an Irrigation Board will be established in the next few years to oversee all irrigation issues. It must not be omitted that the DARD provides a useful extension service to many farmers, irrigators or otherwise, however this still does not justify the subsidisation of water.

2.9 The Costs of Water Supply

This section will discuss the financial costs of water supply for the different responsible institutions. Where relevant the assets and development budgets of each institution will be addressed.

2.9.1. Overview of Government expenditure in the Water Sector

Government as a Whole

Total expenditure by Government on water related activities is very difficult to ascertain, a review of the government estimates by functional classification indicates that between 1.21% (1999/2000) and 2.08% (1997/8) of total expenditure is spent on water supply and water affairs, however this only includes rural water supply. Water resource management is included in the agricultural affairs classification. If both figures are combined, the resulting expenditure levels are indicated in **Table 2.13** below. This shows the decline in the percentage of government expenditure assigned to rural water supply and water resource management, only 1.39% of GRN expenditure being assigned to these two areas.

Table 2.13. Summary of expenditure by functional/economic classification

Water Supply Affairs and Services	**1996/7**	**1997/8**	**1998/9**	**1999/2000**
	N$ million	N$ million	N$ million	N$ million
Current	45.6	41.9	47.4	54.1
Capital (note a)	39.5	77.9	37.7	39.4
Sub – Total	85.1	119.8	85.1	93.5
Water Resource Management				
Current	14.4	14.6	12.0	12.4
Capital (note a)	2.6	1.2	4.8	1.7
Sub – Total	17.0	15.8	16.8	14.1
TOTAL	102.1	135.6	101.9	107.6
Grand Total- Government				
Current	4,249.3	4,755.5	5,901.4	6,672.7
Capital	720.5	886.8	814.3	969.1
Lending	103.5	111.8	68.4	109.3
Total	5,073.3	5,754.1	6,784.1	7,751.1
RWS as % of Grand Total	1.68%	2.08%	1.25%	1.21%
RWS & WRM as % of Grand Total	2.01%	2.36%	1.50%	1.39%

Note (a) Capital refers to both operational and development capital as shown in the departmental tables

However it is only a partial picture as expenditure on irrigation schemes and administrative support are both excluded as well as support for bulk water supply (prior to NamWater) and MRLGH expenditure. Through both direct support (payment of NamWater bills) and indirect support of La's, the MRLGH is extensively involved in the water sector. As greater independence is given to the individual town and village councils, this central expenditure should decline. Although it is difficult to ascertain the extent of the costs involved as neither MRLGH nor NamWater have maintained easily accessible records by individual La.

Furthermore, government institutions are major consumers of water, water bills for government institutions used to be paid by the Ministry of Works, Transport and Communications (MWTC). From financial year 1998/9, this responsibility was transferred to the line ministries. On the broad assumption that one third of the Governments total utilities bills are for water, it is assumed that in 1999/2000, N$81 million will be spent on Government consumption. As there is a high level of government arrears with both NamWater and La's, any budgeted figure is undoubtedly understated.

Investment Plans
A list of water related projects as set out in the 1999/2000 development budget is included in Annex B. The total value of the new and ongoing projects shown in this list is approximately N$1000 million. However many projects (particularly MRLGH projects) are a combination of service provision and therefore only a small proportion of the expenditure is for water and sewerage services. Investment plans for the Directorate of Rural Water Supply amount to N$261 million.

2.9.2 Rural Water Supply

According to the National Development Plan, RWS is one of the developmental priorities of the GRN where particular emphasis has been placed on increasing the coverage of water supply in the communal areas which occupy 41% of the country and support the majority of the population. At independence 40% of rural people had access to safe water (situated within 2.5 km of a water point), currently 60% have access to safe water and by 2010 according to NDP1 the GRN is aiming to ensure that 80% of the population are thus served. It can be seen from the figures in table three that there has been a decline in development expenditure in actual (and more significantly in real) terms. This corresponds with the decline in overall spending on water supply and water affairs as a percentage of total expenditure (shown in **Table 2.14**)

Table 2.14. Breakdown of expenditure for the period 19967/8 to 1999/2000.

Ministry	Dept	Expenditure type	1997/8 Actual	1998/9	1999/2000
MAWRD	RWS				
		Personnel	20.529	22.840	26.004
		Goods & Service [(a)]	38.943	24.548	28.090
		Capital Expenditure [(b)]	1.507	2.124	4.339
		Total Operational	60.979	49.512	58.433
		Development	66.374	35.600	35.100
		Grand Total	127.354	85.112	93.533

(a) The reduction between 97/8 and 98/9 is primarily due to the reduction of 11.2 million on transport costs.
(b) Capital expenditure in this category refers to the acquisition of furniture and office equipment and operational plant and equipment.

The financial implications of the implementation of the Community Based Management Strategy were set out in the "Agenda Memorandum for Cabinet". Over the ten year period, it was estimated that annual savings to the GRN would be between N$3.2 and N$19.5 million (based on 1996 prices). This scenario assumed guaranteed budget support by the Dutch Government for the financial year 1997/8 and commitments for further support and that 60% of the existing infrastructure needed upgrading. These savings are unlikely to materialise before significant investment in human resource development and infrastructure upgrading is undertaken. These issues are discussed in greater detail in the human resources and water resource assessment theme reports. **Table 2.13** shows the operational and development expenditure for the DRWS.

Prioritisation of developments is currently done by a regional level Central Water Committee, although according to a study undertaken by Arcadis (Euroconsult) there are numerous complaints from community members about the non transparency of the process.

2.9.3 NamWater

The audited accounts for NamWater's first complete financial year of operation (1 April 1998 - 31 March 1999) have not yet been officially released. Senior management at NamWater have advised the review team that the audited accounts will be presented to the Board by the middle of July and that only after Board approval will the accounts be available for public consumption. The Auditor General's 1997/8 report is also not yet available and therefore the only information available about NamWater's predecessor, the bulk supply division of DWA are the audited accounts for 1996/7. These show operational expenditure of N$8.85 million, income of N$6.05 million and a consequent deficit of N$2.8 million.

In order to achieve full cost recovery NamWater is pursuing a pricing strategy whereby tariffs are increased by an average of 20% per year (variations do occur between schemes). This policy was initiated by NamWater's predecessor. The extent to which NamWater is achieving its target for individual schemes is shown for some locations in Annex C.

Despite having approximately 2000 customers, about 90% of its sales are to 40 -50 main customers. Its main customers include the Directorate of Rural Water Supply (RWS), and MRLGH, plus a number of other line ministries. Government payment procedures often result in long payment delays and/or non payment. Since its conception, NamWater has been the subject of considerable public debate and criticism. In April 1999, it reduced supplies to Rehoboth by 50% as a result of outstanding arrears of N$5.5 million. Some of the non-payment problems experienced by NamWater are evidently related to confusion over payment responsibility. In general there appears to be considerable public confusion as to NamWater's mandate, activities and tariff policies, as with all new organisations, considerable time and effort needs to be spent on public relations, public education and co-operation.

Investment Plans

According to the NamWater Act, extensions of systems can only be undertaken with the full agreement of the customer. According to its five year plan, NamWater's overall development plans total in excess of N$800 million, although only N$29 million have reached the customer agreement stage.

These figures exclude the controversial desalination plant at the coast for which NamWater is currently receiving bids. The full financial impact of these investment plans seems to have only recently been comprehended by the participating councils and their communities. As the scheme is at the negotiation stage, NamWater are unwilling to divulge any information which may be detrimental to the process. The extent of the public participation process undertaken by its predecessor is unclear.

2.9.4 Local Authorities

Local Government in Namibia is in a state of transition as, in accordance with the government's decentralisation policy, many town and village councils are becoming responsible for their own budgets and activities, including water revenues and expenditure. According to MRLGH, for financial year 1999/2000, direct support (either technical assistance or payment of NamWater bills) will only be provided to seven towns and villages (Tses, Berseba, Gibeon, Uis, Otapi, Opuwo and Eenhana). These represent the Case 1 LA's as described above.

As discussed in the human resource theme report, the capacity to undertake these new roles is limited and as discussed below is of particular concern for the effective financial management of water supply and sewerage services (WSSS). Similar shortcomings are evident in more sophisticated municipalities, which according to the Local Authorities Act should be self sustainable, although there are also some specific difficulties. Audited accounts are only available (if available) for the financial year 1996/7 and therefore are of minimal value in assessing the current situation.

It is clear that the general lack of accounting of water reticulation costs, the subsequent discrepencies in the tariff setting described in section 2.3.2.1 (and .2), and the levels unaccounted for water obscure the real costs of water supply in many urban areas. According to the IUCN study and La representatives, non payment of water bills by customers is a serious problem for many La's. in Uis, non payment is believed to be 90%. Due to the inadequacies of many billing records, the extent of the problem is difficult to assess. In Rehoboth, of the N$5.4 million owed in September 1999, the MWTC and the Ministry of Education (MoE) owed the Council approximately N$1.5 million (almost a third of the debt owed by the Council to NamWater). Cashflows are also adversely affected by late billing, for example, in Rehoboth, bills were three months behind.

In Windhoek, the problem of non payment is being partially addressed by the introduction of prepaid meters for both households and communal taps on a pilot area basis. The concept of prepayment also improves the municipalities cashflow position, if proved cost effective, the schemes will be extended to other areas. Rundu and Rehoboth are also intending to implement prepaid meters for communal taps.

2.10 Water Pricing: Tariffs and Fees

In this section the manner in which the costs of water supply are recovered by different institutions is discussed and the shortcomings highlighted.

2.10.1 NamWater

NamWater is obliged to cost recover the full operations maintenance and capital costs of water supply under the NamWater Act of 1997. The way in which tariffs are calculated is shown in **Box 2.5**. At present the tariff calculation is under review at NamWater with discussions are underway to determine the best method of cost recovery. The tariff policy has not yet been approved by the Board of Directors.

According to NamWater's Draft Water Tariff Policy, the underlying principles are intended to:

- be in accordance with the principle of selling water at full cost recovery;
- be based upon an uncomplicated determination of cost; and
- provide for the full cost recovery of:
  - the (capital) development cost of water schemes;
  - the interest (financial cost which is tied up in each scheme) on the development cost; and
  - the operation and maintenance and overhead costs to supply water.

The Policy further states that NamWater has:

- adopted the policy of no-cross-subsidization between regions or water schemes within regions.
- decided to aim for the achievement of full cost recovery in each year;
- undertaken to, within practical limitations, determine/identify the actual costs as accurately as possible.

The elements which make up the costs of existing schemes, planned future upgrades and extensions to existing schemes, as well as new schemes are:

- development cost (capital)
- interest cost (financial)
- operational cost
- maintenance cost
- overhead cost.

The proposed tariff policy thus recovers all these elements, and the tariff will be split into two components; the availability component and the volumetric component. The manner in which these components are calculated is shown in Box 2.5.

Box 2.5. NamWater's Draft Tariff Policy of 1999.

(a) **The Availability Component**: is a fixed monthly amount, determined in N$/month, with the intention to recover the total annual development and interest costs. The following amortization formula is used:

Monthly Availability Charge (MAC)

$$MAC = \frac{C * i(1+i)^n}{(1+i)^n - 1}$$

Where:

C = development cost in N$
i = monthly interest rate
n = redemption period in months

Development cost:

- For existing schemes: is equal to the accepted remaining book value of the scheme as at 01 April 1998.
- For new schemes or upgrades and extensions to existing schemes: is equal to the actual costs for the investigation, planning, design, construction and construction supervision for the scheme (with no adjustment for inflation).

Interest rate: is equal to the prime lending rate of commercial banks in Namibia minus 1%, adjusted according to market fluctuations, irrespective of source of funding.

Redemption period: is equal to 25 years for existing infrastructure. For new infrastructure, this is weighted according to the development cost of the individual infrastructure components making up the scheme.

Weighted Average Lifetime (WAL)

$$WAL = \sum (C_i * L_i) / \sum C_i$$

Where:
i = 1 to n (n = number of components)
C_i = development cost of component i
L_i = life time of component i

(b) **The Volumetric Component**: This is determined in N$/$m^3$, and is intended to cover the total operations, maintenance and overhead costs assigned to the supply point. It is levied on a monthly basis, being the actual cost of the metred volume of water delivered by the supply point.

In general, NamWater classifies O&M costs as follows:

- **Primary Costs(PC):**
  - Salaries
  - Travel & Subsistence
  - Materials & Supplies
- **Secondary Costs (SC):**
  - Internal Charges (I/C) Maintenance
  - I/C (S&T)
  - I/C (IT)
- **Non-Cashflow Items (NCI):**
  - Depreciation
  - Imputed costs

Where:

- I/C = Internal Charges
- S & T = Subsistence & Transport
- IT = Information Technology

Thus Total Costs (TC) = $\sum$(PC + SC + NCI)

If the planned monthly sales volume is Q, then the volumetric charge will be

= TC/Q (N$/$m^3$)

More recently, however NamWater has shown more interest in a pure volumetric tariff for water. Capital costs will be treated in the manner shown in Box 2.5, but the capital costs will appear in the volumetric component rather than as an availability fee.

The tariffs are reviewed annually and once determined are subject to approval by the Board of Directors, essentially the Government. The tariff schedule for the 200+ water points that NamWater deals with is issued to Government as a secret cabinet submission. Once approved the tariffs are issued in the Government Gazette.

The process is non-participatory and not open to public scrutiny. Before the tariffs are published in the government gazette the tariffs are handed to Government in a secret cabinet submission. The NamWater Act allows for manipulation of the tariffs for political purposes by cabinet, reducing the absolute autonomy that NamWater has in setting its tariffs on a cost recovery basis and reducing the extent to which efficiency gains from full cost recovery can be achieved.

The tariff for water at any water point is dependent to a large extent on the way capital is treated in the tariff calculation. There are several factors to consider:

- changes in the depreciation period for capital
- the interest rate used
- the audited value of the existing capital

In arriving at a tariff that is both fair and affordable, as prescribed by the NamWater Act, it is important to keep all costs to a minimum. The efficiency of production, operation and maintenance is clearly a factor in the level of tariffs and the price that consumers pay for water will be dependent upon the incentives for NamWater to minimise costs.

There are objections particularly from the irrigation sector, to the inclusion of capital costs in the tariff for water where infrastructure has been in existence for many years. The belief by the objecting parties is that the capital costs of a structure such as Hardap Dam have already been paid off, by previous governments and taxpayers, do not represent a financial cost to NamWater, and as such should not feature in the tariff. This is an area of the tariff setting process that requires clarity in order to avert unnecessarily stifling economic uses for water whilst maintaining the returns to NamWater upon its existing capital.

2.10.2 Local Authorities

The tariff setting process for Local Authorities (LA's) i.e. town and village councils and municipalities, is guided by the Water and Sanitation Policy, the Local Authorities Act and the Model Water and Sewerage regulations. The WASP has specific guidelines for water tariffs for urban areas:

'considering the paucity of water in Namibia, the tariff structure should encourage water conservation and reduce wastage through the application of progressive and differentiated tariffs. The tariff structure may also be designed to provide for cross subsidies. It is recommended that the future tariff structure should have:

- *a fixed, low price for a defined minimum lifeline volume of water*
- *progressively increasing rates for increased consumption*
- *rates for mining industrial and commercial enterprises should as far as possible recover the full financial costs'*

It is clear that full cost recovery is advocated in urban areas, consideration of cross subsidisation of the poor is reflected and the issue of 'wastage' is addressed in the WASP.

However, it has been noted that many of the LA's have either a) not heard of the WASP policy or b) not promulgated the Model Water Supply Regulations of 1996 (van der Merwe 1999). Furthermore, as the discussion in section 2.3.2.1 suggests, the tariffs in many municipalities do not reflect the financial cost of water nor do they maintain their real value over time. In some cases the tariffs are not

volumetric. **Annex C** provides a summary of the volumetric tariffs being charged by some of the local authorities, the charges being incurred by those authorities receiving bulk water from NamWater and the extent to which full cost recovery is being achieved by NamWater for these specific schemes.

These charges are in addition to the basic availability charges imposed by all local authorities. According to van der Merwe (1999), tariffs do not in the majority of cases adequately reflect costs incurred in service provision. In some instances, for example Karibib, tariffs are even below those charged by NamWater for bulk supply.

The reasons for under pricing (or incorrect pricing) appear to be numerous and include the following:

- non maintenance of separate water accounts;
- lack of detailed information on costs and infrastructure involved;
- for municipalities where more detailed water accounts are maintained, there is a tendency to concentrate on balancing the entire budget, if revenues do not equal expenditure, further tariff increases are applied across all municipal services;
- tariffs are often based on the recovery of only operational and maintenance costs and include no provision for future replacement;
- tariff increases announced by municipalities and towns do not always reflect inflation levels and furthermore increases based on inflation levels are often an inaccurate reflection of the true rise in the cost of service provision, particularly when electricity costs which form a major part of water supply costs rise faster than inflation;
- tariffs in towns subsidised by MRLGH are not scheme specific and are generally 10 - 15% above the NamWater charge in each town.

2.10.3 Ministry of Agriculture Water and Rural Development

Directorate of Rural Water Supply
Rural Water Supply does not set tariffs or fees for water usage. Water is currently provided free of charge to most communities. As mentioned above, the community based management strategy will encourage communities to bear the cost of water supply.

Directorate of Resource Management
The Law Administration Division is responsible for issuing permits for water abstraction from the perennial border rivers and groundwater protection zones. Permit holders are charged a nominal fee for the issue of the permit, whilst an annual charge is levied on irrigators depending on the number of hectares that are irrigated.

The Directorate of Resource Management charges nominal fees for water abstraction permits from a variety of different sources. Permits for abstraction from the perennial rivers are only charged for water from the Orange River. For irrigation on the Orange River a per hectare fee is levied of N$7 per hectare per annum for up to 30 hectares. A charge of N$37 per hectare per annum is charged for additional hectares. These fees, and the fees levied on other perennial rivers, were derived to cover the administration costs for the issuing of permits and have been only occasionally inflated over the years. All payments for permits are dealt with by the finance division of the DWA, and as such are divorced from the permit issuing process. It is common for non-payment to occur and for accounts not to be sent to the water consumers from the Finance Division of DWA.

Volumetric tariffs will soon become applicable for water from the Orange River. These tariffs have been based upon the O&M costs of the regulation of water from the Gariep and van der Kloof dams in South Africa. It is as yet undecided how or if these tariffs will be paid by the government or by the consumers (largely irrigation).

In general it is not possible to charge volumetrically for the use of water from perennial rivers, ephemeral rivers and groundwater for a variety of reasons:

- Metering of abstraction is not undertaken on the whole.
- Individual users incur the costs of pumping of water or building of small farm dams

- The costs of each water source have not been established and the methodology for calculating the cost of water usage is not well established in the DWA.

Groundwater permits are currently not charged for. Similarly NamWater is not charged for the permits that it obtains from the DWA.

Directorate of Agriculture and Rural Development

The DARD is responsible for charging irrigators at Hardap. The DARD is the bulk water customer at Hardap as of 1998 and it pays NamWater for water supplied to the irrigation scheme (See Box 2.4). The DARD charges tariffs for water on a per hectare basis in the case of Hardap. NamWater charges for water on a volumetric basis. Aside from the bad economic incentives for water use that per hectare charges cause, it is apparent that the current charges that DARD levee do not cover the volumetric tariffs that NamWater wants to charge. For example, the DARD currently charges farmers at Hardap N$333/ha, whilst NamWater is attempting to charge 12c/m^3 for the raw water used in irrigation. Given that approximately 16000m^3/ha/a is used for irrigation[36], would lead to a tariff of N$1920/ha. The shortfall of N$1587 is clear[37].

The irrigation board at Noordoewer performs a similar intermediary function as the DARD at Hardap. The irrigation board also has the responsibility for overseeing the irrigation infrastructure that supplies the farmers at Noordoewer. Rights to consumption of water from the Orange River are issued by the DWA to the irrigation board for use in irrigation. An annual fee is charged by the DWA for these permits which is currently approximately N$37/ha for areas in excess of 30 ha. The irrigation board charges the farmers according to the permit tariff and the service they perform.

The DARD is also responsible for the Etunda scheme where it is the bulk water consumer. The water is billed at 12cents per m^3, which is less than the full cost recovery tariff of NamWater at that point (N$2.64 in 1998). It is unclear as to the tariff that the farmers at Etunda must pay, nor the basis upon which the charge is set. It is clear that a degree of water subsidisation is occurring for these schemes although the continued arguments about the inclusion of capital costs in the tariff for water for these schemes continues.

Permits for the construction of small farm dams (greater than 20000m^3 capacity) on ephemeral rivers are required. Similarly nominal fines (N$50) for illegal construction of dams can be levied in accordance with the Water Act. These fines provide little incentive for abidance by the law and many illegal farm dams exist. Furthermore, if a farmer has 2 dams of 10000m^3 each, no permit is required despite a similar containment of water.

Summary

From a financial point of view the government is missing a fruitful opportunity to cover some of its administration costs in the absence of a coherent 'resource' charge for water permits. By extension, the ability of the government to finance a more extensive monitoring and regulatory service would be enhanced by the application of a resource charge.

In economic terms such a fee could be deemed a 'resource rent' and should be based on the economic value of the use to which the resource is put to. Such a charge would not serve any strict efficiency objectives but would represent a transfer of economic benefits from the users to the government. It should be stated that such a charge would be largely (if not wholly) passed on to the end consumer of water.

2.10.4 Economic Pricing of Water

The price of water is seen by economists to be one of the main mechanisms available to affect the allocation of water both within and between resources. Furthermore, tariff setting is important for cost recovery and hence institutional sustainability. Namibia is making the first tentative moves towards financial cost recovery in the water sector assisted by the recommendations of the WASP and the creation of NamWater. The above analysis of price setting procedures shows that there is a long way to

[36] As is assumed by the DWA in their irrigation permits.

[37] In reality, NamWater have not yet been able to charge this tariff and discussions are ongoing as to how to charge irrigators at Hardap, many of whom are close to the point of bankruptcy.

go before water is always and everywhere priced in a coherent and practical manner that covers the financial costs of supply.

An economic price for water will include all the costs that the production and consumption of water imposes on society. Only if water is priced according to all costs will efficient consumption occur. These costs include:

- Current operations, maintenance and capital costs
- Environmental/external costs
- Opportunity costs (based on the value of different uses of water. E.g. see section 2.2.2)
- User costs[38]

At present it is clear that only NamWater has a distinct tariff policy and this considers only the financial costs of supply. The local authorities do not have a rigid pricing policy and the discussion in sections 2.3.2.1 and 2.3.4 illustrates the problems that are frustrating price setting and subsequently efficient use of water. The fees set by the MAWRD have no distinct basis and because of the lack of metering for many of the water sources, the fees are not volumetric. This means that consumers do not account for marginal consumption, leading to potentially inefficient usage of water.

The full financial cost pricing of water will go a long way to ensure the more efficient usage of water in Namibia. Where there are environmental/external costs of water supply, the movement towards financial cost recovery may benefit the environment to a great extent as demand upon primary water resources is reduced. Similarly the economic contribution from water usagemay also be increased as less efficient water uses are removed. Given the current institutional arrangement in the urban sector, it is important that the tariff charged by NamWater is passed on by the local authorities responsible for reticulation. This implies the need for systematic accounting of reticulation costs by the local authorities.

Nevertheless the absence of all components of social cost from the water tariff at present is an issue which needs to be addressed. However, more pressing is the absence of coherent countrywide pricing policies to ensure that the first step towards efficient pricing is achieved, i.e. full financial cost pricing. This issue is discussed further in the section 4.

2.11 Social Aspects of Water Supply

The supply of a basic minimum quantity of clean water is often seen as a basic human right. Such a stance means that water is not always and everywhere a pure economic good. Water has wider social qualities, such as health related and subsequently productivity related benefits, which need to be considered when addressing the issue of water supply and allocation.

Namibia is one of the most unequal societies in the world as illustrated by a Gini Coefficient of 0.70 (UNDP 1998). The richest 10% of the society receive 65% income, leaving only 35% for the remaining 90%. Hand in hand with the inequities of the Namibian economy is the existence of relative and absolute poverty. Low incomes and lack of access or rights to natural resources such as water describe poverty in Namibia. The social benefits of minimum levels of water consumption and the existence of poverty make the issue of access to water, either physical or economic, of prime importance in light of current policies of cost recovery and Community Based Management (CBM) of water supply.

When communities are **unable** to pay the full cost of water supply the policy of cost recovery or CBM may conflict with policies designed to improve access to water. In addition to this the view that all water consumption is an inalienable right can evoke a situation where people are **not willing** to pay for water. It is therefore likely that willingness and ability to pay should be considered separately and be subject to separate policy recommendations.

Furthermore, it has been shown in previous sections water is often seen as the primary constraint to development and poverty alleviation in Namibia. This is especially true in the rural areas where

[38] The user cost is the cost that current increments in consumption place on future consumers, i.e. the costs of future investments made necessary by current consumption.

agriculture is an important feature of livelihoods and the link between poverty and agricultural development is strong. There are several questions that arise from this analysis:

- How are the poor to adjust to the current policy of cost recovery and CBM?
- How, and to what extent can water related policies ensure equitable access to socially beneficial quantities of water?
- To what extent is water the critical factor in alleviating poverty?

2.11.1 Water and Poverty

Poverty can be defined in a number of different ways. Often monetary measures such as annual income per capita or household are used to describe poverty. These measures are often a reasonable proxy for poverty but neglect non-monetary aspects such as access to natural resources, or factors such as autonomy, self-esteem, participation and vulnerability to shocks. UNDP have a variety of composite indicators which use several factors to determine poverty levels. Of these the first Human Poverty Index (HPI 1) includes access to safe water as one of the determinants of the index. It is clear that by this measure the level of poverty can be reduced through improvements in the access to safe water. Similarly, where the opportunity costs of time used collecting water are high, and the distance of water points acts as a significant constraint to involvement in other activities, improved access to water supply could lead to further reductions in poverty. Furthermore the health benefits associated with access to clean water supply can also provide a motivation for improving the access.

In Namibia access to water in rural areas is defined by physical proximity. The aim of the DRWS is to ensure that 80% of the rural population is within 2.5kms of an improved water source by 2007. Since independence access to water supply has been estimated as shown in **Table 2.15**. There have been no studies in to the time costs of collecting water and as such the benefits of reductions in this time are unknown. The implementation of CBM will require the creation of bank accounts for the depositing of contributions from the community. The process of making deposits will also cost both time and money for the communities involved.

Table 2.15. Access to Improved Water Supply in Rural Areas.

1990	1996	1998
50%	62%	65%

Source: NDP1 1990, SIAPAC 1996, UNHDR 1998.

In urban areas it has been estimated that access to water supply is between 95 and 100% in Namibia (Nepru 1996, UNHDR 1998). However, these estimates do not distinguish clearly between in house connections, yard pipes and communal stand pipes.

Similar disparities exist between urban and rural areas for a variety of other poverty indicators. These are shown in **Table 2.16**. The disparity between rural and urban incomes and the prevalence of poverty in rural areas suggests that ensuring access to water supply is of greater initial concern in rural areas. However, given the relative poverty in urban areas, where wide income disparities exist, the issue of willingness and ability to pay for water are of equal concern in both rural and urban areas

Table 2.16. Indicators of Rural and Urban Poverty

Indicator		Rural	Urban
Income (N$/a)	Household	9453	32335
	Per capita	1550	6676
Average Food Budget Share (%)		46.6	23.4
Have Lighting Without Electricity (% HH's)		95	2 9
Use Bush or Bucket as Toilet (% HH's)		81	8
Over 5 Minutes walk to Pipe or Well (% HH's)		66	3
Own a Vehicle (% HH's)		12	47

SOURCE: National Income and Expenditure Survey 1994, UNDP, 1997.

The link between agriculture and poverty has been expounded in section 2.2.6. There seems to be a general consensus that the variability of water supply, which makes agriculture (rain-fed crops and

livestock) risky, is not the only impoverishing factor in rural agriculture. It seems likely therefore that improved water supply alone would not be sufficient to alleviate poverty.

The fact that only small proportions of income derive from agriculture, particularly crops, in many of the communal areas (less than 20% of household income is estimated as being derived from agriculture in former Ovambo region with under 1% derived from crops, 16% in the Kavango and 34% in the Caprivi) with the remainder coming from the range of non-farming activities, remittances of food and cash, pensions and formal sector employment, suggests that water supply as an input to agriculture is not the pivotal constraint to income generation[39].

The array of potential sources of income also suggests that the opportunity cost of time could be significant[40]. This suggests that there could be income-generating possibilities created through improved access to water supply and reduced time used collecting water. Given that women are most often responsible for water collection, and are often the most impoverished section of society, such a policy could be central to rural poverty alleviation. One corollary of this is that, theoretically, a significant willingness to pay should be registered for improved water supply. However the reality is that women are often not in control of the cash resources in a community, and as such a willingness to pay may not be backed by an ability to pay. However, the existence of the benefits of reducing time used collecting water should enter into the decision to supply water. At present this is not the case.

In the absence of greater information on the precise benefits of improved water supply, and the role this may have in reducing poverty, it is impossible to arrive at more concrete conclusions. Suffice to say that evidence from a variety of other developing countries suggests that the willingness to pay for improved water resources is significant (Pearce 1998, Whittington, 1989)

2.11.2 Willingness and Ability to Pay for Water

Rural Water Supply

The DRWS has embarked on a policy of Community Based Management for rural water points. The creation of local Water Point Committees (WPC) has already begun with the idea that these institutions will become responsible for the operation and maintenance and ultimately the capital costs of their water supply points by 2007.

Studies into the willingness/ability to pay of rural communities in Namibia have used assumptions about the % of income that can be devoted to water rather than rigorous investigations into revealed preferences. Although limited in accuracy, such studies do illustrate something about the communities ability to pay for water and hence the sustainability of the Community Based Management policy.

Based on estimated costs of operations and maintenance of water points in rural areas, regional estimates for the ability of rural communities to pay operations, maintenance and capital costs for rural water points can be calculated. **Table 2.17** shows the extent to which rural communities can cover their operations and maintenance costs assuming that 5% of **median** rural incomes are made available to water point committees[41].

Table 2.17. 5% of Median Incomes Contributed to Water Points

Regions	5% Annual Household Income (N$)	Potential Annual Contribution at WP (N$)	Contribution for Region (N$million)	O&M Costs to Communities (N$million)	Shortfall/ Excess (N$million)

[39] The observant reader may have noticed that quite a significant proportion of income comes from agriculture in the Caprivi, where rainfall is more favourable than in other parts of the country. However, the Caprivi has the second lowest median rural income in the country after Hardap region. The reasons for this are less than clear however this does suggest that water supply for rain-fed crops is perhaps not the only limiting factor to income generation.

[40] Remittances and pensions do not affect the opportunity cost of time particularly.

[41] The median is used to account for the wide income disparities that exist even within rural areas. It represents a more reliable indicator of the income of most households within the region.

Caprivi	157	6320	2.32	0.83	**1.49**
Erongo	280	3523	0.98	2.38	-1.39
Hardap	140	1660	0.54	1.73	-1.19
Karas	300	3874	1.74	2.12	-0.38
Kunene	204	1438	1.27	7.31	-6.04
Okavango	266	5381	4.57	7.04	-2.47
Omaheke	292	3963	1.86	5.30	-3.45
Ohangwena	227	4135	18.4	9.17	**8.97**
Omusati					
Oshana					
Oshikoto					
Otjozondjupa	302	14184	3.57	3.87	-0.30

SOURCE: NEPRU FG, 1997.

The contribution of 5% of median incomes for each household will only support local level O&M in the Caprivi and Cuvelai regions. All other regions will suffer a shortfall, which will have to be covered by the DRWS if water supply is to be maintained. The shortfall is most notable in the Kunene region. This is as a direct result of the low cash incomes and low population densities which means that the costs of water points fall on fewer households. For example the number of households per water point in the Caprivi and Cuvelai regions is estimated to be 40 and 67 respectively. In Kunene region this number is just 7.

The estimates in Table 2.17 should be considered as very rough in the absence of knowledge of the preferences in the rural communities of Namibia[42]. The future costs that will be borne by the DRWS in this scenario are shown in **Table 2.18**. Three other potential scenarios and their respective future costs for DRWS are also shown. The scenarios are:

i) Households contribute 5% of median income (shown above)
ii) Households contribute N$10 per month
iii) Households contribute N$20 per month
iv) 5% of median household income up to a maximum of N$20 per month

Table 2.18. The Potential Annual Savings on O&M from Contributions from Rural Communities[43]

Scenario	Estimated O&M Costs to DRWS without contributions (N$ million)	Contributions from Communities (N$ million)	Total Cost to DRWS with Contributions* (N$ million)	Saving to DRWS (N$ million)
i.	38.6	24.5	21.7	16.8
ii.	38.6	16.6	29.7	8.9
iii.	38.6	23.2	23.1	15.5
iv.	38.6	22.5	23.7	14.8

Adapted from Nepru FG 1997.
* These costs include 20% overheads on total O&M costs required to oversee the CBM process.

It is clear that in each scenario the rural communities as a whole will not be able to afford the full operations and maintenance costs of rural water supply points and assistance will still be required from Government. Furthermore when capital costs are taken into account only 2 regions, Caprivi and Cuvelai, are able to make contributions to capital costs within the scenarios described above. It has been estimated that the contributions to capital costs by these regions could increase the overall savings to DRWS to approximately N$20 million.

[42]Given the income inequalities that exist even within rural communities, 5% of median income is much less than 5% of mean incomes. This implies that the estimates in Table XX could be considered minimum levels of WTP for water.
[43] All figures are in 1996 prices.

The issue of collecting contributions for WPC's is crucial. There are inequalities within rural communities that mean some of its members will be less able to contribute than others. The structure of contributions needs to carefully considered such that it is affordable to the whole community, whilst attention needs to be drawn to the difficulty that some communities may have in converting contributions in kind into cash. The SIAPAC study of 1996 revealed that there was a significant willingness to pay for water in rural areas, and, a feeling that each community, rather than the government, should devise ways in which to help their poorest members.

One way in which this issue has been addressed is through the issue of fees for livestock. In community consultation there has been general agreement with the notion that livestock owners should contribute more for the use of improved water sources. The link between the ownership of livestock and income generation is strong. For example it has been found that the ownership of cattle greatly influenced the production of crops, access to cash incomes and access to alternative income generating activities (NEPRU, 1997). A contribution per household would not seem very equitable in light of this information and as such a tariff based on head of livestock owned may mean that the more wealthy households in a community will pay proportionately more[44].

The move towards CBM will change the water points from an 'open access' resource to a 'common property' resource. The benefits of this change in property rights can be considerable. A fee based on cattle ownership could provide an incentive for cattle owners to use unimproved sources instead thereby reducing the pressure on groundwater resources[45].

The analysis suggests that in order to maintain a sustainable water supply system for the rural communities through the CBM policy will require the short to medium term intervention of the Government. The evidence presented suggests that rural communities may not be able to pay the full cost of water supply whilst the costs of water supply fall heavily on regions with sparse populations and on the poor. Furthermore, given the frequency with which newly created WPC's collapse, the suitability of this type of institution for the management of water points may need to be reviewed (van der Merwe, 1999). In Khorixas for example the following issues were raised by members of the central water committee:

- Water Point Committees are meaningless because in some cases there is only one family at a water point
- Government does not explain how people are to pay
- People could not be denied water because it is culturally unacceptable
- Water point committees do not have legal status and will not be able to enforce or regulate the use of boreholes (MET 1997).

Urban Water Supply

Similarly stark inequalities of income occur in urban areas. Poverty is also a feature of urban areas. Coupled with generally higher prices and the cost recovery basis on which water supply is now run, these features mean that the issue of ability to pay is also of paramount importance. The prevalence of non-payment noted in many of the Local Authorities (LA's) in Namibia (van der Merwe 1999) and the recent friction between the bulk water supplier and certain LA's, willingness to pay for water is also of importance.

The issue of ability to pay has been addressed in certain municipalities by the implementation of increasing block tariff structures. These allow cross subsidisation from high consumers and low consumers due to the higher tariffs charged for high consumption. **Box 2.6** explains how this system has worked in Windhoek.

At face value this tariff system seems like a useful tool to assist those potentially unable to pay for water to have access to water. Box 2.6 shows that the use of block tariffs has a considerable effect in redistributing income, contributing a maximum of 8% to the income of the poor[46]. However, the use of such a system rests upon the assumption that there is a strong link between consumption of water from a given connection and household income.

[44] This system is currently in place in the Omaheke region

[45] It could also provide an incentive for inaccurate estimates of livestock numbers.

[46] This assumes that the poor household modelled in Box 2.6 consumes up to 15m^3 per month. I.e. the poor may be likely to consume less, and therefore not receive the full subsidy.

There are a number of other problems associated with block tariffs which deserve to be highlighted[47]:

- The initial "block" is uniformly set for all family types. It is in general true that poorer households are larger than rich households i.e. have more people. As such this initial cheap block will benefit small households more than large households since a given water consumption per capita will be cheaper per capita.
- This problem could extend to private connections that are being used by water vendors. The connection may be supplying many households with basic water requirements whilst paying higher charges associated with luxury water use.
- Income redistribution is regressive within the first block. I.e. where the cross-subsidy is embodied in the first block, it is necessary to consume the entire block in order to receive the entire subsidy. As households reduce the water consumption the subsidy is reduced.
- In general the maximum possible subsidy is small.
- All consumers, including the wealthy, are subsidised for the initial 'block' or blocks
- Without distinct knowledge of the demand behaviour of consumers it becomes difficult to ascertain whether or not a particular tariff schedule will be revenue sufficient.

Questions also arise as to the motivation for the increasing block tariff structure. It can be economically justified to subsidise water where there are particular health benefits combined with a lack of consumer understanding of the health benefits of clean water supply. This situation, where water is a 'merit' good (See **Box 2.7**), is more likely to prevail where consumers are poor and does not justify the subsidisation of water to all consumers. In many countries there are political motivations for subsidising water in this way and/or the block tariff system is used as a means of redistributing income. The general feeling is that there are likely to be much more efficient ways in which to redistribute income than through cross subsidisation of water tariffs (Warford 1999). This thought is echoed by the WASP which states that any subsidisation for social ends should be an explicit transfer through the social security vote, rather than through circumvention of water revenues.

However, where other instruments for poverty alleviation are absent, there could be a justification for using the increasing block tariff system for income distribution.

Table 2.19 shows the proportion of both mean and median incomes that minimum household consumption will cost in the different regions of Namibia when the full cost of bulk water supply is reflected in municipal tariffs. Where this cost is greater than 5% of median income it is highlighted. Only in three regions, Kunene, Cuvelai and Omaheke does the cost of minimum levels of consumption rise above 5%. Only in the Kunene Region does this cost appear to rise above 5% of **mean** annual income. This suggests that in most regions the ability to pay for minimum levels of water consumption is significant[48]

Table 2.19. Annual Regional Minimum Bulk Water Costs by Region as % of Regional Incomes

NamWater Region	Average Weighted Bulk Tariff (N$/m^3)	Annual Cost of Minimum (N$)	Mean Income (N$/a)	Median Income region (N$/a)	Annual Water Costs as % of Mean Income	Annual Water Costs as % of Median Income
Brandberg	2.74	236.7	6860	5262	3.5%	4.5%
Cuvelai	3.55	306.7	7000	5000	4.4%	**6.1%**
Hardap	2.29	197.9	9474	7065	2.1%	2.8%
Karas	2.30	198.7	26216	9387	0.8%	2.1%
Khomas	2.62	226.4				
Kunene	4.67	403.5	6860	5262	**5.9%**	**7.7%**
Namib	1.93	166.8	7827	8633	2.1%	1.9%
Okavango	1.43	123.6	8259	5631	1.5%	2.2%
Omaheke	7.54	651.5	16740	5916	3.9%	**11.0%**

[47] D. Whittington and J.J Boland 1999.

[48] The annual cost of minimum levels of water supply are based on the 1998/99 weighted full cost recovery bulk tariffs for each region +20% for municipal reticulation costs.

Waterberg	2.52	217.7	12058	6619	1.8%	3.3%

Adapted from Nepru FG 1997.

2.11.4 Summary

The analysis suggests that the current CBM policy may be faced by problems of inability to pay in the future. The ability to pay varies between regions largely as a result of differences in population or livestock densities. It is clear that in the short to medium term the DRWS will have to continue its subsidisation of this sector to ensure continued access to water supply in the future. It should be stated that 5% of median income could very well be an underestimate of the extent of willingness to pay. Estimates from around the world range from 1% of income in Webuye, Kenya to 9% in Ukunda, Kenya to 18% in Omitsha, Nigeria (Whittington 1993, Pearce, 1998). The willingness to pay in Namibia should be investigated further in order to establish the most appropriate management mechanism.

In terms of efficiency, the implementation of CBM can save considerable cost to government whilst encouraging the benefits of resource management that arise from the creation of common property resources (World Bank 1991). Success of CBM hinges on a number of different facets. Most critical seem to be:

- the ability of communities to pay
- the ability of communities to cross subsidise
- population and livestock density
- the institutional strength of the WPC's
- the suitability of CBM and WPC's to pastoral/semi-nomadic peoples

In urban areas the picture is not so clear. The discussion in Box 2.6 describes a potentially worst case scenario in Windhoek. In this case, access to a minimum level of water supply would cost something like 12% of income when charged at full cost. Given that a degree of cross subsidisation is possible in urban areas, this can be brought down to approximately 7%. This compares favourably with observed willingness to pay, however is greater the 3% of income prescribed by the World Bank as an acceptable level of expenditure on water. Whether ability to pay is a problem is difficult to conclude from the evidence available. However, given the extent of non-payment in many of Namibia's urban centres suggests that it is the willingness to pay that is the major factor, not ability.

It is generally thought that there are considerable economic benefits that can arise from ensuring access to water supply such as health improvements and reductions in time costs. These benefits alone may lead to wider income generating opportunities or improved productivity in current activities, implying a potential willingness to pay. In many instances, the time saved is used for leisure purposes, the benefits of which are difficult to measure (Bridger and Winpenny 1989). Box 2.7 describes the notion of water as a 'merit' good as the motivation for subsidising minimum access to water. In general it is thought that the existence of health and productivity benefits is difficult to prove. Indeed, in certain cases the increase in the level of water supply can lead to a reduction in health as water borne diseases are spread. In Namibia for example, the Olushandja dam has introduced Bilharzia. The link between water and productivity can also be tenuous therefore. As such it has been suggested that we can only be sure of the following propositions (Bridger and Winpenny 1989):

- *improved water supplies can lead to improvements in public and private health when they are introduced into a situation which is favourable in other respects (reasonable level of awareness about public and private hygiene, where personal health is otherwise good)*

- *in urban settings, adequate supplies of clean water can prevent epidemics.*

Box 2.6. The Effect of Cross Subsidisation in Windhoek

Using the standards recommended by the WHO, the daily minimum per capita quantity of water required for personal hygiene and health is approximately 30litres. This means a monthly consumption minimum of $1m^3$ per month and $12m^3$ per annum per capita. In Windhoek in 1998, where water is relatively expensive, water costs the municipality approximately N$4.75 per m^3 to supply, and subsequently the annual per capita cost for the minimum recommended consumption is approximately N$57 per annum. The lowest rural annual median income is for Hardap region and is N$2798 per household or approximately N$500 per capita. Assuming that incomes in Windhoek are no lower than that, in the worst case scenario the minimum recommended water supply could cost the poor up to 12% of annual income. This is towards the top end of stated willingness to pay in many developing countries and could mean that the cost of water restricts access to minimum amounts of water (Pearce 1998).

This suggests that water is only a merit good, and hence justified for subsidisation, in very special circumstances. In Namibia however, the issue of equity is of paramount importance, and as such any subsidisation of water is likely to be justified on equity grounds alone. In urban areas the issue of equitable access to water supply can be partly assisted by the implementation of increasing block tariffs, which can help to combine efficiency properties with these equity properties. The analysis suggests however, that water and water tariffs may not be the best medium to approach the issue of poverty alleviation. Where water is scarce this argument is even stronger.

Box 2.7. Water as a Merit Good.

A "merit "good is a good which harbours wider social benefits than might be reflected by the benefits that accrue purely to individuals. Education is considered to be a merit good since a well educated society will harbour wider social benefits than the benefits that occur privately to educated individuals: reduction in crime, innovative population etc. In the same breath, clean water supply is often considered to be a merit good. The reduction of water related diseases as a result of clean water supply infers wider social benefits than those that occur to individuals alone for example:

- a healthier workforce may be more productive

- medical costs to society are reduced.

In cases of education and water it is speculated that the benefit to the economy as a whole is greater than the sum of benefits to private users. Economic theory states that merit goods justify some sort of subsidization since the market in which private individuals make their preferences known, will not reflect the wider significance of the provision of the good.

However, there is some debate as to the extent to which water fulfils the role of a merit good. It is clear that some level of water consumption is required for survival and various guidelines are stipulated for this required daily consumption: World Health Organisation recommend between 25 and 30 litres per capita per day. As such it could be stated that these minimum levels of water consumption should be encouraged through subsidisation.

The question arises when we consider the use of water for other purposes, over an above the minimum level required for health. It would be hard to argue that water for golf courses and swimming pools should be available at a subsidised rate as a basic right for human existence.

2.12 FUTURE WATER SUPPLY OPTIONS[49]

The limits of current water supply are being reached in many parts of Namibia. Nowhere is this more dramatic than in Windhoek and the central areas of Namibia where water demand has been predicted to be rising at between 3 and 5% per annum[50]. In 1995 the second severe drought of the decade occurred and the need for an emergency supply for the city of Windhoek became a matter of prime importance. At this time a number of options were researched and documented in a study entitled "Feasibility Study into the Okavango to Grootfontein Link of the Eastern National Water carrier. The different options, their costs and their respective implications are discussed below.

2.12.1 The Future Cost of Water for Windhoek

Windhoek is the most important population, commercial and administrative centre in Namibia. In terms of the water supply and demand issues that have been illustrated above, Windhoek displays several characteristics that make it representative of the problems that Namibia as a whole faces. These factors include:

- **Rising water consumption**: on account of population and income growth as illustrated in the demand prediction above.
- **Present capacity almost fully used**.
- **Increasing marginal costs of water supply.**

To illustrate the comparative cost of the different water supply options, values for Windhoek have been listed in **Table 2.20**.

Table 2.20: Comparative Analysis of the Unit Costs of Water Supply Options for Windhoek (1998).

Potential Water Supply Options	Potential Volume of water Assumed per Year (Mm^3/a)	Unit Cost, N$/$m^3$ at Windhoek	International Agreement Status	Comments
Existing Supply	15	3.17	None required	
Okavango	17	6.25	None	Environmental and Political consequences
Kunene (option 1)	30	7.85	Agreement with Angola. $6m^3/s$, or	Very variable flow, demand in the

[49] This section draws heavily on the State of Environment Report for Water, (Interconsult/WCE 1999).
[50] Various demand projections have been undertaken for the central areas and the estimates for demand growth have differed in each case. See Section 2.2.4.

			190Mm^3/a.	Cuvelai affects the availability.
Kunene (option 2)	190	10.36	"	"
Hardap	30 (95% yield of 50Mm3/a)	4.92	None required	Opportunity Costs.
Tsumeb Aquifers	20	6.40	None	Investigation into the sustainable yield required.

The unit costs in Table 2.20 are average incremental costs assuming that water supplied is the same as that supplied in the emergency scenario of the aforementioned feasibility study[51]. The unit costs include an increment of N$1.63 for the use of existing infrastructure between Grootfontein and Windhoek. The unit costs are comparable in this sense although each option has its own peculiar factors, over and above the pure financial cost elements, which affect their overall practicality and desirability.

2.12.1.1 The Kavango Option

The basin states of the Okavango River are Namibia, Angola and Botswana. The Okavango is a shared water resource meaning that all major abstraction decisions are subject to agreement by the other basin states, all of whom have interests in the distribution of water rights.

Given the current war in Angola, the main cause for concern that arises when considering abstraction of water from the Okavango River is the downstream effect on Botswana and particularly the unique wetlands of the Okavango Delta. The tripartite Okavango Commission, OKACOM, has been created as a forum for such debate and an Okavango basin management project is being planned with the expected financial assistance of the Global Environment Facility (GEF). A preliminary agreement has been signed stating that no significant action will be taken by any of the basin states until a management plan has been established for the Okavango Basin.

The involvement of the GEF also highlights that there are significant external costs and benefits, and "global non-use values" at stake in the Okavango basin. For example, Namibia may not account for the environmental damage that may occur to Botswana's detriment, whilst Botswana may force Namibia to invest in significantly more expensive water infrastructure. There are costs and benefits on both sides which can only be resolved through discussion. Similarly, there is intense international interest in the Okavango Delta, and it is this interest in this unique environmental resource from which the "global non-use values" arise. These values should be considered distinct from direct economic losses that may occur in Botswana, Namibia and Angola should mismanagement of the river basin occur.

The financial cost of bulk for the emergency supply from the Okavango River is N$6.25/m^3. The current bulk costs to Windhoek are N$3.17/m^3. As such this investment would represent a near 100% increase in the cost of water to the Windhoek municipality, a cost that would inevitably be passed on to the consumer.

2.12.1.2. Hardap Dam.

Although the unit cost of N$4.92/m^3 indicates that this is the cheapest option for emergency supply, there are several aspects worth mentioning:

- Further investments in storage infrastructure may be required in Windhoek itself unless the three dam system is used

[51] This is the so-called Total Secured Supply of the "Feasibility Study of the Okavango To Grootfontein link of the Eastern National Water Carrier". This is an amount of water determined by a systems analysis of the existing infrastructure and includes an allowance for the evaporation that occurs whilst the water is in transit.

- The water of Hardap Dam is currently being used for irrigation and for the supply of water to Mariental. There are subsequently significant opportunity costs to the water.
- The yield of Hardap Dam is likely to fluctuate with the yield of the three dam system. Subsequently if the three dam system has a year of low flow, Hardap Dam is also likely to have a low flow year.

However, there are some positive aspects to this option:

- This option would avoid the environmental and political costs associated with abstraction from a shared perennial river such as the Okavango River.
- The water will not suffer the same evaporative effects as the water pumped from the Okavango or Kunene which must pass through the open canal of the ENWC.
- If a system of tradable water rights were set up in which current users could sell their rights to Windhoek in times of drought or in the future when demands have outstripped supply, the water would have an opportunity cost to the current users and as such they may be encouraged to use water more efficiently.

2.12.1.3 The Kunene Option

Namibia is allowed to abstract 190m^3/s from the Kunene River according to the agreement of 1929. Option 1, obtaining an emergency supply from Oshakati, can only be considered as a short-term supply option since the demands of the Cuvelai will take up the remaining capacity. Option 2 will be that much more expensive but will supply over the longer term.

The water rights to the Kunene have been resolved for many years. However, there may still be environmental concerns associated with extraction from the Kunene, concerns over the variability of the flow of the river, which can be less than 1m^3/a in the dry season, and the potential opportunity cost of power generation that water abstraction may incur. The cost of the two Kunene options is also prohibitive compared to other options.

2.12.1.4 Tsumeb Aquifers

Investigation has begun into the capacity of the Tsumeb Karst aquifers to contribute to the bulk water supply of Windhoek. Currently groundwater from the area is being pumped into the Eastern National Water Carrier (ENWC) from the old Berg Auchas mine. Similarly, until very recently, water pumped from other mines in the region also supplied water for urban usage.

The unit cost of the Tsumeb aquifers is highly competitive with the other conventional supply sources. Indeed, the unit cost was calculated on the basis of the emergency demand projected for 1998, rather than the estimated total sustainable yield of 30Mm3/a[52]. The use of the Tsumeb aquifer as a source of water for the growing demands of Windhoek will mean that the uncertainties associated with abstraction from the Okavango River will be eliminated. Although the Tsumeb aquifers do not require international negotiations on abstraction levels, there are important issues that must be addressed with respect to this source of water.

At present the water from these aquifers has only been partially tapped. Current abstraction is used to supply the town of Tsumeb and private boreholes in that area. Total use is approximately 24Mm^3/a at present. There is likely to be a question of property rights with respect to tapping the water from this source and transporting it to Windhoek. In fact the water resources belong to the government and they have the power to transfer water, however there is likely to be resistance to the proposals from the users in the Tsumeb area. The same could be said of the Grootfontein aquifers, although they are not specifically addressed here.

The sustainability of recharge and the possibility that there are strong environmental linkages to the level of groundwater in the aquifer are also issues that need to be considered when comparing the costs of the different options. It is likely that if there are environmental costs to this water they will occur

[52] This was estimated by the Okavango pipeline study. In reality the sustainable yield of the Tsumeb aquifer is not known with certainty and the complexities of recharge flows in the region are little understood.

within the confines of Namibia, rather than outside the country as in the case of the Okavango. In this respect Namibia will internalise these costs and may have a greater incentive to mitigate against them

2.12.1.5 Summary

The conventional supply options have been compared on the basis of financial unit costs and a brief discussion of the implications of each proposal. Nothing has been said of the different financial risks that may arise due to the varying degrees of capital investment required in each case. For a complete analysis environmental and other external costs and the economic benefits of each supply option would have to be quantified and the optimal timing of the investments determined therefrom. Although this is beyond the scope of this paper, the principles of cost-benefit analysis should be applied to water investments to ensure economically viable and optimal investments are undertaken.

2.12.2 The Costs Unconventional Water Supply Options[53]

"Unconventional" water supply is defined here as water supply sources other than traditional or "conventional" bulk water supply augmentation; dams, pipelines, further groundwater exploitation etc. A variety of options have been highlighted for Windhoek.

The increasing expense of conventional bulk water supply augmentation investments has made unconventional sources a more practical and economic alternative source of additional water. Technological advancements have also been very important in making these investments practically more appealing. This is particularly the case when considering reclamation of water. Furthermore the environmental and political costs associated with conventional water sources, e.g. the Okavango River, have highlighted the need for alternative sources of water.

Table 2.21. Unconventional Supply Sources[54].

Existing Supply Sources	Potential Volume of water Assumed per Year (Mm^3/a)	Unit Cost, N$/$m^3$ at Windhoek	Comments
Existing Supply	15	3.17	
Goreangab ext	3.65 (7.5 in future)	2.50	Environmental costs are low
Desalination	50	19.65	Expensive
Artificial Recharge	4-8	1.25	Testing still occurring. Supply from reduction in Evaporation.
Boreholes	2.3	1.15	Subject to recharge
Purified Effluent	1.14	1.57	Environmental costs are low

The tariffs that appear in **Table 2.21** are not directly comparable to the tariffs of the conventional water sources in Table 2.20 because the tariffs here are not based on the emergency supply volume of water. It can be seen that in general the quantities of water that the unconventional sources are able to supply are small in comparison to the shortfall assumed in the emergency scenario, $17.28Mm^3/a$. There are natural constraints to many of these options, e.g. recycling and reclamation.

2.12.2.1 Reclamation of Wastewater for Direct Potable Use (Goreangab Reclamation Works and Extension).

[53] This draws heavily on the work of Ben van der Merwe: Windhoek case study of the Water Demand Management Namibia Country Study, and "Strategies for Water Re-use".
[54] The tariffs shown here are not equivalent to the conventional tariffs in Table 2.19. They do not use the same assumptions with respect to the quantity of water supplied. They have been supplied by Ben van der Merwe City of Windhoek Case Study of the Namibia WDM study.

Water reclamation for direct potable re-use is practiced when water is reclaimed and blended with good quality water from other sources.

In Windhoek the reclamation of sewerage effluent for potable water use was pioneered in 1968. The system in Windhoek has been upgraded several times since then and now can supply a maximum of 3.65 Mm^3/a, or approximately 20% of the total demand of Windhoek. The cost of this water is estimated to be in the order of N$ 2.35/m^3, which compares favourably to the bulk water tariff of N$ 3.17/m^3.

The Windhoek water reclamation project is based on the premises that successful reclamation can only be achieved when three equally important elements are controlled:

- diversion of industrial and other potentially toxic wastewater from the main wastewater stream
- wastewater treatment to produce an effluent of adequate and consistent quality and,
- proper effluent treatment to produce acceptable potable water.

These three requirements are controlled by systematic regulation of water pre-treatment quality and the use of a series of multiple chlorination and maturation pond phases to remove pathogens.

The capacity of the plant is to be extended and the projected cost of this water is N$2.50/$m^3$. The capacity is expected to increase to 7.7Mm^3/a. This will represent a useful and relatively cheap source of water to the city of Windhoek which is expected to be on line by the year 2000.

2.12.2.2 Desalination

At nearly N$20/$m^3$, desalination is by far the most expensive option considered above. Although largely benign in terms of the opportunity costs of the water used, desalination is an energy intensive option. Intensive energy use has environmental consequences. Furthermore, infrastructure will ultimately have to be built to supply the joint electricity demands of desalination and the coastal areas. It is also likely that there will be significant environmental costs associated with a pipeline of over 300kms from the coast to Windhoek.

2.12.2.3 Artificial Groundwater Recharge.

The water engineers of Windhoek have initiated a pilot project for the artificial recharge of the secondary fractured rock aquifer serving the town. This process will reduce the evaporative losses incurred in thethree-dam systen which supplies Windhoek[55]. It is estimated that the underground storage capacity of the Windhoek Aquifer is in the order of 15 – 25 Mm^3 and that a minimum annual recharge at a rate of 6 – 10 Mm^3 will be possible. In 1998, 100 000 m^3 of water supplied by NamWater was treated through Granular Activated Carbon and injected into a production borehole over a period of 2 months. To date, no negative effects have been detected while some of the surrounding boreholes are recovering at four times their natural recovery rate (van der Merwe 1998). A similar approach could be used to store excess reclaimed water.

It is clear that the option of artificial groundwater recharge is a cheap and efficient use of water. There is likely to be greater scope for the use of this technique in Namibia and in the Windhoek area. Furthermore the issue of "water banking" is an obvious offshoot of this technique, i.e. saving water now for use when it is more valuable, i.e. in times of drought, or higher relative demand. Artificial recharge seems ideal for emergency situations, particularly in consideration of the high level of evaporation that occurs in the three dam system.

2.12.2.4 Boreholes

The Municipal boreholes provide the cheapest water to Windhoek. Their use is monitored for sustainability and excessive pumping has been reserved for times of drought. It is these boreholes that are being recharged artificially. Essentially the boreholes will only represent a long-term source as long

[55] Currently the evaporation from the three dam system is in the order of 35Mm^3/a, compared to an assured yield for Windhoek of approximately 15 Mm^3/a.

as the losses from evaporation can be reduced through the artificial recharge. This cheap water is not in limitless supply therefore, but used conjunctively with other sources will enable efficient management of existing supplies.

2.12.2.5 Purified Effluent

Purified effluent is used for irrigation of sports fields, public gardens and cemeteries. The use of this water rather than potable water means that demands on potable water are reduced. This essentially releases potable water for consumption elsewhere. 1.14Mm^3/a of purified effluent are used in this way, implicitly supplying 1.14Mm^3/a of potable water to the city of Windhoek. Again this is a cheap source of water, but in the long-run this source is limited since there are only so many parks and fields that require irrigation, and only a few more that can be converted to purified effluent irrigation. The saving is one-off in this respect. Furthermore a minimum sewerage flow is required for the current reticulation system.

Further savings could perhaps be made by the use of this water in private gardens through domestic dual pipe systems. However, the cost of this strategy is unavailable here, but is likely to be very high.

2.12.2.6 Summary

The unconventional options are appealing for 2 main reasons:

- They are competitive on financial cost
- They avoid many of the environmental and political costs associated with the border rivers and perhaps groundwater exploitation.

Questions remain as to the extent of the period of time that these supply sources will be sufficient to cater for current demand growth. However, careful consideration of the effect of these investments on the optimal timing and capacity of any further conventional investments. It seems likely that unconventional supply options will improve the efficiency of overall water investments and hence yield economic benefits.

2.12.3 Water Demand Management.

The scarcity of water in Namibia is characterised by several factors. The erratic and low rainfall, high evaporation and more recently expense of additional supply augmentation schemes (see above) and the diminishing amount of funds available for public works all combine to make water a scarce resource. In this climate focus has shifted away from traditional large-scale water supply schemes towards managing existing supplies, and the demands therefrom, more efficiently. This is the essence of Water Demand Management (WDM).

In the past demand for water was seen as a requirement and water supply schemes were designed and implemented to satisfy existing patterns of demand and demand growth. For example, demand projections such as those in section 2.2.4 would be used to determine the timing of future supply investments. More recently demand is being viewed in the economic sense, i.e. a price quantity relationship, and as such the pattern and growth in water demand are no longer being viewed as requirements but rather subject to the prevailing economic cost of water.

WDM begins with the economic pricing of water. Pricing of water aids the efficient allocation of water between and within uses. Once water is priced properly water is seen to have "value" and users are encouraged to be more frugal with water. Beyond this, the promotion of water saving devices, the use of "moral suasion" and the use of restrictions, fines and legislative changes all make up the constituent parts of a wide WDM policy.

2.12.1.1 Water Demand Management in Namibia

The IUCN Water Demand Management Namibia Country Study (van der Merwe 1999) surveyed the level of awareness and practice of WDM in Namibia. WDM was defined in the study as follows:

> *"Water Demand Management (WDM) is the use of policies and investments in order to influence the demand for water. Primarily "demand" is treated as an economic concept and water is treated as an economic good. As such the primary measures for WDM are economic/financial, such as economic pricing and fines, and moral suasion in the form of awareness and education. In this sense WDM attempts to reduce the consumption of water through directly influencing and removing* ***inefficient consumer demand.***
>
> *The demand for water impacts on primary water sources; perennial rivers, ephemeral rivers, groundwater etc. Reducing the pressure on primary water sources is one of the aims of WDM and therefore technical measures, such as reducing unaccounted for water and the use of unconventional water sources can also be considered WDM. In this sense WDM attempts to supply a* ***given service*** *to water consumers with* ***reduced demands on primary sources"****.*

This definition isolates two sorts of demand. Firstly the price quantity relationship that constitutes consumer demand and the overall demand that impacts upon primary water sources. The latter is affected by leakages, evaporation, and administrative errors, known collectively as unaccounted for water. As such the focus of WDM is on reducing unaccounted for water, ensuring that consumers internalise the true cost of water, creating an awareness of the value of water and encouraging re-use of water. In this sense, many of the unconventional sources of water were also viewed as water demand management strategies.

It is clear that there is nothing intrinsically good or preferable about WDM per se. WDM is just another type of investment in the water sector which should be subject to the same economic appraisal as supply augmentation investments. WDM has become a desirable policy as a result of the increasing cost (including environmental and political costs)of supply augmentation and the history of under-pricing in the face of growing demands for water. This state of the world has made WDM investments such as reducing unaccounted for water relatively cheap, and the benefits from full cost pricing of water significant. There are also a number of other benefits that WDM has over supply augmentation:

- WDM avoids external and environmental costs associated with supply augmentation. In Namibia examples include:

    - the transboundary costs of use of the Okavango River
    - the environmental costs of dams on ephemeral rivers
    - the impact of large scale groundwater abstraction

- Improvements in economic efficiency (static and dynamic) as a result of economic pricing,
- Dynamic gains may be derived from the delay of future supply investments. Such dynamic gains can arise from:

    - Income growth: reducing the relative impact of investment on the economy over time
    - Technological progress: Improved technology/engineering techniques may make the supply investment relatively cheaper.

All of these factors reduce the relative economic costs of WDM. Provided the WDM strategies are suitably designed they can make the stream of investment required to maintain water services more cost effective and hence use economic resources more efficiently.

The IUCN Namibia country study brought to light the best and worst case scenarios in Namibia, highlighted the benefits of WDM over traditional water supply schemes and illustrated where water efficiency gains can be made in the future. Namibia does not have a national WDM policy. The only example of a functioning WDM policy is in the capital Windhoek.

2.12.3.2 Water Demand Management in Windhoek

Windhoek municipality has established its own WDM policy in response to the vulnerability to drought and the growing demands resulting from population growth and rural-urban migration. The policies that have been approved and implemented in Windhoek are listed in **Box 2.8**:

Box 2.8. The Main Facets of Windhoeks Water Demand Management Policy.

Windhoek's integrated WDM policy falls into 4 main categories.

1. Policy

- Maximum Re-use of water:
  - Semi-purified effluent is used for irrigation of sports fields, this has replaced 1.1Mm^3/a of potable water demand.
  - The Goreangab reclamation works can provide up to 3.65Mm^3/a of potable water. This is to be upgraded to 7.5Mm^3/a.
  - Grey water re-use is encouraged in private premises.
- Plot sizes for new residential developments have been reduced. Evidence suggests that household consumption of water is strongly correlated to plot size.
- Guidelines have been developed to efficiently supply water to the growing urban population.
- Municipal water use, for public gardens and the like has been reduced by 50%.
- Wet Industries:
  - Guidelines are given to wet industries on a continuous basis for the efficient use of water.
  - New wet industries will have to implement plans to re-use water.

2. Legislation

- Water Efficient Equipment: From 16 December 1996 the following measures are compulsory:
  - Metering taps must be used in all hostels.
  - Taps outside non-residential buildings must be self closing or lockable.
  - Toilet cisterns must be 6/3/ litre dual flush units.
  - Automatic flushing devices are prohibited.
  - Retrofitting of inefficient devices must occur within 3 years.
- Groundwater:
  - Abstraction from private boreholes is to be monitored and groundwater levels to be controlled.
- Gardens:
  - Watering may not be done between the hours of 10.00 and 16.00, i.e. times of high evaporation.
- Swimming Pools:
  - Swimming pools must be covered when not in use.
- Prevention of Pollution.
  - Regular testing of underground fuel tanks is mandatory. All tanks are registered.

3. Technical Measures

- Lowering of Unaccounted for Water:
- Efficient Ways of Watering Gardens.
- Artificial Recharge of the Windhoek Aquifer.
- Rainwater Harvesting.

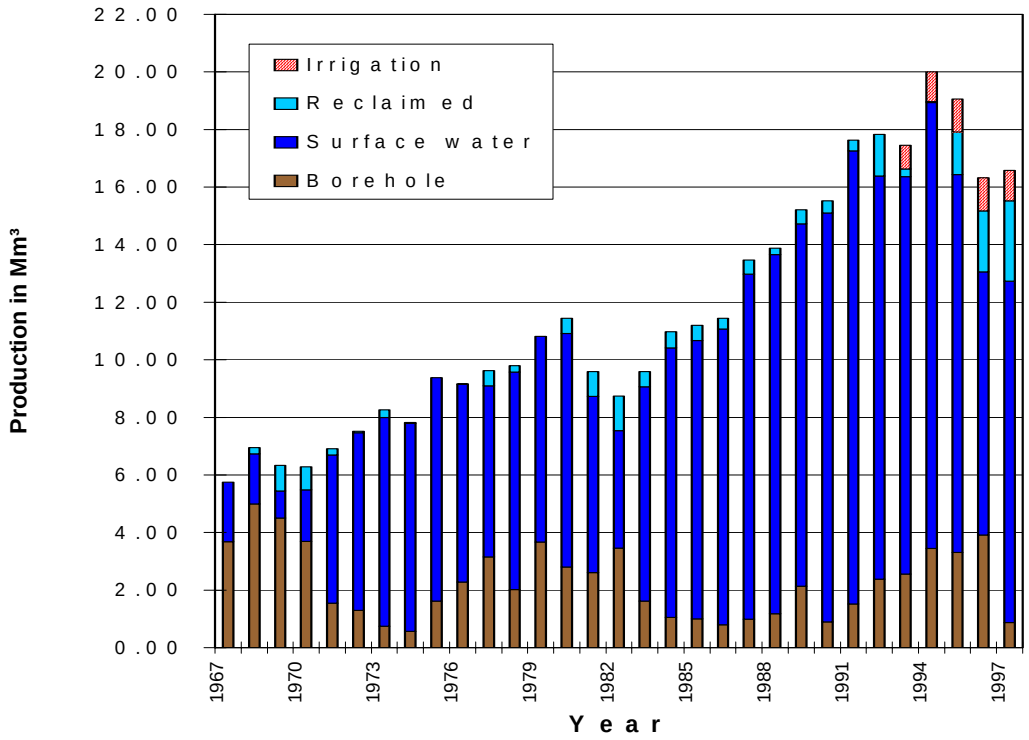
4. Public Campaigns and Awareness

- Lectures in schools and other institutions of learning on the subject of water management.
- Radio and television appearances.
- Advertisement in the local Media.
- Pamphlets on water saving ideas both inside and outside the house distributed with bills.
- Advice on all water related issues including reduction of water losses and pressure reduction.
- Information on how to detect leaks in premises is supplied.
- Advice on Efficient Gardening Methods.
- Community Empowerment in formerly neglected areas.

- A programme to train community based plumbers was initiated for proper maintenance of water installations on private residential plots.
- Training of gardeners was identified as an important task, which should still be addressed.

It is the combination of these measures, implemented in an integrated manner that has achieved considerable success in dampening down demands for water from conventional sources. Indeed as one can see from **Figure 2.3**, the level of water consumption from conventional sources (surface and borehole) in Windhoek was the same in 1997 as in 1987, despite the population nearly doubling.

Figure 2.3: Water Production in Windhoek from Different Sources Including Irrigation



The success of the WDM strategy in Windhoek could easily be replicated in other urban centres of Namibia. The IUCN WDM Namibia Country Study also isolated both current good practice cases and the potential for efficiency improvements in other sectors such as mining, agriculture, tourism and light industry.

Water demand management represents a wide range of inter-linking policies intended to reduce the amount of water people use in obtaining the services they require from water. It is useful however to compare the unit costs of these policies to the other water supply techniques.

The water demand management programs of the municipality of Windhoek are financed by a levy on the income from water. At present this levy represents less than 1% of the total income from water, and is the equivalent of 4.2cents/m^3. Estimates of the amount of water that are saved as a result of WDM are given in **Table 2.22**

Table 2.22. Predicted Water Demand in Windhoek, With and Without WDM.

Water Consumption	**1995**	**2000**	**2005**	**2010**	**2015**
No WDM (Mm^3/a)	21.1	26.7	34.6	44.4	57.1
WDM (Mm^3/a)	17.9	20.7	24.1	27.9	32.3
Savings (Mm^3/a)	**3.2**	**6**	**10.5**	**16.5**	**24.8**

Given that the savings shown for 1995, 3.2Mm^3, have been achieved at a cost of 4.2c/m^3 for total consumption, the total cost of these savings is N$750,000. The unit cost of this saving is approximately 24c/m^3. Indeed if the prediction shown in Table 2.22 is correct the Average Incremental Cost of this strategy is 11c/m^3 [56]. This compares favourably to other supply options and the NamWater cost

[56] This includes the investments in the recycling plant at Goreangab, but excludes any cost savings that

recovery tariff for Windhoek of N$3.17/$m^3$. Calculations for the 1997/8 period suggest that the AIC for WDM could be in the region of 4.3c/m^3 (Ben van der Merwe, pers comm)

The long-run capability of WDM strategies to ensure water services to the growing demands in Windhoek is questionable. What is likely however is that the combination of WDM and the eventual supply augmentation that will be necessary, if current demands continue to rise, will be a more efficient water supply investment than supply augmentation alone.

2.12.3.3 Conclusion

The advantages of WDM and the effectiveness of the Windhoek policy in reducing water consumption is clear. The reductions in demand in Windhoek affected the revenue sufficiency of the municipality's tariff system. Losses were made as a result of the reduced sales in water. This highlights the need for greater awareness of the price elasticity of demand for water in the urban centres of Namibia, before WDM is implemented.

The issue of optimal pricing is intrinsically linked to WDM. The issue of optimal timing of investments in water supply is also linked since the changing growth in demand as a result of proper pricing of water and other WDM strategies will be crucial to the planning of and economic feasibility of future investments.

There are further implications for the bulk water supplier which need investigation. I.e. to what extent will WDM affect the revenue sufficiency of NamWater and local authorities? Economics would suggest that revenues will increase should the response to price be inelastic, and vice versa, highlighting the need for careful investigation of the shape of consumer demand.

In sum, there are many efficiency advantages associated with WDM not least of which is the improvement in economic efficiency that will be associated with full cost recovery volumetric pricing.

---

are made from the reduced level of consumption. It also excludes the reduction in the unit cost of water as a result of the delays in the need for supply augmentation. The unit cost is calculated assuming that the cost of WDM is 4.2c/m^3 for total consumption occurring each year. It has been stated that the reduction in water consumption could be an underestimate. Ben van der Merwe pers comm.

2.13 SUSTAINABILITY

The term sustainability is a widely used and yet little understood term. Different disciplines have different and occasionally inconsistent definitions for the term, and as such confusion often abounds. Sustainability in geo-hydrological terms may imply using water from a groundwater resource in amounts equal to the recharge of the aquifer. In ecological terms sustainability may make reference to a stable ecological system such as that found in the tropical rainforests before the intervention of man, or the bacteriological contents of a sewage pipe. In this sense not using groundwater could be considered sustainable. Both definitions refer to the continuity of a system through time without making reference to the desirability of the scenarios they describe as "sustainable" from the context of economic development and social welfare.

2.13.1 Sustainable Economic Development

Within the economics literature there are several variations on the definition of sustainability, which are essentially based on the notion of "sustainable economic development". Sustainable economic development refers to a pattern of economic activity that maintains societal welfare over time. More precisely the economic definitions of sustainable development refer to ensuring that societal welfare is non-decreasing over time, and preferably increasing, hence development. Implicit in this definition is the notion of inter-generational equity such that no future generation over the planning horizon should be any less well off than the current generation. For example a development path that involved a higher welfare for today's generation at the expense of the next would not be considered a sustainable path of development.

The most widely used definition of sustainable development is that contained in the World Commission on Environment and Development report of 1987 (also known as the Brundtland Commission):

"Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED 1987, p3)

The measurement of sustainable development also has a wide literature. Economists often translate "needs" in the statement above to mean some measurement of societal welfare. Measurements of societal welfare are often difficult to attain and are often controversial and as a result popular thought has focussed on the source of societal welfare, i.e. the wealth of a nation, which in turn is interpreted as the capital base.

2.13.1.1 The Capital Base

The capital base drives the welfare of a nation. The stream of benefits to society that flow from the capital base is dependent upon the productivity of capital. Capital is often thought of as machinery, and investment funds however the capital base is diverse, containing several different components. The Wealth of a nation, and hence the capital base, can be divided into different classifications:

- **Man-made Capital**: machines, buildings, etc
- **Natural Capital**: environmental resources of a renewable and non-renewable nature such as forests, fisheries, wildlife, biodiversity, minerals and water.
- **Human Capital**: skills, knowledge and stocks of information.
- **Social Capital**: Cultural diversity, social networks, family systems etc.

Since all of these categories provide an economy with a stream of benefits it has been argued that sustainable economic development can be achieved through the maintenance of a capital base made up of all these components. Clearly quantity and quality of capital are considerations here.

Water is clearly part of the overall capital base. It is easy to see that a stream of economic, social and environmental benefits is derived from the use and existence of water resources and as such the

maintenance of these benefits over time raises distinct questions about the sustainable use of water resources in Namibia. At first glance an obvious conclusion that one could draw would be that the maintenance of all water resources in the current quantities and qualities would constitute a strategy consistent with overall sustainable economic development. However, this conclusion would ignore several crucial issues, namely:

- the ability to substitute other inputs for water
- the notion of water as 'critical capital'.

2.13.1.2 Substitutability

The definition of sustainable economic development has focussed thus far on maintaining a constant overall capital stock. This implies that a degree of substitution between different components of the capital base can occur without contravening this measure of sustainable development. For example, an increase in man-made capital may compensate a reduction in natural capital, thus maintaining the overall capital stock.

The extent to which one type of capital is substitutable for another, and particularly the substitution of man-made capital for natural capital, has been the focus of much discussion in the realm of environmental and ecological economics. There are two extremes of this debate: those who state that natural capital can be replaced by man-made capital and those who state that this can never happen if sustainable economic development is desired. The two schools have been labelled 'weak' and 'strong' sustainability respectively. Those who promote strong sustainability state that environmental resources can only be consumed in quantities less than or equal to their replenishment rate. This precludes the usage of non-renewable resources such as oil and fossil water for example.

The sensible compromise lies somewhere in between and suggests that some elements of natural capital can be substituted and others cannot. For example, if a stock of fossil water exists, strong sustainability would suggest that this water could never be used. Any usage would mean a decrease in natural capital. It is clear that in many cases this could be an overly restrictive policy, stifling economic growth and imposing high costs on society for alternative water resources. However, in certain cases, where there are strong environmental/ecological linkages to the stock of groundwater, the mining of groundwater could cause the cessation of vital primary ecological functions. To use the jargon, in certain places groundwater, or other types of natural capital could be regarded as 'critical capital'.

2.13.1.3 Critical Capital

It has been suggested by some (e.g. Dasgupta and Maler 1997) that certain types of natural capital can be described as critical capital because their existence is critical to human life and the functions they perform are irreplaceable. A decrease in critical capital cannot be compensated by increases in other sections of the capital base and any reduction in critical capital would be therefore deemed unsustainable.

Numerous examples of critical capital have been cited (Pearce. 1993). The ozone layer is one example, due to the potentially catastrophic consequences of further depletion. Similarly the carbon cycle is often considered critical capital due to the threat of global warming. Biological diversity can also be considered as being critical capital since it is widely thought that its loss would threaten primary life support functions of ecosystems. Since humans depend upon the secondary values that these ecosystems provide; clean air, climate control, food, timber recreation etc. bio-diversity would seem to count as critical capital.

Classifying certain types of natural capital as "critical" may also arise due to uncertainty about the function of the capital in, for example, the ecology of a country or region. Similarly the extent to which degradation of capital may be irreversible will to some extent provide a rationale for treating certain types of capital as critical. Ultimately there is an implicit cost-benefit analysis involved in determining critical capital; if the costs of depletion are known to be high, or are thought to be high and degradation is irreversible, then the natural capital in question could be thought of as critical.

It is easy to talk about water being critical capital as a result of being crucial for the survival of human beings also (Dubourg 1998). This can also serve as a rationale for non-depletion of water resources.

2.13.1.4 Water as Critical Capital or Substitutable?

When we think about the consequences of sustainable economic development, as defined above, for the management of water resources, a pragmatic approach is required. Particularly when thinking about groundwater management, it is essential that the extent to which specific reserves of groundwater can be considered 'critical' is established before decisions are made concerning usage regimes. Ultimately both economic and ecological objectives need to be evaluated.

There are several arguments suggesting that water can be defined as critical capital. Dubourg (1998) states that water should be defined as critical capital as a result of its consumption being critical for human existence. This is slightly different from the rationale of Dasgupta and Maler (1997) who base their notion of critical capital on the critical environmental/ecological functions that water performs *in situ*. These two approaches seem to contradict one another when we consider stock of fossil ground water. It seems that groundwater could be critical both *in situ* and in consumption. Again a pragmatic approach is necessary weighing up the costs and benefits of abstraction or non-abstraction.

Such an approach, however, implies that natural capital can indeed be substitutable and that the benefits of water consumption can outweigh the costs of loss of environmental capital (associated ecosystems and water). However, consuming the water will not ensure sustainable economic development in terms of our constant capital rule. If non-renewable (or renewable) resources are to be mined, the capital base needs to be increased elsewhere such that once the resource is exhausted future generations are faced with the same overall capital base. Essentially the water component of the initial capital base needs to be converted into some other component of capital.

Hartwick (1979) has proven that under certain conditions investment of 'rents', or 'water profit' (Schiffler 1998) derived from the mining of a non-renewable resource satisfies the constant capital rule for sustainable economic development. Rent can be thought of as the difference between the marginal price received for the resource and the marginal cost of provision, or the difference between the marginal benefit and the marginal cost of the resource. Rent is clearly a context specific concept when it comes to water, and for a given source, will be entirely dependent on the uses to which water is put.

However, in practical terms it may be reasonable to suggest that for sustainable economic development to be achieved, in places where non-renewable fossil groundwater is being mined, some provision should be made to sustain water supply after the depletion of the resource[57].

2.13.2 Sustainable Development in Namibia

2.13.2.1 Policies and Legislation for Sustainability in the Water Sector

There are many components of Namibia's natural capital which are crucial for development and hence for which 'sustainability' is a crucial issue. With respect to water there are only a few references to the sustainable use of water, and none recognize specifically the potential for the substitution of other components of the capital base for water. Sustainability of water use is mentioned in:

- The Water and Sanitation Policy of 1993.
- The NamWater Act of 1997
- The Constitution of Namibia 1990

The mission statement of the Directorate of Resource Management also contains reference to the issue of sustainable usage of water resources.

[57] This brings to light another substitutability issue i.e. should the water sector be sustained from the rents from water resource depletion, or should compensation occur in other sectors. Again this is a critical capital/critical sector issue.

2.13.2.2 Groundwater in Namibia

As we seen from section 2.3.1, on average 60% of Namibia's current water consumption comes from groundwater, whilst groundwater is estimated to hold much of Namibia's potential water supply in the future. There are certain other characteristics that make it important to focus on groundwater as a water source from the point of view of sustainability. These factors include:

- the irreversibility associated with over use (aquifer collapse, salination, etc)

- the dependence of rural communities on groundwater

- the increasing costs of deeper water levels

Over use of groundwater could lead to the termination of an aquifer as a water resource. The collapse of aquifers is commonplace where abstraction causes the drawdown of the aquifer levels. Similarly abstraction will inevitably lead to some alteration in the groundwater flows, potentially leading to the presence of saline water which is unsuitable for either human or livestock consumption. Such a deterioration of quality, combined with the increased costs of pumping can lead to situations where it becomes uneconomical for groundwater to be used further, hence the supply of water from a source is not sustainable in the hydrological sense.

In Namibia there are several examples of these occurances. In Oranjemund the prospect of groundwater becoming saline is a very real concern. Abstraction is in the order of 6Mm3/a for domestic consumption, whilst the residents are not charged for water consumption directly. Such a practice could be regarded as unsustainable.

At the coast the Kuiseb and associated aquifers have a substantial overdraft. Abstraction has exceeded the recharge for the past few years, intensifying the need for desalination to secure water for the coastal area. Water levels in the Stampriet artesian aquifer are reported to have dropped over the past few years. In places formerly artesian water has become 'sub-artesian', as water pressures have dropped. In hydrological terms such an occurrence could indicate over use. (Further examples of decreasing water levels can be seen in the Strategic Water Resources theme paper). In economic terms, the natural capital base is being diminished and hence Namibia's ability to generate welfare for future generations.

57% of the rural water consumption is supplied by groundwater. Boreholes supply by far the majority of the country's rural areas. In a sparsely populated country boreholes provide an appropriate technology for isolated communities, precluding the need for transporting water over long distances. It is clear that the sustainable usage of groundwater is imperative for maintaining development in rural areas, improving food security, and is one factor in alleviating poverty.

These examples provide some insight into the current situation regarding the sustainable usage of water resources in Namibia. These outcomes must be seen in light of the current situation on Namibia's water supply institutions as described in section 2.3.2, and the legislative shortcomings described in the legal theme report.

3. Key Issues

The Key Issues that have arisen from the discussion in Chapter 2 have been broken down into 3 broad categories: Efficiency, Equity and Sustainability.

3.1.1 EFFICIENCY

Economic efficiency can be thought of as having components:

- Productive Efficiency
- Allocative Efficiency

In turn efficiency can be thought of statically and dynamically where dynamic efficiency requires incentives for innovation and efficiency improvements over time. The production of water is the responsibility of the various supply institutions mentioned in section 2.3.2 and productive efficiency refers to ensuring water is supplied at the lowest cost[58]. The efficiency with which water is supplied is dependent upon the incentives presented to each individual agency and the manner in which the institutions interact.

Efficient allocation of water between uses in order to promote the maximum economic contribution to GDP is largely a matter of pricing water properly and ensuring the general compatibility of water related and sectoral policies. Efficient pricing will give correct signals to supply institutions with regard to the need for and viability of future investments whilst giving the correct signals to consumers of water about their consumption decisions and the viability of water saving devices. It is clear, therefore, that productive and allocative efficiency are inter-linked since the correct allocation of water will provide information regarding the correct investment in the production/supply of water which in turn will determine the efficient price for water.

In certain cases water will need to be allocated between competing uses within a river basin, region or country. Pricing on the basis of supply costs will not always allow water to be used in the highest value uses. Where prior rights to water use exist, more productive uses may be 'crowded out'. In such cases the transferability of water use rights, in water markets, through tradable water permits or similar market mechanisms can be a useful and effective manner in which to take account of opportunity costs and therefore help to ensure allocative efficiency. This brings to light the question of transferability of water resources. In this regard the following **Key Issues** arise from the analysis in section 2.

3.1.1 Institutions/Institutional Arrangements

The price of water to consumers is dependent in part upon the costs of production. Therefore, provision of water at the lowest cost is important in order to maintain the supply of affordable water and ensure economically efficient water consumption. Productive efficiency within the water supply institutions; NamWater, Local Authorities and the Department of Water Affairs is critical therefore.

3.1.1.1 NamWater

KEY ISSUE: Efficiency in NamWater

NamWater is currently a non-profit organisation. The control of profits could in theory act as a regulatory mechanism guarding against its exploitation of the natural monopoly position that NamWater holds. However, the lack of profit motive removes many of the incentives within the corporation for improving technical efficiency and reducing the overall costs of water provision. The shareholder is the government, whose objectives are not necessarily the improved efficiency of the company, but are perhaps largely political. Although NamWater has a variety of internal incentive mechanisms for efficiency improvements, and benchmark performance indicators, the lack of profit motive reduces the overall incentive for static and dynamic productive efficiency.

[58] Productive efficiency is assumed to consider 'X' efficiency here, i.e. the use of the lowest cost technology.

3.1.1.2 Local Authorities (Municipalities, Town Councils and Village Councils)

KEY ISSUE: Efficiency in Local Authorities

The incentives that exist for local authorities to supply water in a productively efficient manner are questionable. There are several manifestations of inefficient behaviour in local authorities (Van der Merwe 1999). There are financial implications for the LA's of the inefficiencies presented here. These invariably translate into economic inefficiencies where there are no incentives to improve service provision over time and where the consumers loseout.

Non payment for services provided

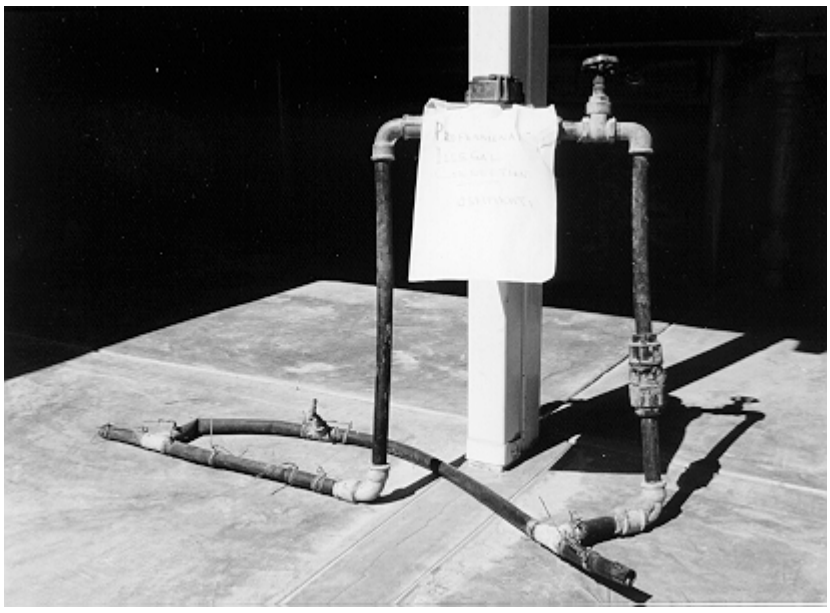
Continued non-payment for services rendered is a major constraint on the long term financial sustainability of the sector. There appear to be two interrelated components to non-payment. Firstly customer willingness to pay and secondly ability and willingness of service providers to enforce payment.

The ability of service providers to enforce payment is directly related to the strength and quality of their management systems and the relative autonomy of the organisation. Traditionally those towns and villages which have not been responsible for the payment of e.g. NamWater bills have had less incentive to collect revenues. Furthermore the existence of soft-budget constraints in many of the local authorities has reduced the incentive for collection of revenues, and subsequently the payment of bills.

Unaccounted for Water

In addition to the problems of non-payment, service providers in some areas experience relatively high revenue losses as a result of unaccounted for water. These losses appear to be caused by a combination of factors including leakages, illegal connections, (see **Picture 1,** note NamWater have resolved their problem in this respect by registering a number of illegal connections as individual customers), lack of, or faulty metering equipment and inadequate billing systems.

Picture 3.1. Illegal Connection in Oshakati



Inadequate financial management and financial control systems

Accounting records maintained at both central and local government level do not facilitate the accurate recording of all water related expenditure, even for operational and maintenance costs, thus inappropriate tariffs are charged. Billing systems are outdated and do not provide meaningful management information and often water and electricity charges are combined in a single bill making the accurate recording of water revenue complicated. Furthermore, if accurate records are not

maintained, income from water sales may be consciously or unconsciously used to subsidise other activities, to the ultimate detriment of the water supply system.

These inefficiencies are not prevalent in all local authorities however, they do represent the general case for many towns. It is clear that revenue sufficiency is threatened by these factors. The efficiency of the service provided by the LA's is questionable. In some places water is one of the main revenue earners, in others the price of water does not reflect the cost of water. In both cases the level of water consumption could be uneconomic whilst where water is overcharged consumers lose out.

3.1.1.3 Department of Water Affairs

KEY ISSUE: Efficiency in Government

The efficiency of water resources management in Namibia was the motivation behind the review process. The following are examples of where inefficiencies may lie. Again there are financial and economic consequences.

Inefficient management practices

Since Independence there have been a number of initiatives which were designed to improve sectoral co-ordination such as WASCO and the National Water and Sanitation Forum (for rural water supply and sanitation). The institutional shortcomings of these organisations are discussed in the theme report on institutions and participation. Although the financial implications of poor co-ordination, duplication of activities and poor service delivery cannot be readily quantified, they do adversely affect long term sustainability. Similarly, there are instances whereby poor communication and co-ordination of activities on an inter-departmental and inter-ministerial basis result in e.g. a number of data collection/field visits to the same location by different staff. Government accounting systems do not facilitate the quantification of the cost implications, but it is obvious that there is scope for improved resource utilisation and potential cost savings.

Regulation

The DWA is slowly coming to terms with its new role of bulk water supply regulator. However, there are no clear strategies towards ensuring the least cost supply of water by NamWater, that reasonable prices are charged and the quality of the service is maintained at an acceptable level. An *ad hoc* approach is the general case.

Water Permits

Fees for water permits are only levied on the Orange River and a few other water users. The economic rents derived from the use of the government's resources accrue to the users only. The collection of fees for the issuing of water permits is divorced from the Law Administration Division, which issues the permits. This can lead to a general non-payment for permits. A recent directive by the Ministry of Finance has stipulated that some level of cost recovery for government services should be encouraged in all ministries. However, where the fees are non-existent or their collection is divorced from the division providing the service, the incentives for revenue collection are reduced, and the potential for improved financing of government services is lost.

Unnecessary Intermediaries

In supplying to irrigators at Hardap Dam, payment to NamWater by the farmers must go through the DARD, MAWRD. It appears that this is an unnecessary institutional arrangement, which exists purely to facilitate the subsidisation of water to irrigators at Hardap. Similar situations occur elsewhere in Namibia, e.g. Naute Dam and Etunda.

3.1.1.4 Community Based Management

KEY ISSUE: The Efficiency of CBM in Rural Water Supply

The sustainability of the CBM strategy and the full cost recovery basis upon which water points are eventually to be operated under CBM is open to analysis. Whether this strategy is the most efficient strategy to maintain access to water in rural areas is unknown.

The extent to which the water point committees will be able to levy charges will depend upon their authority, capacity and legal backing. In particular their ability to resist the opposition from 'outsiders' to the concept of cost recovery in general and the introduction of progressive fees in particular. Part of the decentralisation process also involves empowering regional councils to raise revenue locally. Regional councils may consider the imposition of e.g. royalties on water and this could seriously undermine the CBM initiative.

3.1.1.5 Regulation

KEY ISSUE: Regulation of Water Sector

The current water supply institutions are not regulated in a distinct and coherent manner. The quality of service, the level of efficiency, the environmental integrity and the price of water are all factors that should be monitored closely. Currently it is possible that tariffs for water are economically inefficient given the potential for improved incentives for efficiency within the supply institutions. The consumer could be losing out as a result.

Given the social role of water it is clear that there is a role for government or some independent agency for regulating the current or future water supply institutions. There is general agreement with the need for an independent regulator for water (and potentially other utilities).

The **Key Issue** for the financial and economic theme becomes more a question of finding the most appropriate regulatory mechanism for the different sections of the water sector.

3.1.2 Pricing of Water

Getting the price right for water is one of the most crucial facets of creating an enabling environment for the water sector. The price of water is one of the key instruments available to the policy maker to promote the efficient allocation of resources both within and between uses, i.e. allocative efficiency. From the financial perspective pricing is key to recovering costs of supply and hence being financially sustainable. In the absence of a distinct tariff policy there are several issues that arise in each of the water institutions that charge for the use of water.

3.1.2.1 NamWater

KEY ISSUE: The Determination of the NamWater Tariff

The tariff policy of NamWater is subject to some debate. The questions that arise when addressing this Key Issue can be separated into two distinct categories: Financial and Economic.

The important financial issues for pricing are:

- How should historical costs, i.e. depreciation be valued?
- How are current capital, operations and maintenance costs controlled?
- How are overheads to be controlled in NamWater?

The important economic issues include:

- Should the current water tariff include historical costs?
- Should the future costs of capital to be included in the water tariff? I.e. LRMC. If so how?
- To what extent should environmental costs be a factor in the water tariff?
- How is the NamWater tariff to be regulated?
- Should political desires influence corporate decisions on tariffs etc?
    - The important economic issues also include considerations of opportunity cost, the impact of tariffs on the poorest segments of the population, willingness/ability to pay.

3.1.2.2 Local Authorities

KEY ISSUE: Pricing and accounting of water in LA's

The pricing is "sub-optimal" in many local authorities for the following reasons:

- non maintenance of separate water accounts;
- lack of detailed information on costs and infrastructure involved;
- for municipalities where more detailed water accounts are maintained, there is a tendency to concentrate on balancing the entire budget, if revenues do not equal expenditure, further tariff increases are applied across all municipal services;
- tariffs are often based on the recovery of only operational and maintenance costs and include no provision for future replacement;
- tariff increases announced by municipalities and towns do not always reflect inflation levels and furthermore increases based on inflation levels are often an inaccurate reflection of the true rise in the cost of service provision, particularly when electricity costs which can form a major part of water supply costs rise faster than inflation;
- tariffs in towns subsidised by MRLGH are not scheme specific. (and are generally 10 - 15% above the NamWater charge in each town - implying inefficiency).
- There is a political dimension to the setting of water tariffs in LA's.

There is clear scope for a review of the tariff setting and accounting procedure in the local authorities. Again the issue of LRMC pricing, profit making and political acceptability are crucial issues to address in addressing the tariff setting procedure of local authorities.

Often the local authorities are the last supply institution before the end user. For efficient allocations of water to be achieved requires that the pricing of water at this stage reflects the full economic costs.

3.1.2.3 Irrigation

KEY ISSUE: Water is subsidised for irrigation

There are two main issues which have arisen from the discussion of pricing and irrigation:

- Irrigation water is still subsidised in many area's (Hardap and Naute Dam, the Etunda scheme)

- Where water is charged from the perennial rivers it is done so on a per hectare basis which does not provide incentives to use water efficiently.

There is little justification for the subsidisation of water to agriculture. In the same vein, there is little economic justification for the subsidisation of water to commercial agriculture. Such practices distort the input mix, encourage overuse of water and can divert water from potentially higher value uses.

3.1.2.4 Transparency

KEY ISSUE: Transparency in tariff setting

The issues of transparency and consultation have been largely addressed in the institutional theme report. However, given the importance of consultation and transparency and the link to customer's willingness to pay, these issues are worth repeating here. These issues are also linked to the institutional issues noted above as well as the pricing issues. The main points of note include:

- confusion over payment responsibilities - councils/ MRLGH/government institutions
- public misunderstanding re NamWater commercial/business/profit
- confusion over the methodology behind the way in which tariffs are set (NamWater, LA's)
- concern over uniform irrigation charge (rather than scheme specific)

In light of the recent antipathy towards water supply institutions that has been observed in Rehoboth and some of the coastal areas, the transparency of tariff setting and operational objectives seems to be of paramount importance.

3.1.3 Allocation of Water

In order to obtain the maximum economic production from the limited water resources available requires some acknowledgement of the productivity of water in different economic sectors, and within different parts of particular sectors. Furthermore, mechanisms need to be introduced in order to allow water to be re-allocated from low to high value uses.

3.1.3.1 Value Added and Water

KEY ISSUE: Maximizing the economic productivity of water

The evidence in section 2.2.3 shows clearly the comparative productivity of water in the different sectors of the economy and as a result suggests an order of preference for the competing uses of water in Namibia. However, all economic activities are not possible in all locations and as such only low value uses for water may be available, e.g. irrigation on the Orange River. In such cases, it is imperative that competition for water is facilitated and that the opportunity costs of water are brought to bear on low value uses.

3.1.3.2 Property Rights

KEY ISSUE: Property Rights to water

Currently the government is the prime owner of water resources in Namibia. This is stipulated in article 100 of the constitution. The government conveys user rights to the population by issuing permits. Permits exist for the perennial rivers, the ephemeral rivers and the groundwater control zones. Only along the Orange River are irrigation permits charged for. Groundwater abstraction permits are free, with few exceptions. There are also many areas where water use is not controlled since not all of Namibia is a groundwater control zone.

In essence much of Namibia's water resources are 'open access', i.e. there are no distinct enforced rights to the water resources and over use and depletion can result from such property rights regimes. This is particularly the case for groundwater aquifers.

3.1.3.3 Transferability of Water

KEY ISSUE: Transferability of Water

The allocation of water to higher value uses, and hence the value of water is dependent in part upon the transferability of water resources. For example, at present it is felt that water in Hardap Dam has no other use than for irrigation and the supply of Mariental town. However, were this water, a potential of nearly 50Mm^3/a, were usable in Windhoek the opportunity cost of using this water in irrigation would be much higher. The issue of transferability is of great importance for the allocation of water resources.

3.1.4 Sectoral Economic Policy

In most sectors, development policy has been based upon Namibia's comparative advantage, sustainable usage of the natural resources that contribute to Namibia's GDP and adherence to an open trade policy.

In encouraging SME's and the development of infant industries, industrial policy has created tax and other incentives for new businesses and industries. Furthermore the EPZ scheme has aimed to encourage the production of goods for export. It is encouraging to note that the incentives given to infant industries, SME's etc do not include subsidisation of water, and indeed NDP 1 states that specific consideration be given to the effect on local water supply when siting new industries such that 'wet' industries should be discouraged. It is likely that if these policies are successful water demand in urban centres will grow.

The main point of interest is agricultural sector policy and water policies concerning irrigation.

3.1.4.1. Agricultural Policy

KEY ISSUE: Agricultural Policy incompatible with water use goals

The issues that have arisen in the agricultural policy have been:

- The protection of Namibian maize and wheat growers may encourage the use of water in low value crop irrigation whilst potentially exacerbating poverty

- There is still an affinity for the idea of national food self-sufficiency which is clearly an uneconomical and unsustainable use of water resources

- Subsidies to agricultural inputs (particularly in irrigation) other than water are significant and may be encouraging the use of water in low value uses

- A special subsidy for water to irrigation appears in the WASP contrary to economic theory and to the detriment of policies attempting to improve the efficiency of water usage in Namibia.

Since agriculture is the lowest value and yet largest user of water in Namibia it is clear that the potential for saving water and re-allocating water to higher value uses could be high. This is particularly so in the irrigation sector.

Elements of the current National Agricultural Policy and current practice in the crop growing sector are not compatible with the goals of NDP 1: job creation, poverty alleviation and income generation. Neither is current practice necessarily compatible with the goals of water resource management.

3.1.5 Future Water Supply and Water Demand Management

3.1.5.1 Supply Augmentation

KEY ISSUE: Supply augmentation is economically, politically and environmentally costly and alternatives exist

There are several Key issues that arise from the discussion in section 2.4 about the potential future water supply in Namibia:

- Future conventional supply augmentation for the central areas of Namibia is expensive
- There are likely to be considerable transboundary externalities from the exploitation of the perennial rivers
- The economic costs (including externalities) of the different supply options are not currently available
- The demand for water, and hence the benefits of water supply augmentation have not been measured and as such the economic viability of supply augmentation is unknown
- In the absence of knowledge of the shape and growth of demand for water (in the face of economic pricing for water) the efficient choice of investment is unknown
- In the absence of distinct knowledge of the shape and growth of demand for water in Namibia, and particularly the central areas, the economically efficient timing of future investments is unknown

The economically efficient timing of investments in water supply requires detailed knowledge of the potential investments and the growth and strength of demand in the face of long run marginal costs. The effect of Water Demand Management and the efficiency improvements that such investments and policies can evoke are crucial factors in determining the most efficient stream of investments in water supply. Integrated planning is clearly required.

3.1.5.2 Water Demand Management and Conservation

KEY ISSUE: Water Demand Management

WDM should be considered in the full array of potential investments in maintaining water supply. The emphasis on WDM as a viable, environmentally friendly, economically efficient practice needs to be increased in Namibia. The principles of this approach need to be imparted to all the participants in the water sector: NamWater, Local Authorities, irrigators, water consumers etc. Specifically:

- The full effect of economic pricing and moral suasion on water demand needs to be established

- There is considerable room for improved efficiency of water usage in Namibia in residential, agricultural and industrial sectors

- A national Policy for Water Demand Management is absent at present

3.2 EQUITY

The equity issues that emerge from section 2 focus on willingness and ability to pay, mechanisms to assist access to water, and the poverty dimension of water supply.

3.2.1 Willingness and Ability to Pay

Ability to pay for water is a potential problem at present in urban and rural areas. The analysis of section 2.3.5 shows that many communities may not be able to afford to pay the full cost of water in rural areas when compared to some benchmark percentage of incomes. The same is true in certain urban areas.

The willingness to pay for water supply has not been strictly established in rural and urban areas and may bear only minimal resemblance to the benchmark percentage of income measurement. Willingness to pay for water is affected by income, attitudes, ownership, perceived benefits of water supply, perception of water supply institution, transparency, consultation etc. The issues specific to urban and rural areas are discussed below.

3.2.1.1 Rural Water

KEY ISSUE: Willingness and Ability to pay and access to water in RURAL communities

Most of Namibia's poor are in rural areas. The ability of rural communities to cover the costs of water supply will depend upon the extent to which funds can be collected from the community and the poorer members of the community can be assisted. Access to water will ultimately be determined by the success of the management strategy. In rural areas the following points are of interest:

- communities may not be able to support the full cost recovery of the water points proposed by the CBM policy

- the ability (and willingness) of communities to cross subsidise the poorest members of their community is unknown in practice

- There are questions as to the suitability of the CBM strategy in areas where the populous is nomadic/semi-nomadic and/or where population densities are low

- Evidence suggests that certain rich communal farmers are still being subsidised by the government though water.

3.2.1.2 Urban Water

KEY ISSUE: Willingness and Ability to pay and access to water in URBAN areas

In urban areas the access to minimum levels of water consumption can be influenced by the tariff system employed. In the **urban areas** the issues are:

- to what extent should water tariffs be cross subsidised

- What is the most effective tariff structure to allow the poor access to minimum levels of water consumption

- To what extent should water tariffs, particularly increasing block tariffs be used as a means of redistributing income

General experience in Namibia suggests that willingness to pay, not ability, is more of an issue in urban rather than in rural areas. Non-payment of water accounts has been a feature of many local authorities. Some of the factors that have influenced this have been:

- The regularity of bills
- The transparency of the tariff setting process
- Perception of water as an economic good

3.2.2 Water and poverty alleviation

KEY ISSUE: Water as a constraint to poverty alleviation

The extent to which water is the key constraint to poverty alleviation is questionable. The ability of water supply to alleviate poverty, the availability of access to safe water for basis needs, and perhaps, requirements for subsistence agriculture in the poorest communities, depends upon a variety of different factors. These include:

- the benefits of reducing the time spent collecting water

- improvements in health that may occur through improved access

- the economic uses for the water; livestock, irrigation, industry etc

Water is by no means the only constraint to economic development and poverty alleviation in Namibia. Section 2.2.6 lists land quality, carrying capacity of land and weakly developed markets as examples of the other constraints to development and poverty alleviation in agriculture. Many of these constraints exist in urban areas also. For a sensible approach to decisions on investing in the supply of water in rural and urban areas, further research into the potential benefits of water supply and the other constraints to development and poverty alleviation is required.

3.3 SUSTAINABILITY

Sustainability can be looked at from a variety of different perspectives. The discussion in section 2.5 focussed largely on the economic interpretation of sustainability and the conditions required to attain sustainable economic development. This approach has been chosen in order to provide a potentially quantitative definition for sustainability and can differ from ‘sustainable resource use’. In essence all facets of the water sector fall under this definition, bringing to light the issues of substitutability, critical capital and resource accountancy for water as a resource, the water sector and other sectors of the economy.

3.3.1 Sustainable Economic Development

The issue of Sustainable Economic Development (SED) and the ‘constant capital’ rule for SED has brought to light two key issues for the water sector as a whole.

3.3.1.1 Substitutability

KEY ISSUE: Substitutability of water

The extent to which one can substitute other inputs for water is the most important issue for SED. In the past water was seen as a 'requirement' and the inputs to certain processes: industrial, domestic, agricultural, was seen as fixed. However, with the advent of improved water technologies, leakage reduction, recycling of water and other techniques, it is clear that certain capital inputs can essentially replace water.

The broad (some say 'weak') definition of SED allows some depletion of natural capital provided that renewable substitutes for these resources are developed. As such SED could be achieved without sustainable resource use.

However this analysis only considers the uses to which abstracted water can be put. It is clear that in assessing sustainable economic development the *in situ* value of water resources needs to be addressed. Where there are linkages between watercourses, groundwater and other environmental services, the sustainability of water resources becomes more intricate.

Similarly there are clearly situations where water cannot be substituted for by other resources. There are minimum levels of water required for human health, drinking, cooking etc. This use of water and the environmental/ecological role of water may not be easily replaceable. This introduces the idea of 'Critical Capital'. It also introduces the idea of 'Virtual Water' (high value uses of water).

3.3.1.2 Critical Capital

KEY ISSUE: Water as critical capital

In order to have SED it is necessary to establish when and where water can be considered as irreplaceable 'critical capital'. If the capital base is to be maintained for future generations critical capital cannot be depleted. Water is critical for human existence and for the maintenance of certain critical ecological functions.

3.3.1.3 Sustainable Development or Sustainable Resource Use?

KEY ISSUE: Sustainable resource use VS sustainable economic development

Sustainable resource use requires that water resources are not depleted. Sustainable economic development can allow depletion where renewable substitutes can be found. To achieve sustainable resource use required requires significant data inputs such as:

- Renewable water resources (groundwater recharge, potential yield of ephemeral rivers, allowable abstraction form the perennial rivers etc.)
- The current abstraction from existing water resources

In the absence of this information it will be impossible to determine whether water resources are being used sustainably[59]. Currently there are clear data gaps that have hindered sustainable resource use in Namibia, and will continue to do so if not addressed in the future.

If the objective of water resource management is to contribute to sustainable economic development the scope of required information is wider. If the constant capital rule for SED is seen as a desirable objective, its measurement will require the following information in addition to the above:

[59] This is discussed in more detail in the strategic water resources paper.

- the economic value of water uses
- the economic value of water *in situ*
- the value of substitutes for water
- where water is 'critical' capital

Only if there are monetary values for the water resources as part of the overall capital base can we make meaningful judgements about the substitution of other capital items for water, and subsequently the maintenance of the value of the overall capital base. Only then can SED as we have defined it be measured.

3.3.1.4 SUMMARY

The Key Issues for the socio-economic and financial theme are numerous. Even so there are many wider issues attached to them that have not been explicitly covered in the theme report. The Key Issues described above should be considered as the issues of immediate concern in the water sector from the socio-economic and financial perspective.

Section 4 will describe the how these issues could be addressed through the application of economic principles and management instruments. The Key Issues are summarised in Table 3.1.

Table 3.1. Key Issues for the Socio-Economic and Financial Theme

Broad Category	ISSUES	KEY ISSUES	COMMENT
EFFICIENCY	**Institutions and Institutional Arrangements**	- Efficiency in NamWater	Technical efficiency within the supply institutions is essential for affordable water supply. Expertise is necessary for suitable service provision. Coordination between institutions is required for proper financing, management and planning. Regulation is needed to ensure accountability of institutions
		- Efficiency LA's	
		- Efficiency in DWA	
		- Efficiency of CBM	
		- Regulation	
	Pricing	- The NamWater Tariff	The price of water is crucial determinant of the 'allocative' efficiency of water and for the financial sustainability of the water institutions.
		- The LA Tariffs	
		- Irrigation Tariff is subsidised	
		- Transparency in tariff setting	
	Allocation	- Maximising value added	Allocation of water to maximise the social and economic contribution of water.
		- Property rights to water	
	Sectoral Policy	- Agriculture Policy is incompatible with water use goals	Sectoral policies need to be compatible with overall water management strategies
	Future Water Supply	- Supply augmentation is costly	A balance between WDM and Supply augmentation needs to be found. Decisions on future supply augmentation require knowledge of the strength of demand and full costs.
		- Water Demand Management	
EQUITY	**Willingness and Ability to Pay**	- Willingness and ability to pay and access in RURAL communities	Ability to pay constrained by incomes. Willingness to pay is influenced by information regarding water provision, quality of service etc.
	Access to Water	- Willingness and ability to pay and access to water in URBAN areas	Inability to pay may reduce access to minimum levels of water. Pricing policies and community strategies need to account for this.
	Poverty Alleviation	- Water as a constraint to poverty alleviation	The extent to which water is the constraining factor to poverty alleviation needs to be established.

SUSTAINABILITY	**Sustainable Economic Development**	- Substitutability of water	Water is a necessary input into economic activities. Water can also be considered irreplaceable 'critical capital'. Sustainability monitoring water resources and economic development requires the efficiency principles described above. Sustainable economic development must balance these two aspects.
		- Water as Critical Capital	
		- Sustainable development of sustainable resource use?	
		- Resource accounting	

4. Options and Recommendations

The options and recommendations below focus largely on the institutional issues, in keeping with the overall thrust of the Namibia Water Resources Management Review, and the issues of pricing. Issues of Equity and Sustainability are also described here in keeping with the overall focus of this paper.

4.1 EFFICIENCY

4.1.1 Institutional Efficiency

The incentives for efficiency within the water supply institutions have been highlighted as being of paramount importance. The economic costs of water provision will be reduced if efficiency is improved meaning that full cost recovery tariffs will be reduced potentially improving the affordability of water for the consumer. **The goals** for the institutional arrangements in the water sector should include the following:

- **Skilled Management**
- **Productive Efficiency**
- **Dynamic Efficiency**
- **Accountability**
- **Financial Autonomy**

The World Bank (World Bank 1993) has highlighted some of the **conditions** for ensuring that these goals are met and the efficient provision of services arises from the institutional arrangements within the sector. These conditions include:

- **Creating Competition**:
  Within the water sector competition can encourage a reduction in costs and a dissipation of monopoly power. The contestability of the market needs to be addressed and exploited whilst competition for contracts needs to be encouraged.

- **Effective Regulation**:
  In the case of a natural monopoly the role of the government is to guard against monopoly power. More specifically high prices, quality of service, health, safety and environment should all be addressed.

- **Developing Effective Participation**:
  Water investments need to be highly responsive to the customer base. This is especially important where there are few substitutes for the good (described as a low potential for 'exit') and a lack of potential for users to express preferences (exercising 'voice').

- **Reducing Risk**:

The risks involved in the supply of services can act as a barrier to entry and by extension a reduction in potential competition. Large risks, be they commercial, political etc. may need to be balanced by returns on capital whilst operators should not be unnecessarily insulated from the commercial risks.

The current water sector institutions are addressed here in order to establish how these conditions can be created where they do not already exist. In essence: how can the water sector be more efficient, how can regulation be complementary to incentives for efficiency, and where can participation can become more effective, and what are the best roles for public and private sector?

Table 4.1 describes some of the criteria for assessing the role of the public and private sector in the provision of services. These criteria suggest that the role for Government in the Namibian water sector is justified on the basis of:

- the social qualities and potential externalities of water supply/water use
- the low contestability due to the sunk costs of the water sector
- the lack of alternative water supply sources for customers (esp in bulk sector)

In turn this implies two distinct possibilities for government involvement in the water sector:

- a role for the public sector in planning/policy making, financing and ownership

OR

- private sector ownership under public regulation.

Box 4.1. Clarifying the Rationale for Private versus Public Involvement in Infrastructure.
The first issue is to determine whether market conditions exist for each infrastructure activity, based on the following criteria:

a) *nature of the good/service* - whether jointly consumed ("public good") or privately consumed ("private good");
b) *conditions of production* - to what extent there are economies of scale creating natural monopoly; whether there are high sunk costs which would deter new suppliers (if not, the activity is said to be "contestable"); and what degree of co-ordination (e.g., of technical standards) in production is needed for efficiency.
c) *externalities and social objectives* - to what extent are there benefits and costs affecting persons other than those directly involved in the activity;
d) *characteristics of demand* - such as the degree of consumers' access to information about supply alternatives, and the existence of substitutes for particular kinds of service.

The above conditions provide the *a priori* justification for assigning to the private sector or to the public sector responsibility for various functions - including sectoral planning and policy-making, ownership, regulation, financing, execution of investment, and/or operation and maintenance (O&M) - for each infrastructure activity. The following general guidelines for policy are suggested by this analysis:

- For activities involving public or quasi-public goods, natural monopoly, or capital with high sunk costs - e.g., the provision of network, trunk-type facilities such as power transmission grids, major highways and pipelines for water and sanitation, port installations, etc. - there is a case for a public sector role in planning/policy making, financing and ownership; or alternatively, for private sector ownership under public regulation.

- The activities necessary to generate services from these facilities may best be carried out on the basis of competitive bidding for the right to operate the monopoly. The government's responsibility in this case is to issue the exclusive contract and monitor performance under its terms; to ensure that other providers of services using the network facilities face fair conditions of access (including price); and to protect users from the other possible abuses of the monopoly

- For most activities involving capital with low sunk costs (e.g., road freight transport), entry by the private sector should be fully liberalised (urban bus transport being an exception where regulation of entry can be justified); the government should mainly be responsible for ensuring fair competition.

- Additional characteristics of infrastructure activities such as externalities, social service objectives, and certain features of user demand may provide justification for public intervention through investment planning, regulation and/or fiscal transfers (taxes/subsidies) - but rarely for public ownership or direct public execution of investment of service operation.

Source: "Institutional Options for the Provision of Infrastructure", Christine Kessides, World Bank Discussion Paper No. 212, 1993

Box 4.2: Choosing Institutional Arrangements with Appropriate Assignment of Responsibilities to the Public and Private Sectors

The institutional options considered here represent a continuum from mainly public sector, to mainly private sector, responsibilities for the functions of planning/policy making, ownership, regulation, financing, investment, and O&M. These options include: (i) government department, (ii) public utility, (iii) service contracts, (iv) management contracts, (v) lease contracts (*affermages*), (vi) concessions, including BOTs[60], (vii) private entrepreneurship (i.e., with at least majority private ownership), including divestiture, and (viii) communal or "self-help" schemes, including co-operatives. Much of the prevailing attention to "privatisation" in infrastructure tends to focus on only a few of these options (notably BOTs and divestiture).

Experience with the alternative institutional arrangements in various infrastructure activities leads to the following observations regarding the potential advantages and disadvantages:

- Some improvements in management and productive efficiency can be gained from introducing commercial practices (such as by shifting activities from a government department to a corporatised parastatal) and even a modest degree of private sector participation (as in contracting-out of specific services or management of operations); these approaches are often impeded by political interference, however, so that benefits may not be sustained. Such incremental arrangements may still be useful as part of a transition to fuller private sector involvement.

- Arrangements which give the private sector producer of services full managerial autonomy and full commercial risk (e.g., lease contracts), and in addition, responsibility for both operation and investment (e.g., concessions) have the potential to produce stronger and more lasting benefits than more limited forms of private sector participation such as service contracts and management contracts.

- BOTs and complete private entrepreneurship through divestiture may, in addition, mobilise new sources of funding and further reduce government's financial risk - but this depends on the terms of the specific agreements.

- Service contracts and management contracts are arrangements which appear to have unexploited potential as part of a strategy of transition to greater privatisation. As the public and private sector gain experience with these partnerships, they can lead to progressive expansion of private sector participation through leases and concessions and, in some cases, ultimately, divestiture.

As has been described in section 3, the current situation the bulk sector in Namibia is somewhere in between these two scenarios. NamWater is owned by the Government and run on a commercial basis. NamWater undertakes much of the planning for bulk water supply whilst the DWA in effect acts as the regulator. This is a recent arrangement, which compares to the complete ownership and management of bulk water supply by the government that prevailed up to 1997.

[60] Build-Operate-Transfer

Ultimately the choices among these institutional options for the water sector should depend in large part on the weighting of the objectives described above, and/or the benefits sought from involving the private sector. However, the advantages and disadvantages of the full range of institutional options for water supply described in **Table 4.2** suggest that the current situation in the bulk water sector is a small step in the right direction for attaining these objectives. It also suggests that since Local Authorities are completely responsible for urban water supply at present there are considerable opportunities to improve the effectiveness of institutional arrangements therein. In short private sector involvement needs to be considered for LA's.

The possibility for greater private sector involvement in the water sector also raises the important issue of regulation and how this can be effected. In each of the water supply institutions highlighted in section 3 options are described and recommendations are proposed based on the assumption that the efficiency and other objectives described above are desirable and the prevailing wisdom in the arena of institutional economics.

4.1.1.1 NamWater

Several steps could be introduced to improve the incentives within NamWater to improve the efficiency they are as follows:

Competition

NamWater is currently a monopoly supplier of bulk water. A single supplier is probably the most efficient manner in which to supply bulk water on account of the large sunk costs/capital investments required. NamWater cannot exploit the full potential of its monopoly position at present since it is a non-profit organisation; it cannot price discriminate or make super normal profits. This is a form of regulation.

However, the absence of any competitors in the bulk water sector, and the absence of substitute goods for consumers could mean that NamWater may not be encouraged to reduce costs, improve dynamic efficiency to industry and provide a flexible service to its customers.

OPTIONS:

a) **Competition for the Market**: In cases where the most efficient institutional arrangement is a single natural monopoly supplier competition could be introduced for the 'right to operate' the monopoly. This implies competition for the market rather than competition within the market. Policy should be orientated towards ensuring contestability is not unnecessarily restricted i.e. that entry into the market is not restricted. The extent to which other private sector operators might find bulk water supply in Namibia attractive would need to be investigated.

b) **Competition for Contracts**: This should be encouraged where it currently does not exist. This happens to a large extent in NamWater at present and there are some good incentives for this to occur. It should also be recognised that a great deal of expertise exists in NamWater and as such contracts should not be encouraged where this expertise may become redundant and/or would be cheaper.

c) **Profit Motive**: Encouraging competition for the 'right to operate' the market will be fruitless in the absence of a reward for the competitors. At present NamWater is a non profit organisation and as such there are few incentives to compete for the right to operate, or to improve efficiency. Economic theory dictates that profit maximisation is a fundamental incentive for efficiency improvements. Under these circumstances improvements in efficiency will benefit the company itself and could feed through to shareholders, research and development or to management themselves. The profit motive is an essential driver of static and dynamic productive efficiency

NamWater has many of the desirable characteristics described in Table 4.2. It is a Parastatal and it bears much of the commercial risk (although would still fall back on government if bankruptcy loomed).It has also investigated greater private sector involvement in water supply[61]. NamWater is

[61] Desalination on the coast is to be a Build Operate Transfer scheme.

currently in the process of establishing a bonus scheme for employees who perform well in one way or another. All of these aspects have reduced the role of government and/or provide incentives for improved efficiency. However, there is still the question of government ownership and political influence in management decisions which implies potential for further institutional/commercial freedom and/or private sector involvement.

Effective Regulation

The regulation of NamWater by the government does not have a clear basis at present. Furthermore, if a profit motive is to be introduced to NamWater in the absence of the regulatory forces of competition, the regulation of prices for water is necessary to avoid the monopoly exploitation of the consumer. Even in the presence of competition or contestability regulation of prices may be required. There are methods available for regulating prices which do not impinge upon the potential efficiency benefits that arise from the profit motive.

It is important to ensure that the drive for efficiency does not impinge upon the quality of the service provided by NamWater. In this sense it is important that some regulation or monitoring of service standards is considered alongside any price regulation. Furthermore it is imperative that economic externalities such as environmental costs are monitored and controlled.

The possible institutional arrangements for regulatory bodies are discussed in the institutional theme report. However, this aspect is discussed further under section 4.1.5 which is devoted to regulation. The options describe the regulatory tools available to a regulatory institution.

OPTIONS:

a) **Regulation of Price**: There are in general 4 methods currently employed in other countries:

- **Price Cap**: the level of price increases is controlled by the regulator
- **Price Controls**: prices are controlled
- **Rate of Return**: A specific maximum rate of return on capital is stipulated and prices set accordingly
- **Yardstick competition**: The industry is compared to other similar industries and prices set accordingly.

This is discussed in more detail in Section 4.1.1.4 on regulation. Where profit making is allowed in the face of price regulation the incentives for productive and dynamic efficiency are maintained while the consumer is protected. There are informational, practical and occasionally incentive problems associated with each of these regulatory methods. The applicability of these methods to the Namibian circumstances should be investigated before concrete recommendations are made.

b) **Benchmarking**: The quality of service provision can be monitored or regulated through the development of service agreement. At present this could take the form of a performance contract with the government or regulator. Examples of areas worthy of a benchmark in a service contract could be:

- **unaccounted for water**
- **consumer complaints**
- **water quality**
- **continuity of supply**
- **time taken to fix or establish new connection**

Benchmarks could also be established to encourage and monitor efficiency. Examples of potential efficiency benchmarks that have been used internationally include:

- **overheads as a % of operations and maintenance costs**
- **number of employees per connection**
- **salaries as compared to international standards**
- **recovery of bills**

It is imperative that there are incentives in place for these benchmarks to be achieved. Good performance needs to be rewarded whilst bad performance should be punished. The profit motive will remain a major incentive to reduce the costs of service provision in NamWater, but how these profits are distributed will be a major determinant of the internal incentives.

c) **Externalities**: Externalities such as environmental costs can be regulated in a variety of different ways. This is discussed in the section on pricing **Section 3.1.2**. It is sufficient to state that these economic costs an be regulated by:

- **Economic pricing of environmental costs**
- **Restrictions on the allowable abstraction of water**
- **Standards or service agreements**
- **Participation of third parties in decision making process**

NamWater has also been subjected to 3 salary reviews since being beginning commercial operations in 1997 and measures many of the capital and maintenance costs of new and existing schemes against international civil engineering standards (a type of yardstick competition). These measures provide a modicum of regulation of costs. However these aspects are purely internal and divorced from regulatory scrutiny at present. This is an area for further research.

Effective Participation

NamWater currently involves customers actively in the process of establishing new supply schemes and in the running of existing schemes. Before water supply is extended to the customer (LA, Mines etc) a contract of service is signed between customer and provider. This provides clear involvement of the customer at that stage.

The issue of participation is addressed further in the institutional theme however it may ultimately be worthwhile to establish the extent to which efficiency of service provision may be improved through further ongoing participatory measures. Examples may include:

- transparency in tariff setting
- the publishing of efficiency indicators
- publishing of indications of resource status

Such approaches (and similar ones) may improve relationships between customer and provider, allow greater knowledge of the options available to customers and afford NamWater more accurate information as to the actual demands of customers. This will have clear efficiency implications.

Some of these measures are undertaken by NamWater at present in certain circumstances. It is speculated here that a broader more formalised policy of participation could be established.

RECOMMENDATIONS:

This theme paper is in no position to assimilate fully the economic costs and benefits in the Namibian context of the options described above for achieving the aforementioned objectives. The discussion has focussed largely on the various dimensions of efficiency within NamWater, namely productive and dynamic efficiency. It seems clear that the economy, the water sector, and consumers of water will gain significantly from improvements in efficiency in the provision of water. Similarly it should be reiterated that the options presented above will affect positively many of the remaining objectives in the water sector namely: skilled management, financial autonomy and accountability.

In consideration of these points the recommendations are as follows:

Recommendation 1

There is a prima facie economic argument for improving the productive and dynamic efficiency of NamWater through the introduction of a profit motive to the bulk water supply sector. The pursuit of profit is one of the driving forces behind productive and dynamic efficiency in any industry. However, in order to avoid the inefficiencies associated with a profit making natural monopoly it will become

increasingly important to ensure that the market is contestable and open to competition and that potential barriers to entry in to the market are minimised.

The profit motive can be introduced to NamWater as a parastatal, as is the case in other parastatal companies such as NamPower. Alternatively NamWater could become partially or fully owned by private investors. Such a strategy could help to eliminate the Principal-Agent problems touched on in Section 2.3.2 i.e. political intervention.

The political and customer acceptability of this strategy needs to be investigated. Similarly there are likely to be considerable equity effects resulting from privatisation. These are likely to be negative, but could also be positive. The achievement of the objectives described above, and therefore the benefits of this strategy depend to a large extent upon the acceptability of the policy.

In summary the recommendations for NamWater are:

- **Introduce the profit motive to NamWater**
- **Ensure competition for the bulk water market or sub sections thereof**
- **Investigate the potential benefits that could be derived from private ownership of NamWater**
- **Ensure minimization of potentially inequitable outcomes**

Recommendation 2

The corollary of recommendation 1 is the need for regulation. Regulation of water tariffs will be imperative if the NamWater is to be come profit motivated. However, even in the absence of profit making there is a clear need for regulation of the current situation in the bulk water sector. Regulation of the bulk supplier needs to be free of political intervention, mindful of the level of service provision and must not impinge on the efficiency aspects desired from private sector involvement/parastatal commercialisation. The appropriate regulatory tool must be developed for the Namibian context.

The NamWater Act makes provision for a contract between the company and the Minister. This contract could be used as a regulatory tool and a progress monitoring instrument. The main aspects of the bulk water sector that require some kind of regulation include:

- Price of water
- Costs
- Leakage rates
- Overheads
- Water quality

It is suggested that a range of benchmark standards be developed, based on relevant international experience to encourage efficiency improvements over time, and to protect consumers from monopoly inefficiencies. Such benchmarks could appear in a contract form as stipulated in the NamWater Act of 1997.

In sum the recommendations for regulation of NamWater are as follows:

- **introduce an appropriate regulatory mechanism for NamWater**: e.g. price cap, yardstick competition, rate of return.
- **introduce benchmarking in contract form in order to monitor the performance over time**: This is allowed for in the NamWater Act of 1997.

4.1.1.2 Local Authorities

A similar analysis can be applied to the current institutional arrangement in urban areas of Namibia. Local Authorities vary in the degree to which they manage to achieve the institutional goals described above. The economic incentives for the efficient provision of water in local authorities are unclear. Essentially the local authorities are non-profit organisations, which are only regulated by the voters. A reserve fund exists in many LA's, the use of which is usually restricted to emergency or future investments or acts as a financial buffer. Employees are civil servants and any benefits they receive are based on the duration of their employment, not on efficiency gains. The employees do not change with the change of Town Council, and are therefore insulated from any inefficiencies perceived by the voters. Again the question of the control of overheads arises in certain LA's, while in others it is the control of debt which is of primary concern. The term of a Town Council is usually 5 years, meaning that decisions regarding water pricing will potentially only consider the medium term.

The options below take a general view of LA's, and describe what theoretically could be undertaken to improve dynamic and productive efficiency, accountability and financial sustainability etc.

Private Sector Involvement and Competition

LA's strive to undertake the various services required of them under the Local Authorities Act. In most cases these service are provided by civil servants within the LA. Services are essentially provided by government with very little input from the private sector. Box 4.3 describes examples of where private sector involvement in the water sector has been successful.

Box 4.3. Examples of Successful Private Sector Participation in the Muicipla Water Sector.

Leases/ Affermages

Abidjan: The Societe de Distribution d'Eau de la Cote d'Ivoire (SODECI) is the private firm responsible for the operation of water supply to Abidjan. It holds an *affermage* (a lease contract, i.e. private operation of publicly financed facilities). In 1973 SODECI also became responsible for the rest of the country including rural areas. The private company sets tariffs in accordance with standards for staff, equipment, energy and other inputs, plus a margin based on agreed overheads and profits. The fee to SODECI covers operations and maintenance as well as debt service.

The standard of water supply in Cote d'Ivoire is among the highest in West Africa. Systems are well maintained, equipped and operated whilst losses are low. Several factors contribute to these results:

- the institutional separation of investments from operations makes it easier to evaluate SODECI's performance and ensures government control over the expansion to the system.

- By setting water tariffs to reflect total costs fully, Cote d'Ivoire can finance its existing services. Water rates are among the highest in Africa; thus the consumer, rather than the tax payer, pays for the services they receive. The low rates for small quantities help the poor afford water.

- During periodic reviews, the government can carefully scrutinse SODECI's costs

- As a private company, SODECI is free (within the contracted limits) to hire, fire and compensate its staff. This freedom, plus a strong emphasis on training (SODECI runs its own training centre) enables the company to attract train and keep qualified people.

1 Concessions

Santiago de Chile: two private companies operate in the city: Emprese de Agua Potable Lo Castilla Ltda and Empresa de Agua Potable Manqueue. Each holds a territorial concession. Competition between the two companies is on the basis of the quality of service provision, since tariffs are the same as approved by the Ministry of Works. Each company is **responsible for investing** in extensions to or replacement of infrastructure under the terms of the concession contracts. The quality of services is controlled by public agencies. This system has been operating successfully for many years with concessions lasting for approximately 30 years.

(SOURCE: Roth, 1987)

There is scope for an investigation into the viability of delegating service functions to the private sector from LA's and increasing competition. In order of private sector autonomy the following possibilities exist:

OPTIONS:

a) **Service Contracts**: Services within the water sector within LA's may well be more efficiently provided if they are contracted out to the private sector. The extent of the efficiency gains will be determined in part by the extent of competition within the private sector for the service contract, and the current level of efficiency within the LA. Service contracts have been employed in the water sector in Chile with great success. The public water company reduced costs and the size of staff and whilst maintaining one of the highest levels of productivity in this sector in Latin America (World Bank. 1993). Closer to home NamWater has contracted out its catering services as a means of reducing its costs. Other examples may include:

    - **Meter reading**
    - **Plumbing**
    - **Emergency repairs**
    - **Routine operations and maintenance**
    - **Debt collection**

b) **Management Contracts**: The private sector involvement could realistically extend beyond service functions to broad operations and maintenance of the reticulation system. Here the public sector maintains control of the major management decisions and sets the objectives. The incentives for efficiency improvements could be built into the contracts and linked to efficiency benchmarks such as unaccounted for water, customer complaints etc. A management contract for water reticulation could be envisaged for many LA's in Namibia.

c) **Lease Contracts**: the private contractor could pay for exclusive right to operate the facilities and bear the commercial risk. Major capital investments are still public responsibility, although working capital and minimal replacement is the responsibility of the lessee. Such a system has been extensively used in the water and sanitation sector in Europe.

d) **Concessions**: the private contractor will have all the same responsibilities included in a lease contract but will also bear the responsibility for financing extensions to the system and replacing fixed assets. Concessions usually last between 15 and 30 years. Both leases and concessions need sufficient incentives to avoid the running down of assets in the closing years of the contract. France has long experience of concessions in the municipal water sector. In the Cote d'Ivoire efficiency improvements and a reduction of expatriate staff in the water company have been achieved through this kind of private sector involvement. Similar arrangements for the water sector have been noted in Buenos Aires, Argentina.

Other examples of concessions include Build Operate Transfer (BOT) or Build Own Operate Transfer (BOOT) schemes. NamWater has already encouraged this strategy for the coastal desalination project.

e) **Private Entrepreneurship**: New entry into the market, joint ventures with minority private ownership, divestiture of assets to the private sector (as has occurred in the United Kingdom water sector), can all help to achieve higher levels of efficiency, mobilisation of investment funds and the formation of skilled management. Similarly the responsiveness to customers is also improved.

The role of Local Authorities in the water sector is a clear area for reform and determining the role of the public and private sectors is paramount in addressing the shortcomings noted in Section 2.3.2. While the emphasis of the options above has been on mobilising the private sector in varying degrees in order to promote competition and efficiency in water supply, the ability of this approach to reap efficiency gains in Namibia needs to be investigated. There are several issues which suggest that the involvement of the private sector at a local government level may not be successful. These could include:

- **Scale**: the scale of the local authorities may not be large enough to evoke sufficient local competition for contracts, leases or concessions

- **Isolation**: the isolation of many LA's may also reduce the effective competition and hence the potential efficiency gains of private sector involvement

- **Lack of expertise**: the limited expertise in the field of water management that exists in LA's currently may well be representative of a wider scarcity of expertise. Again this may limit the extent to which competition in the private sector exists for water related contracts.

In sum it may well be that for the time being the Local Authority scenario is the most efficient institutional arrangement available to Namibia. If this is the case, then the options to achieve the objectives described above concentrate on improving the incentives within LA's to improve efficiency, accountability etc. The evidence in Section 2.3.2 suggests that the ongoing decentralisation process will have positive effects for efficiency and quality of service provision.

There are a number of generic problems which are common to the majority of La's. In order to contain costs and minimise losses of revenue, and ultimately improve the efficiency and quality of water supply services it is recommended that the relevance and application of some of the following measures should be assessed:

f) **PPP's**: the establishment of public/private partnerships or joint ventures whereby private sector capital could be utilised for extension or rehabilitation works;

g) **Economies of Scale**: the level of economies of scale that could be achieved through joint working/association, for example, it may be more efficient for a number of small la's to have a joint leak detection/general maintenance team, or it may be more cost effective for a number of municipalities (those who do not purchase bulk water from NamWater) to jointly purchase expensive chemicals;

h) **Technology**: the introduction of new technology, there is always considerable debate about the costs and benefits of metering, however, the water supply and non payment problems in Namibia suggest that e.g. prepaid meters could have a positive impact on revenue collection;

i) **Capacity Building**: the need for extensive capacity building at local authority level in terms of financial management, maintenance of accounting records for costing purposes, implementation and running of billing systems, basic operation and maintenance techniques and clear separation of water revenues;

j) **Enforcement**: the introduction and stringent enforcement of improved disconnection procedures and policies;

k) **Cost Accounting**: an assessment of the condition of existing infrastructure and the cost of rehabilitation /annual maintenance; and

l) **Water Budget**: the introduction of suitable regulatory measures to ensure that water revenue is not used to subsidise other activities either to the detriment of service delivery or to overall water usage.

A number of the measures discussed above have significant cost implications, it is essential that the scale of investment required in the sector is adequately addressed if long term sustainability of water supply is to be achieved in Namibia.

Effective Regulation

At present there is a need for effective regulation of the quality of the water service in LA's. LA's essentially hold a monopoly position with respect to water supply and as such may have an incentive to

exploit the consumer. The only means of regulation is the WASP policy 1993 and the Local Authority Act which make no explicit stipulations with respect to profit making.

In many LA's the margin on the bulk water tariff is up to 50%, and water is seen as one of the main revenue sources for the LA's. Grootfontein municipality is estimated to have made a profit of approximately N$5.7m on the water account in 1998/99. The revenues were used to subsidise other social expenditures or loss making services.

Regulation of pricing and service standards could be introduced in a manner similar to that recommended for NamWater to avoid consumer exploitation.

Effective Participation

The issues of stakeholder consultation and participation are also important issues for efficiency in the LA's in order to encourage a move away from the supply side decision making towards the demand side decision making. The methods for achieving this are discussed in the institutions and participation theme paper. In particular transparency in the setting of the water price may improve the relations between customers and suppliers in situations like those witnessed in Rehoboth. Non-payment may be reduced as a result of this type of consultation.

RECOMMENDATIONS:

Given the uncertainties surrounding the potential for private sector involvement in municipal water reticulation the recommendations for improving productive and dynamic efficiency therein are not particularly strong .

Recommendation 1

The potential for private sector involvement in undertaking municipal water reticulation needs to be investigated. Private sector involvement should only be advocated where there are clear gains to be made. The recommendations for private sector involvement are:

- **Investigate the possibility for the use of service contracts and management contracts as a first step towards private sector involvement. Suggested areas of involvement include:**
  - Meter reading
  - Accounts
  - Debt collection
  - Operations and Maintenance

- **In time more comprehensive involvement of the private sector could be considered provided significant efficiency gains are exhibited by the interim involvement**

There is considerable evidence world-wide of the success of private sector involvement in achieving the objectives above: productive and dynamic efficiency, skilled management, financial autonomy and accountability to customers.

Recommendation 2

Where the private sector is not guaranteed to yield significant benefits initially and over time, the internal efficiency of LA's needs to be improved. This may be achieved by:

- **financial autonomy of the LA (this is often the case already)**

- **separation of the water budget to ensure:**

- the costs of water are fully accounted for
- revenues are used to maintain the water system and not for general usage

- **improved incentives for workers to perform:** bonuses based on prescribed targets of achievement e.g. cost cutting, improved service quality etc.

- **capacity building for LA:** technical ability is required on many levels: plumbing, accounting, enforcement of payment, community consultation etc.

- **Regulation of the quality of service provision**: through performance contracts or indicators to ensure the quality of service provision is maintained or improved

- **Regulation on the price of water**

4.1.1.3 Efficiency in Government

The efficiency of the Department of Water Affairs to perform its functions and achieve its objectives is not easily assessable. Section 3 has cited several examples of where the DWA is not performing and thus several potential areas of reform:

- **Inefficient management practices**: Duplication, poor co-ordination, poor accounting systems

- **Regulation**: there is no coherent regulation policy within government

- **Water permits**: there appears not to be the capacity to ensure effective monitoring of all water use in Namibia. E.g. the groundwater control zones do not cover the whole country, permit conditions are not adhered to and enforcement is lacking

- **Unnecessary intermediaries**: the intermediary position of the DARD in the supply of water to certain irrigation schemes appears to be unnecessary

The economic incentives for efficiency in the Government sector are notoriously bad; revenues and expenditures are often divorced, budget constraints are often soft, pay scales are not performance based, duplication of tasks is commonplace and dynamic efficiency is not encouraged since there are often no specific performance indicators etc. Many of these problems are illustrated above. Furthermore, the private sector (NamWater) will often pay higher salaries with more attractive conditions meaning that there is an incentive present for the erosion of skilled staff in DWA. In addition, the Government of Namibia is inherently overstaffed and has the largest government sector, as a percentage of GDP, of all African countries.

The institutional analysis at the beginning or this section suggests that the role for government in the water sector is a purely regulatory role with the actual supply portions open for operation by the private sector as either a privatised entity or as an operator under public sector ownership. The trend in recent years has been towards a downsizing of government and the outsourcing of many of the currently undertaken roles. Conventional wisdom states that public sector involvement in the supply of water services should be kept to a selection of minimum policy actions (World Bank 1993):

- **Regulation**: of monopolies, externalities, distributional requirements/equity considerations, information, etc[62].

- **Planning and Coordination**: where there are several institutions in the supply chain coordination of activities is required

- **Policy Making**: the government has a role in policy making

[62] These regulatory requirements are discussed further in section 4.1.1.4.

- **Standards**: technical, environmental and safety standards

The ownership of water infrastructure and the water sector as a whole has been seen as a pre-requisite for maintaining control over water supply. However, whether ownership of water infrastructure by government is a strict requirement for efficiency is open to question as described in section 4.1.1.1. Certainly financing of water infrastructure need not be a government responsibility, as shown by the current corporatisation of the bulk water sector.

In light of the recommendations for increased private sector involvement in the water sector, the role for government becomes an enabling role. This role could include the removal of significant barriers to entry, the de-politicisation of water as a commodity and the reduction in the potential risks borne by private sector that may arise therefrom.

OPTIONS:

The options for government reform to improve the efficiency, accountability and management are as follows:

a) **improved links between revenue and expenditure**: given the nature of the proposed government involvement described above, this is not always and everywhere possible. There are many facets of government involvement which cannot be run on a cost recovery basis. However, where this is possible it should be undertaken. Current possibilities include:

    - **issuing of water abstraction permits**:
    - **specialised services**: emergency flood management, data collection, specific hydrological, geo-hydrological and environmental services provided to other ministries for example etc

b) **clear management objectives**: objectives and goals need to be stated clearly. This can often be difficult given the nature of the tasks undertaken by government.

c) **performance indicators**: the performance of the Government should be monitored on the basis of specific performance indicators.

d) **The removal of unnecessary government involvement**: it appears that there may be some unnecessary involvement of the government in certain water related areas e.g. at Hardap dam. Similarly DRWS is the customer for NamWater in the northern communal areas. In time this could be phased out such that rural communities purchase water from NamWater

In essence these measures intend to simulate the market scenario as much as possible in order to create a clear relationship between the service provision and the beneficiaries of these services. This in turn can help to create an environment in which the incentives for good management are increased and the quality of the service potentially improved.

In sum, as mentioned in point a), not all the services that are provided by government can be treated in a cost recovery manner. However, most government services can be improved by the improvement of incentives for internal efficiency and by the movement of service provision closer to the beneficiaries. One of the ways in which it is believed that this can be achieved is through **decentralisation**. The government has had a decentralisation policy since 1996. The following functions are considered to benefit from decentralisation:

- **local planning**
- **local programming**
- **local execution**

Section 2.3.2 has illustrated some of the benefits that decentralisation of responsibilities to a local government municipality level can achieve. It is speculated that similar benefits can be achieved

through the decentralisation of similar governmental responsibilities, recognising that decentralisation is not a costless process.

Centralised functions should remain as described above: strategic planning, monitoring, setting of standards etc.

RECOMMENDATIONS:

The recommendations are as follows:

- **Accountability**: expenditures and revenues should become linked. The extent to which this is practical and appropriate for different services should be established.

- **Cost recovery**: fees should be charged for the issuing of water abstraction permits reflecting the costs of processing. The fees should be made directly payable to the division responsible. Other areas of cost recovery within government should be investigated

- **Decentralisation**: this process should be encouraged for appropriate functions

- **Co-ordination of actions**: to avoid duplication of actions co-ordination between existing divisions and directorates of the DWA should be improved

- **Business Plans**: them objectives and goals of government should be clearly stated and subjected to specific performance indicators. The creation of a business plan including clear financial strategies should be encouraged

- **Enable Private Sector**: the risks associated with the politicisation of water, changes in government sectoral policies barriers to entry into the market can be reduced in places by government involvement. The government should become an enabler in the water sector.

To a large extent these issues are addressed in the institutional and participation theme paper. Separation of function such as water resource management, data collection and policy making could potentially be an excellent way in which to improve accountability of government functions and hence the internal and overall efficiency. However, such institutional change will come at significant cost, will require coherent coordination between all parties and may centralise many functions that could be better performed at a local level.

An acceptable system of management in the water sector may arise from improved efficiency of current resources. However, the possibility of extra funding being required to achieve certain targets needs to be entertained. The use of self funding agencies, or the use of charging for government services may improve the financing capabilities of the water sector to achieve their targets.

Clearly there are significant benefits to be achieved from governmental reform. Similarly with the importance of sustainable and efficient management of water resources being paramount, the efficacy of governmental reform is paramount. Where possible the potential role of the private sector, outsourcing and the general reduction of government intervention to a menu of minimal tasks should be encouraged.

4.1.1.4 Efficiency and Sustainability of the Community Based Management Strategy

The efficiency and sustainability has been highlighted as a key issue in section 3. It is not the scope of this paper to offer an analysis of the success of the CBM strategy nor to suggest an alternative since to do so would have no basis. Given the analysis in section 2.3.2 there are significant financial savings to

be made from the implementation of CBM, and the conveyance of property rights to rural communities may provide a greater incentive for the efficient use of water resources.

However, the issue of ability to pay is of paramount importance. Section 2.3.5 suggests that many communities may not be able to afford the full costs of water supply assuming that 5% of median incomes is a reasonable and equitable norm. The implication of this is that continued government subsidies will be required to reach the DRWS target of 80% access to water. However, willingness to pay has been found to be upwards of 10% of incomes in many developing countries, suggesting that the extent of subsidies in the future may be reduced. In total the key factors in the sustainability of the CBM strategy are:

- **Willingness to pay**
- **Ability to pay**
- **Training and extension offered by the DRWS**
- **Population density**
- **Cattle ownership**
- **The compatibility of CBM with the existing communities' lifestyles**
- **Whether CBM is the most cost effective way to provide water to rural areas**

As outlined in the Human Resources theme report and other reports on the CBM project, in order to attain the level of training and stakeholder participation required for the successful transfer of responsibility and ownership to the rural communities, there is an urgent need for funding requirements to be revisited, priorities determined, timescales reviewed and level of upgrading reassessed. Furthermore, the support of rural water extension officers (and supervisors) will be crucial for the successful implementation of the cost recovery policy. From a financial perspective, it is recommended that a realistic reassessment of the costs of the implementation of CBM is undertaken. The funding requirements would then be known by all parties and a practical implementation plan established.

CBM is a crucial part of the MAWRD's approach to the decentralisation policy of 1997. The sustainability of water supply to the rural communal areas of Namibia is dependent upon a successful management strategy for these areas.

OPTIONS:

Given the failures of community based strategies in other developing countries (Dreyer, 1998, J.Burke pers comm) and the current delay in the implementation of the strategy, the CBM strategy requires further analysis. Willingness to pay by communities, the efficiency of DRWS as an implementing agent, the level of skills in communities are all open to questions of overall efficiency.

- **Assessment of the willingness to pay of rural communities**: I.e. a rigorous investigation into the amounts of money the communities are willing to pay, or water point committees are able to mobilise from the community; livestock owners etc. Such a study will provide an estimate of the potential economic benefits of the CBM strategy

- **Social benefits of water supply should be quantified**: this will determine the extent to which the government can be justified in subsidising the CBM process.

- **Full cost accounting of the CBM strategy**: the costs of CBM need to be established and compared to the benefits in order to establish its economic viability

- **The involvement of the private sector**: where willingness to pay is sufficient the involvement of the private sector may be a desirable efficiency measure. Much outsourcing already occurs in the DRWS indicating the perceived value of such an exercise.

In the absence of the information described above it is impossible to make any sensible suggestions as to institutional changes that may improve efficiency in Rural Water Supply.

4.1.1.5 Regulation

Rationale for Regulation

The implementation of regulation into a sector should be dependent upon the nature of and market for the good in question (World Bank 1993). The direct and indirect costs of regulation world-wide are considerable and the current focus of regulatory policy in many sectors throughout the world is upon liberalisation rather than regulation. Hahn (1996) analysed 5 regulatory impact analyses (RIA's) covering health, safety and environmental regulations from 1990-1995. Although the cost benefit analyses were often incomplete, in 80% of cases the costs of imposing regulation (i.e. government intervention) were higher than the benefits.

However, it is clear that given some of the social qualities of water as a good, the existence of externalities, the water sector being predisposed towards capital indivisibility, economies of scale and hence natural monopoly characteristics, a strong economic case exists for regulation in the water sector. In the same breath, given the potentially high costs of regulation (e.g. the costs of regulation in Australia were estimated to be between 9 and 19% of GDP in 1986, 12% in Canada in 1996 and 9.5% in the USA in 1991[63]) a full investigation into the economic costs and benefits of regulation and the different approaches to regulation should be undertaken before significant regulatory decisions are taken (Guasch and Hahn 1999).

The case for government intervention in the form of regulation of the water sector in Namibia has already been made in sections 4.1.1.1 and 4.1.1.2 above on the grounds of the natural monopoly status of the bulk water supplier NamWater and the Local Authorities, the social qualities of water, the absence of competition and the lack of faith in contestability as a means of regulation. The case for regulation in the bulk water sector is strong with the current institutional arrangements: NamWater being non-profit natural monopoly. However, the need for regulation will be heightened if the efficiency recommendations above are implemented: profit making and private ownership or operation. Inversely, in order to promote competition for the market or for sub-sections of the market, liberalisation of the industry is likely to be the most effective strategy.

Regulation is advocated above on economic efficiency grounds: to reduce the inefficiencies associated with monopoly profits and thus control the price of water to consumers whilst maintaining the correct incentives for productive and dynamic efficiency. Similarly regulation requires particular levels of service to be achieved and performance criteria to be established, including environmental standards, water quality and pricing. Regulation essentially corrects 'market failures' and this rationale is commendable.

In reality however, regulation is often 'captured' by interest groups and motivated not by economic efficiency principles but by political agendas and/or private sector interests (Guasch and Hahn 1999). Regulatory measures often redistribute resources and are generally used to prevent a transfer of resources from consumer to investor (Solanes 1998). However, this transfer process can be used for political or private sector ends, whilst impacting adversely on the consumers, the poor and the powerless.

Regulatory Conditions

There are several ways in which regulation of a natural monopoly can be undertaken. However, for an efficient and effective regulatory framework to exist requires certain conditions to prevail (World Bank 1993, Solanes 1998):

- **Legal Framework**: a clear framework of law is required pertaining to property rights, liability, conflict resolution and contracting

- **Enforcement**: the regulatory authority must have the capacity to enforce laws and ensure compliance with regulations, with recourse to appeal

- **Information**: the regulator must be provided with sufficient information upon which to base analysis and decisions e.g. costs in regulated utilities, calculation

[63] This is regulation in all sectors, not just the water sector.

of tariffs, the state of water resources and the like. However, data demands should not be overly burdensome

- **Independence and Impartiality**: the rationale for regulation is primarily economic and as such regulation should be undertaken upon this basis only and should be free from influence or 'capture' by politicians or other interest groups.

- **Participation**: users and other affected parties must be able to address the regulator

- **Separation**: it is widely thought that the functions of operation and regulation (price regulation and standard setting etc)should be separated

- **Efficiency**: regulation should not impinge on efficiency incentives

Other factors that need to be considered are; the jurisdictional level upon which the regulatory law is to be applied; financial, procedural, judicial and substantive controls upon the regulator itself; the power of public participation to derail the economic rationale for regulation.

Regulatory Institutions
The way in which regulation of the water sector is to be institutionalised is crucial to its success.

OPTIONS:

There are commonly 2 different scenarios compared which describe how regulation can be institutionalised; the UK model and the French model.

a) **UK**: In the UK regulation is undertaken by a legally independent agency, (the Environment Agency), which sets the standards and makes regulations, and a separate pricing regulator (OFWAT). In this way the enforcement of standards for environment, service quality and prices is separated from the operation of the private water companies, whilst regulation is separated from government[64]

b) **France**: In France regulation is generally imposed through contractual over sight by municipalities or central Government who have delegated the operational responsibilities through contracts (lease, affermages or concession for example) or monitor public utilities. The basic parameters for regulation (service quality, pricing, returns to concessions etc.) are specified in a contract between the municipality and the operator, or the government and the public utility. The contract will usually stipulate that the working capital must be returned after the concession to the same state as when the concession began. This removes the possibility that the concession will 'run capital down' towards the end of the contract (Roth 1987).

The independent agency approach provides a clearer separation of the standard setting and the operation of the water sector, and is less prone to 'capture' by private of political interest groups. The independence and discretionary power of the independent regulatory agency have been advantageous in so far as they have :

'*limited the ability of ministers and politicians to intervene in the privatised public utilities'*
(Armstrong, Cowen and Vickers, 1994, quoted in Solanes 1998)

The benefits of independent agencies have also been seen in the USA. Political independence also requires those employed to undertake the regulatory role to be professionals and not have political or other interests in the water sector (Solanes 1998). Regulation by contractual oversight is more open to capture by those who negotiate the contract and thus may not serve the public as well in all cases.

Experience in the UK with this approach has had varying degrees of success however. The existence of a completely privatised water sector has meant that the regulatory system in the UK has by necessity been very strong. However, the UK regulatory system has proven to be costly, often unwieldy and

[64] Although final decisions are in the hands of the Minister.

often unsuccessful. A review of the system in 1994 revealed several potentially disturbing factors (Solanes 1998):

- directors salaries had doubled
- costs were rising in excess of inflation
- capital expenditures were not at the expected level

Operating profits had increased by 34% on average in the 1992-1993 period. This was despite the regulation of prices through the price cap system.

If the road of privatisation is to be followed in Namibia in the bulk sector it is likely that equivalently strong regulation will be required. However, in developing countries resources are scarce and crucial decisions need to be taken with respect to the prioritisation of government spending as compared to other developmental goals. Ultimately the consumer or the tax payer will end up paying for regulation and the decision on how to formulate a coherent regulatory institutional arrangement must take this into account.

The need for a gradual and methodical involvement of the private sector in the water sector at a Local Authority level illustrates how regulation on a contractual oversight basis may be the most appropriate form of regulation on that level. The informational requirements for an independent, largely centralised agency to effect regulation of either LA's or the private sector operators are likely to be too burdensome to be workable. The World Bank has stated that despite the potential for political intervention:

'instituting regulation through a transitional process of expanding the practice of contracting may be a more practical approach in many developing countries than starting from scratch with a full-blown independent regulatory agency' (World Bank 1993)

The NamWater Act makes provision for contractual regulation of the Bulk Water sector at present and therefore provided the legal backing for this the contractual approach. At present action has not been taken to ensure this regulatory technique is instigated. As stated in section 4.1.1.1, NamWater is effectively undertaking self-regulation. Clearly the incentives for the public interest to be a factor in self-regulation are limited and this process should be augmented.

Finally there is the question of how the regulatory body; an independent agency as suggested in the institutional theme paper, is to be funded. Options include:

- central government funding
- levies on water consumption: resource charges, administration fees etc (see section 4.1.2.4)
- Fines

The pros and cons of each source of funds should be investigated, particularly the burden on government.

Price Regulation

The methods for regulating the price of water, and yet maintaining the incentives for efficiency brought about by profit making and competition have been discussed above. These options include:

- Price controls
- Price cap
- Reasonable rates of return
- Yardstick competition

OPTIONS:

a) **Price Controls**: where the market is not subject to competition (within the market or for the market) price controls are necessary to reduce monopoly exploitation of the consumer. The difficulties of such a regulatory technique include:

- **asymmetric information**: the regulator will often not have the information that the firm or industry will have making negotiation of an acceptable price control difficult and open to coercion.

- **Translating returns into price controls**: the regulator will have to balance high prices against prices that are so low as to cause exit from the industry, or a reduction in service quality.

b) **Price Cap**: a price cap represents a restriction on price increases. In the UK a price cap approach has been adopted using a so-called K factor, where K represents the amount above or below the consumer price index that price changes should be limited to. In the water sector this factor is positive to account for capital intensity and generally low productivity. It is thought that this system is difficult for the regulated to capture and low in administrative cost. Difficulties include:

    - **no control on profits**: restricting price increases does not control profits and may 'tip the balance in favour of investors to the detriment of consumers' (Stelzer 1995, in Solanes 1998)

    - **starting price**: Determining a reasonable starting price

    - **information**: the need for information about cost and industry structures can be considerable

c) **Reasonable Rates of Return**: the rates of return on invested capital can be used as a regulatory tool. The difficulties lie in determining what the reasonable rate of return on invested capital actually is: past returns, portfolio returns, returns in comparable industries etc. The rates of return will have to be reviewed and must bear in mind current economic conditions. There is also the issue of the comparability of a public sector utility with the private sector.

d) **Yardstick Competition**: comparisons are made to similar industries or to the industry in other countries. Yardstick competition usually focuses on costs, which are restricted according to this yardstick and the prevailing conditions in question. Similar issues of public/private and inter-industry comparability arise here. Finding a sensible comparison is often difficult.

It is also important that regulation involves ensuring the quality of service is maintained, consumers obtain the service they demand, performance of water supply institutions is improved or maintained, and environmental objectives are achieved. From this perspective it is important that performance indicators and service benchmarks are developed such as those described in section 4.1.1.1. Furthermore, the use of environmental pricing, standards on effluent and policies for sustainable resource usage can also be considered to be forms of regulation. The regulatory system should be able to manage these important components of the regulatory rationale.

RECOMMENDATIONS:

The current regulatory system involves informal self-regulation by NamWater, no regulation of pricing and service provision in LA's, and lack of institutional power within the government to impose requirements thereupon. The current regulatory framework is fragmented and unclear. The need for regulation is paramount in the current situation and will become more important if the private sector is to become involved in the water sector as recommended. The regulatory requirements may differ in the bulk water sector from those in the urban sector and the framework proposal should consider this. Similarly it must be established whether or not the costs of regulation outweigh the efficiency gains from privatisation and profit making, or removal of the current regulatory system. The recommendations therefore are:

- **A full cost benefit analysis should be undertaken to establish the desirability of either a fully independent regulatory agency, regulation by contractual oversight, or indeed any other institutional arrangement for regulation of the water sector**

- **Contractual oversight offers a feasible and cost effective option for an initial regulatory system and should be promoted as a first step**

- **Should an independent regulator or contractual regulation be implemented they should adhere to the '*regulatory conditions*' described above. Specifically:**

    - Legal power
    - Independence/impartiality
    - Efficiency
    - Participation

- **The appropriate regulation of price should be investigated**

- **Performance indicators and service benchmarks should be established within LA's and NamWater**

4.1.2 Pricing

Pricing is important to consider from two initial perspectives.

- Financial Cost Recovery
- Economic Efficiency

The difference between the financial and economic aspects of water pricing is sometimes overlooked, however each aspect is equally important. Financial sustainability is important from the point of view of maintaining a sufficient cash flow to maintain a functioning water reticulation system, a quality service which meets consumer preferences and the quality of staff involved in the water sector. In many ways financial cost recovery can aid access to water supply as a result of these factors. Financial cost recovery should make provision for operations, maintenance and capital costs (both existing and replacement) such that a water supply institution can cover all the financial costs incurred.

Box 4.4. Long Run Marginal Cost and Average Incremental Cost Pricing

Marginal cost pricing is advocated by economists as a prerequisite for the efficient use and allocation of water. In general marginal cost pricing is subject to practical limitations in the water sector on account of the 'lumpiness' of investments i.e. large capital investments are required at certain points in time in order to cater for demand growth in the long-term. The existence of such investments would lead to a highly variable marginal cost price leading to conflicting signals to consumers as to the real cost and scarcity of water. As a result of this it has been suggested that an approximation of the marginal cost price could be used which evens out the fluctuations in pure marginal cost approaches. The Average Incremental Cost (AIC) approach to pricing does just that, taking the present value of required future investments, based on predicted demand, and assuming existing large capital investments are sunk costs and hence not economic costs (Warford 1994, World Bank 1994). In this sense the AIC is different from the financial costs of water supply provision raising questions about financial cost recovery.

Where the marginal costs of water supply are increasing AIC pricing will more than cover the financial costs of water supply. This is certainly the case in most places in Namibia. Current capital redemption and interest payments, as well as operations and maintenance costs will form part of the AIC meaning that efficiency improvements with the water supply institution will be reflected in the water price and passed on to consumers, owners and managers themselves under a profit making scenario. The incentives for efficiency are not impinged upon by this pricing strategy, although complications may arise when the private sector competes for tenders for future water supply schemes.

Warford (1999) suggests that there are 3 components of AIC:

- **the operations maintenance and capital costs**: current O+M and capital redemption and interest.
- **the environmental costs**: the present value of all environmental costs.
- **the user costs**: the present value of all necessary future capital investments and operations and maintenance.

Each component should be calculated based on the costs that will be incurred given the existing demand projections, where demand is considered to be backed by a willingness to pay, and not a 'requirement' as was often assumed in the past. This will be an iterative process requiring knowledge of how demand projections will change in the face of AIC pricing and how the least cost stream of future investments changes in response to demand changes and so on.

In common with many developing and developed countries, Namibia does not yet achieve full cost recovery (and in many instances may not fully achieve the recovery of operation and maintenance costs). Achievement of financial full cost recovery (particularly for urban water supply) should therefore be seen as a first step in achieving longer term economic sustainability.

Economic efficiency strives for optimal allocations of water resources through reflection of the economic costs in a volumetric tariff such that consumers are provided the correct signals to guide their consumption choices and conservation investments. Other desirable aspects worthy of consideration when determining an appropriate water price include:

- equity
- environmental sustainability
- stability
- political acceptability
- simplicity/understandability

Economic theory states that marginal cost pricing is the correct and optimal pricing policy to use for any good or service. **Box 4.4** describes how 'pure' marginal cost pricing can be applied to the water sector. In essence the practical application of Long Run Marginal Cost Pricing is offered by long term approximation of the future economic costs imposed by current demands. LRMC can be approximated by the Average Incremental Cost (AIC). This methodology should strictly use only economic costs, i.e. existing costs, future required investments and externalities such as environmental costs, taken at shadow prices. However, variations on this principle are sensible in the case of Namibia where AIC pricing may be considered as a relatively new concept.

Only if prices are forward looking, like AIC pricing, will the full cost of water supply be reflected and the correct incentives to conserve water, invest in water saving devices or augment supply be provided to consumers and the water industry. Currently the general case is something resembling an average cost price including components of historical costs in historical prices. Such pricing reflects what the provision of water cost in the past and not what it will cost in the future. Given that marginal cost of water supply is generally rising in Namibia financial cost recovery will also be achieved by LRMC/AIC pricing. There are several difficulties associated with AIC pricing, these include:

- **difficulty in predicting precisely the full least cost of water supply augmentation or recycling/re-use/reclamation options in the future**: Uncertainties include:
    - discount rate or interest rate to be used in assessing the future value of money or cost of capital
    - the timing of the investment given an AIC pricing regime and associated demand growth responses
    - the actual costs of future investments given technical change; this could be especially important in the case of desalination technology
- **the acceptability of profit making**: where AIC is introduced and marginal costs are higher than average costs

It should be recognised that LRMC pricing has been used successfully where water scarcity has become extreme. In the United States several water scarce towns use LRMC pricing (Reed and

Johnson 1994). In Manila, Philippines it has been estimated that groundwater overdrafts can be efficiently reduced and economic activity maintained as a result of LRMC pricing as approximated by a least cost AIC approach (Ebarvia 1997). Similarly, it should be recognised that LRMC/AIC pricing is the exception rather than the rule, generally for political acceptability reasons. However, the benefits of such a pricing policy are likely to be significant in highly water scarce regions such as Namibia.

The following options and recommendations are based on the economic theory of efficiency described above. In the summary that follows the practicalities of the recommendations are addressed and the overall recommendations qualified. These options and recommendations draw partly on the findings of the tariff study commissioned by the Review to look into the numerous aspects of tariff design.

4.1.1.1 NamWater

The move towards full cost recovery began with the WASP 1993 and continued with the creation of NamWater in 1998. NamWater has made great strides forward in achieving full cost recovery over the past 2 years. Although NamWater appears to have achieved full financial cost recovery there are several reasons why the current NamWater tariffs will not achieve economic efficiency:

- the tariff is based on historical costs at historical prices (depreciation)
- externalities (e.g. environmental costs) are not considered
- the tariff does not include future investments
- cross subsidisation occurs

In sum the true cost of replacing existing capital and providing new capital where demands are growing is not reflected in the current NamWater tariff. Similarly the costs imposed on third parties (externalities) are ignored. The revenue obtained from current tariffs will not be sufficient to cover the costs of replacement and increments to the system and as such the tariffs will not be economically efficient in the long-run whilst financial viability will only be achieved through steep price increases at the time of the investment.

At present where investments will be required in the future the current practice is to put prices up as and when the investment occurs. This leads to uncertainty about the scale and/or timing of the investment, in the absence of knowledge of the strength of demand i.e. willingness to pay or the service. This could lead to potentially inefficient investments, and inefficient prices thereafter. This risk is borne by NamWater primarily, but also by the government as owner of the corporation. However, the cost of inefficient investments will ultimately fall on the consumer.

One example of where problems have arisen under these circumstances is the coastal desalination project. Since the customers (local authorities) have rejected a move towards the long run financial cost price (i.e. a price which reflects the future financial cost of provision) prior to investment, uncertainty arises as to the size and timing of the investment. Indeed, taken to the extreme uncertainty may arise as to whether demand is sufficient for the investment to proceed at all.

Furthermore, some bulk water supply schemes may not have been embarked upon had a commercial entity been responsible for the investment decision. For example in Gobabis the current cost recovery price is in the region of N$40/m3, an unreasonably high tariff which few consumers will be willing to pay. It is likely that some clear policy on cross subsidisation, which does not erode the scheme specific nature of the current tariff setting procedure, is required in such cases.

AIC pricing will address many of these issues. The following options present themselves as potential solutions to these issues. The options are forwarded with reference to the list of desirable qualities for water tariffs

Efficiency and Full Cost Recovery

There are many ways in which the principle of AIC pricing could be adopted in Namibia. These range from the highly theoretical (shadow pricing etc) to the more practical (expected future financial costs of provision).

OPTIONS:

a) LRMC using the AIC approach with economic prices: current costs, future costs and environmental costs, at shadow prices.

b) A financial cost equivalent of AIC: a price which reflects the expected future cost of necessary supply augmentation investments

c) The cost of externalities/ third party costs, such as environmental costs, appearing in the bulk water price. (should be seen as an addition to b)).

d) Externalities such as environmental costs could be regulated by restrictions on abstraction based on knowledge about the quantity of water required to maintain these environmental functions.

e) All costs should be represented in a volumetric rather than a 2 part tariff proposed at NamWater recently. The Water Demand Management effects of this type of tariff are generally considered to be greater[65].

f) Catchment management fees and resource use fees charged by government for exploitation of water resources (see section 4.1.2.4) could also be included in the NamWater tariff.

Sustainability and Environmental Costs

It should be mentioned that **environmental costs** generally have similar qualities to operations and maintenance, and capital costs. I.e. some environmental costs are like capital costs; fixed one off costs such as the costs associated with the inundation of a dam site. Other environmental costs vary with consumption such as the costs associated with the draw down of aquifers (e.g. vegetation/ecosystem loss, salt water intrusion). As with capital costs, any environmental costs that occurred in the past are considered 'sunk' costs[66]. All current and future environmental costs should be considered. Measuring environmental costs of either variety is often very difficult and often subjective. Establishing the link between water consumption and environmental degradation is one example of the difficulty involved in measuring/valuing environmental costs. The existence of threshold effects, where environmental costs occur suddenly and irreversibly at a given level of consumption also make the incorporation of these costs in the price very troublesome.

Furthermore the inclusion of environmental costs on the price for water is recommended largely on economic efficiency grounds and any achievement of sustainability (e.g. sustainable resource use) will be entirely coincidental. Sustainability can be seen as a constraint to pure economic efficiency which attaches a priority to inter-generational equity. As such efficiency pricing will not necessarily guarantee sustainable resource use or sustainable economic development.

The efficiency argument for the inclusion of environmental costs is strong however since it will imply greater efficiency in the use of natural resources: water, wildlife, ecosystems etc. As such the importance of environmental charges from an efficiency and hence economic development perspective should be strongly emphasised.

OPTIONS:

- **Environmental price**: environmental costs could be included in the price for water on efficiency grounds where possible, especially when considering new investments

- **Restrictions**: environmental sustainability (sustainable water resource use and/or ecosystem preservation) could be ensured through the use of non-economic instruments such as restrictions on abstractions, monitoring of water sources etc

[65] It is imperative that the price is passed on to the final consumer for the efficiency effects to be achieved. It likely that this strategy would promote the use of this tariff structure by LA's however.
[66] An appropriate term for a dam site!.

Equity
Equity is taken to relate to access to water supply and is perhaps best dealt with by the final institution in the supply chain, the local authorities, when considering the price of water. However, where there are 'loss making' investments being operated by NamWater, i.e. inefficient investments from pre-commercial days, or there are instances where economically viable investments are not financially viable for a commercial enterprise, the issue of cross subsidisation between needs to be addressed. More particularly the currently implied cross subsidisation in of schemes within NamWater should be clarified (Interconsult/WCE 1999).

When considering environmental costs it may be important from an equity/fairness perspective to consider to whom they accrue. For example if environmental costs are incurred by the rich and then paid for by the poor a potentially unfair outcome may occur.

OPTIONS:

- **The equity (both access and fairness) outcomes of the NamWater tariff need to be investigated**

- **Access can be assisted by end supplier pricing policy**

- **Cross subsidisation considered for special cases but not adversely undermining the scheme specific nature of tariffs**

Political and Customer Acceptability
Political acceptability has many dimensions:

a) **Profits/Excess Revenues**: AIC pricing will mean that profits are made in the short-run where marginal costs are higher than the average costs of water supply. This would require a change in NamWater's non-profit making status as suggested above. Furthermore including environmental costs in the water supply tariff means that NamWater would receive revenues from environmental charges. It is clear that some thought needs to go into finding a politically acceptable and transparent use for these excess revenue sources.

   There are several options available for the treatment of profits:

   - profit taxes
   - dividends to shareholders
   - research and development

   Environmental revenues could be used as follows:

   - compensation of third parties
   - research into environmental and ecological links
   - research or investment into water saving technologies

Experience from around the world has shown that the willingness to pay for environmental costs, catchment management and the like are increased when there are transparent uses for the funds that arise.

b) **Transparency of Tariff Setting**: Confusion over the current status of NamWater has lead to widespread public misunderstanding and concern over the commercial nature of NamWater's activities, many people assume that commercial equates with profit seeking and thus the exploitation of the poor and disadvantaged. In this sense transparency of dissemination of information regarding the commercial nature of NamWater and in particular tariff setting would diminish public confusion.

c) **Political Commitment**: Political interference in for example, tariff setting can seriously undermine the long term economic and financial sustainability of NamWater. It is crucial that distinct political commitment is shown towards the principle of full cost recovery.

d) **Stability**: Stability and predictability of water tariffs is also important. When industry and residents are deciding on the extent to which they find it economic to invest in water saving devices, a long-term planning horizon is usually required. In this sense agents need to be fairly certain about the future cost of water. In many ways AIC pricing will provide this certainty, as it is based on the future required investments. However, a price which reflects the future costs will be higher in many places than the existing tariff and as such consumers will be faced with higher bulk water prices. The way in which any higher tariff is phased in will be crucial to its acceptability.

RECOMMENDATIONS

The recommendations for pricing in NamWater are:

- **Bulk water should be priced at a rate which reflects the current and future costs of supply**: This should initially be AIC pricing using predicted financial costs. This tariff should be phased-in in a similar way to the move to full cost recovery has been phased-in over the past few years, i.e. clear, predictable rises.

- **Cross Subsidisation**: Cross subsidisation between richer areas (e.g. Windhoek) and poorer areas, should not undermine the scheme specific nature of current tariff setting procedures. Evidence from around the world suggests that overt cross subsidisation can result in revenue deficiencies in the water companies and uneconomic water intensive investments in water scarce areas.

- **Environmental Costs**: the extent to which it is feasible to include environmental costs in the bulk water price should be investigated. One possible strategy is to include quantified environmental costs of current consumption and future investments in the AIC price. For environmental sustainability to be achieved requires investigation into what state of the environment it is desirable to sustain and which methods: economic or non-economic are the most appropriate to achieve this.

- **Equity should be considered when adopting the above pricing policy**: LRMC/AIC pricing including environmental costs are likely to have large welfare impacts on particular parts of society. The distribution of these welfare impacts needs to be investigated. Should these impacts be particularly inequitable, i.e. they impact adversely on the poor and/or reduce access to water supplies, policies supplementary to the LRMC/AIC pricing should be implemented rather than rejection of AIC policy altogether. Where equity considerations are implemented through the price of water this should be the responsibility of the Local Authorities (these policies are discussed in the Equity section).

- **The tariff setting should be an open process in which consumers are fully aware of what they are paying for**: This will help to overcome consumers' confusion over the nature of water tariffs, and perhaps encourage willingness to pay for water, combating non-payment.

- **Political commitment to the principle of full cost recovery**: full cost recovery is essentially a commercial concept with potential economic efficiency effects. As such the pricing of water should not be subject to political interference. Similarly, political intervention in cases of non-payment should removed[67].

4.1.1.2. Local Authorities

[67] Rehoboth is an example of where this has been the case, resulting in a strategy to ensure debt repayment by the LA and good incentives for future management of water resources are maintained.

As the final supply institution in bulk water supply it is important that the pricing policy of the Local Authorities represents all the costs associated with the bulk water supplier and local reticulation. Again there are issues of financial sufficiency and economic efficiency when considering this pricing policy.

At present the LA's only have the WASP and the Local Authorities Act as a guide to their water pricing policy. However it has been discovered less than 50% of those LA's surveyed has promulgated the WASP. Furthermore as described in section 3.1.2.2 that there are many issues concerning the price of water that need to be addressed. The issues and options are discussed below.

Efficiency and Full Cost Recovery

The optimal economic pricing of water has been described above. In common with many developing and developed countries, Namibia does not yet achieve full cost recovery. Achievement of financial full cost recovery for urban water supply should therefore be seen as a first step in achieving longer term financial and economic sustainability.

OPTIONS:

a) **Full Cost Recovery Tariffs**: for tariffs to maintain full cost recovery over time requires several conditions to be fulfilled:

   - price rises in line with inflation
   - price rises synchronised with the NamWater tariff increases
   - a fixed charge for connections and or meter reading aspect could be administered to ensure a degree of financial stability
   - full knowledge of the costs incurred in supplying water

b) **Economically Efficient Tariffs**: Tariffs should be volumetric (and water metered) to achieve economic efficiency. The debate over water metering in the UK has revealed that issues of cost can often prevent this being a viable strategy, however given the general predisposition towards metering, and the scarcity of water in Namibia, an assumption is made towards this being a viable strategy.

   The tariffs should include full knowledge of the costs involved in supplying water: bulk water costs, current and future reticulation/expansion costs. Again an AIC approach could be taken in which the LRMC is reflected in the tariff, providing the correct economic signal to consumers in their consumption decisions.

c) **Block Tariffs**: Increasing block tariffs are becoming popular in Namibia for reasons which reflect, amongst other things:

   - **Equity**: inequities in income distribution and a desire to secure access to minimum levels of water supply to the poor cross subsidised by the rich

   - **Water Demand Management**: the need for disincentive tariffs for water consumption

   Equity is discussed below. Economic theory states that the disincentive tariff, or conservation tariff, is best served by pricing at the LRMC. Prices in excess of this can provide perverse economic incentives to conserve water by restricting water use to uneconomic levels. Any price in excess of the LRMC can be considered as price discrimination based on water use, and loosely based on income levels. Price discrimination can be used in two ways:

   - **Life-line rates**: to subsidise lower water tariffs for lower levels consumption to ensure access for the poor.
   - **Profits**: to disperse profit making

   To promote efficiency LRMC/AIC pricing should be introduced in one of the blocks of an increasing block tariff structure. Two options are considered here:

- **2 blocks**: the first block should be a lifeline block should be subsidised at a level which allows access to minimum levels of water supply for the poorest individuals. The second block should represent the LRMC

- **3 blocks**: the first block as above. The second block representing the financial costs of current supply, the third block representing the LRMC.

It is considered unnecessary and overly complicated to introduce more than 3 blocks in such a structure. There are no economic efficiency gains that accrue from having more blocks. The second option may be a more acceptable way in which to use LRMC/AIC pricing on a municipal basis. However it is clear that if NamWater is using the AIC approach also, the financial cost to LA's will already include this to a large extent. **The arrangement between NamWater and LA's needs to be clarified.**

Of critical importance for the revenue sufficiency of a block tariff system for the LA is the size of the blocks. In Windhoek a loss of approximately N$10m was made as a result of a faulty block tariff. In Tucson Arizona, the blocks are set on the basis of measurements of the needs of particular households. Punitive tariffs are imposed for consumption levels higher than these norms.

Equity

Subsidisation of water is only economically justified where water is considered to be a merit good (see Box 2.6). Furthermore, the discussion in section 2.3.5 suggests that only in extreme cases will access to minimum levels of water supply not be affordable. Box 2.5 estimates that in Windhoek the water bill will be at most 11% of the lowest median income level in Namibia. This suggests that subsidisation of water should only occur in extreme cases and should be targeted. Given the equity problems associated with increasing block tariffs, illustrated in section 2.3.5, i.e. the subsidy to water is for all consumers, other options are worth considering.

OPTIONS:

a) **Lifeline Block**: Access to water, and the general issue of affordability can be addressed by having an initial lifeline block of water available at a subsidised price, as suggested above.

b) **Rebate system**: rather than having a lifeline block, to which all users have access regardless of wealth, it has been suggested that the subsidy to the poor be more directly targeted through a rebate system for those who consume less than a certain amount of water. This removes the universality of the subsidy. Although this is not a perfect means of targeting the subsidy, it is more appropriate than a pure block tariff system (Whittington and Boland 1999). This system may be open to abuse however, and should be monitored carefully.

Subsidies to water can be applied for reasons of equity in addition to the social efficiency criteria presented by merit goods. Some consideration of the percentage of income made up by water expenditures is an oft cited criterion for such decisions. The World Bank cites a 3% of income rule of thumb, often 5% is used (World Bank 1994, NEPRU 1997). Combined with standards regarding minimum levels of water consumption, such as the 25-30litres per capita per day cited by the WHO, this type of information can be used to determine the lifeline block or the cut-off point for the rebate system. Price discrimination can be used in the tariff system in order to achieve revenue sufficiency and access to water for the poor.

Political and Customer Acceptability

The same issues of political and customer acceptability present themselves to Local Authorities. Indeed being the last line of the urban supply chain raises the importance of these issues.

a) **Profit Making/Excess revenues**: the introduction of AIC pricing could lead to profit making as in the NamWater example. The options for profits/excess revenues are similar therefore. Many LA's make profits on their water account at present with no significant complaints from consumers.

b) **Transparency**: Again transparency of tariff setting is paramount if consumers are to adapt and accept changes in the tariff methodology

c) **Political Commitment**: LA's need to be committed to full cost recovery, enforcement of payment, equity and water demand management in order for the economic efficiency/financial cost tariffs to be effective.

d) **Stability**: If AIC pricing is to be introduced it must be done so gradually and thereafter remain stable and predictable. In many ways stability is one of the qualities of AIC pricing.

RECOMMENDATIONS:

The recommendations for pricing in LA's are as follows:

- **Tariffs should reflect precisely the full financial costs of water supply**: these costs include the bulk water cost, the current operations, maintenance, capital redemption and interest costs. This will require full accounting of the costs within a LA.

- **Tariffs should reflect the LRMC**: Much of the LRMC will be reflected in the NamWater tariff if the recommendations above are accepted. However, where the LA may require extra infrastructure for growing demands the future cost of this reticulation system or recycling system should appear in the tariff for water.

- **Block Tariffs**: the increasing block tariff should have a maximum of 3 blocks, the highest of which should be the LRMC as approximated by the AIC. The introduction of AIC pricing should be gradually introduced by the use of a 3 block system initially in which the level of consumption at which the AIC price is incurred is gradually reduced. It is this AIC pricing that should be considered the **conservation tariff**. The consumption level at which this tariff should be imposed should be determined by some measure of reasonable household consumption.

- **Equity**: the considerations of equity should manifest themselves in rebate system for water consumption less than a certain amount rather than a lifeline tariff block. The amount of the water below which a rebate occurs should be determined with respect to standards for minimum per capita consumption of water and rules of thumb percentages of the lowest income[68].

- **Environmental Costs**: Should any environmental costs specific to any particular LA occur then these should be included in the tariff where possible. This is subject to the same proviso's of equity as in the case of NamWater above.

- **Water budgets should be separate**: In order to ensure the maintenance of a working water infrastructure it is important that water revenues are spent specifically on the water system itself, and not for the subsidisation of other services.

- **Transparency**: the tariff setting procedure should be open to scrutiny. A distinction between the NamWater Costs and the costs within the LA should be highlighted. Similarly the reasons for environmental costs, catchment management costs and the like should also be highlighted.

[68] In the absence of distinct data on the social benefits of minimum access to water supply these standards and rules of thumb are the most sensible option for determining how much water is subsidised.

A tariff model for use in urban areas (LA's) has been developed as part of the tariff study. This model will allow simple calculation of the water tariffs for a local authority. However, at present there is no allowance for the specific inclusion of the LRMC in tariff setting procedure, only 2 blocks are allowed, and the rebate system recommended above is not incorporated in the calculation. If this model is to be accepted as a useful framework it is recommended that these factors be included.

4.1.2.3 Irrigation

Water for irrigation is subsidised by the government from state water schemes such as Hardap and Etunda. At Hardap alone the present subsidies amount to approximately N$4m per annum[69]. At Etunda subsidies to water are in the regions of N$2.00/$m^3$. Here subsidisation refers to the tariff being charged to the users of the water being less than NamWater's full cost recovery charge for water. This subsidy has historically lead to the growth of low value crops and the inefficient use of water. However, whether this is truly a subsidy is open to question.

As has been explained above, the NamWater cost recovery charge contains some sunk cost elements such as the depreciation charge on existing capital. Such elements are included in the tariff in order to account for the replacement of capital in the future. However, not only is the literal replacement of dams such as Hardap a fictional concept, the depreciation charge used by NamWater will bear no resemblance to this cost. Furthermore questions have been raised by interest groups in the Ministry of Agriculture as to the methodology used in calculating the tariff, particularly the inclusion of capital costs. NamWater is charged with the responsibility of maintaining the value of the assets as a commercial entity for the shareholders, the Government. As such there is a justification for charging capital costs. However, depreciation of an existing asset for which there are no direct financial responsibilities, as is the case at Hardap, is not considered to be an economic cost. Ultimately, the inefficiencies of monopoly provision of water should not be brought to bear on the irrigation sector, bringing to light once more the need for coherent regulation of pricing in the bulk sector.

In addition to the issue of depreciation, an issue which received extensive debate in South Africa during the drafting of their tariff policy, is the issue of scheme specific versus general pricing. There is a great deal of concern within the irrigation sector (which feels it has the most to lose from full cost recovery pricing of water) that the NamWater tariffs in certain regions reflect costs which are not incurred by their operations. E.g. electricity costs are charged at Naute which is a gravity fed scheme. This is another area for concern.

Where the price of water may be the crucial factor in maintaining economic activities such as irrigation it is crucial to look at the economic costs of water. The economic price for irrigation is the Long Run Marginal Cost.

The LRMC only includes expenditures on current operations and maintenance and future capital investments made necessary by the existence of irrigation. In the case of Hardap Dam such investments include the relining of the dam wall and the like, and will probably bear no resemblance to the cost of building a new dam in its entirety. Although the proposed NamWater irrigation tariff is perhaps unjustified on pure economic grounds, the LRMC as approximated by the AIC will not necessarily be any lower than the current or proposed NamWater tariff. As such the irrigation sector will require an adjustment period in order to internalise the change in tariff. This adjustment period is required because the changes in the irrigation techniques: movement towards drip irrigation and higher value crops for example, that are necessary to make irrigation viable for farmers, will take time to undertake and are often subject to their own constraints in the short term. In this regard it is recommended that in order to establish a culture of water payment operations and maintenance costs should be charged (at the very least) on a volumetric basis (Water Research Commission 1996).

There are likely to be some incentives for NamWater not to price irrigation out of the market however. Given the large sunk costs associated with Hardap Dam (and other schemes) there is likely to be room for negotiation of the price in the short term such that NamWater can maintain a reasonable cash flow.

[69] Based on the full cost recovery tariff of 12 cents per m^3, the current charge to farmers at Hardap of N$333 per haectare, 2500ha under irrigation and 16000m^3/ha/annum. Indeed 16000m^3/ha/a could well be an underestimate.

In the long-run irrigators will have to pay the full financial costs of water supplied from NamWater. Similarly, in the long-run the potential for transferability of water from Hardap to Windhoek for example means that the issue of opportunity costs will ultimately have to impress itself upon such water sources.

The WASP makes specific reference to a 'special subsidy' for irrigation on the basis of wider social benefits that agriculture conveys. There is a misconception that these wider social benefits; largely income and employment multipliers, should somehow feed back into subsidies for the water tariff. There is absolutely no economic justification for this type of input subsidy. Subsidies should always be as transparent as possible; explicit rather than implicit, and targeted to achieve some aim or objective. Where it is believed that there are significant multiplier effects that will be lost as a result of the economic or full financial cost pricing of water, there may be a justification for government intervention through a general subsidisation which bears no relation to water usage. However before this intervention occurs the existence of multiplier effects must be established in order to establish the returns to government expenditure.

It should be noted that a great deal of diversification has occurred in the irrigation sector partly as a result of the prospect of full cost recovery policies for water. Indeed given the higher levels of employment and the higher incomes earned from higher value crops, it is likely that a move to full cost pricing (AIC pricing for example) may increase the income and employment multiplier effects. However, there are still many places where water is used free of charge for irrigation, or where water is charged for on a per hectare basis as is the case along the Orange River, and the incentives to use water frugally remain low.

The options/recommendations for the irrigation sector as a result of this discussion are:

OPTIONS/RECOMMENDATIONS:

- **Economic Pricing**: the economic price of water at the state water schemes should be applied. This entails the calculation of a tariff in accordance with the recommendations in section 4.1.2.1 in the case of NamWater schemes, and in accordance with the costs involved in abstracting from the perennial rivers in the case of government permit issuance.

- **Gradual Implementation**: implementation of AIC pricing should be undertaken gradually in order to allow time for a change in production techniques. Operations and maintenance costs would be a good starting point and is currently being charged by NamWater at Hardap. This means the water subsidy is gradually reduced over time.

- **A Tiered Tariff System**: it has been suggested that a tiered tariff system, where the price of water increases for consumption above some level of irrigation deemed 'efficient' for a given crop, could improve the incentives for water efficiency (Water Research Commission 1996).

- **Explicit subsidies**: subsidies to irrigation should be explicit: if the intention is to preserve the agricultural incomes then this should be made explicit and an income subsidy used. In this way Government expenditure of clearly accounted for.

- **Metering**: volumetric charges should be levied in irrigators where feasible. This will require metering. This will be most appropriate along the Orange River monitoring is becoming important due to international commitments. Other areas of concern include Stampriet, the Maize triangle, Okavango River, and Hardap where the Government intervenes.

- **Scheme specific tariffs**: tariffs should be scheme specific and not entail general costs. e.g. the cost of water at Naute contained elements of the electricity costs, however it is a gravity fed scheme (Dudley Biggs pers. comment).

In addition to these recommendations it is crucial that the value of water in irrigation is investigated further. The initial estimates of Value Added per m^3 indicate that irrigation is the least productive use of water. However a common argument used against this assessment is that it ignores the multiplier effects (income and employment) of irrigation as a whole. This issue must be investigated further in order to determine a sensible economic argument about the value of water in irrigation.

4.1.2.4 Department of Water Affairs

The way in which the DWA charges for water has been discussed briefly above. Charging for the right to use water is the exception to the rule. There has been much talk about a resource use charge whereby all users of water resources should pay a charge for the permit. It is important that the economic rationale for this is clear, as well as the economic implications.

Resource charges

At present the permits for water use are largely issued free of charge. The exception is along the Orange River where water abstraction permits are issued on the payment of a fee per hectare of irrigated land. Groundwater permits and permits for the use from other perennial rivers are issued free of charge, even to NamWater. This could represent a loss of potential financial income to the government and the absence of a water management tool.

OPTIONS:

a) **Administration fee**: A fee could be charged representing the administration costs of processing the permit application. This option is currently in the process of being implemented.

b) **Volumetric tariff**: in order to promote the efficiency of water use from the various sources water fees should be charged on a volumetric basis. Along the Orange River it is expected that a volumetric charge for specific allocations of water will be implemented by South Africa. In this case the volumetric fee will be determined and must be passed on to water consumers. However, determining a sensible tariff for other water sources, such as groundwater may be difficult in the absence of any measurable costs.

c) **Resource charge**: A resource charge would reflect a payment for the right to use water which belongs to the government. It could represent a transfer of the benefits derived from the use of the resource from the user to the owner. It could be volumetric or a lump-sum and could be implemented for the following reasons:

- **Resource rent**: Resource rent only exists where scarcity exists and reflects either the depletion of a non-renewable resource, which denies potential future users, or the scarcity that arises from the competition for a sustainably used renewable resource, e.g. an allocation from the perennial rivers. As such the rent derived from a resource represents the ‘scarcity price’. The rent from water use will clearly differ between users depending upon their profitability, and may be difficult to calculate for all users. However, charging the resource rent can have several desirable properties:

  - **Efficiency**: charging the resource rent can ration water between competing users to a level of water use which coincides with sustainable resource use e.g. of groundwater or perennial rivers. Charging the resource rents will also provide the correct signal of scarcity when making the economic decision on the depletion of a non-renewable resource.

  - **Equity**: the resource rents charge will provide a return to the owner of the resource, the Government, and hence provide a transfer of benefits from users to the owners which can be used for other social purposes. Provided that those being charged resource rents are not the poor, this can be an equitable outcome.

  - **Sustainability**: if the resource rents are invested in reproducible capital sustainable economic development can be achieved in terms of maintaining a constant level of capital. I.e. the funds will allow some economic activity to be maintained after a

resource has been depleted. An example of this can be seen in Botswana where the rents from the mining of minerals are placed in a government trust fund for investment in other elements of the capital base described in section 2.5 e.g. education, health, infrastructure. This fund could also be reserved for investments in water supply.

There are difficulties that arise from the calculation of the rent for different sources and different users, which might prevent clear implementation of the policy. Furthermore, it may not be an equitable policy to charge resource rents to poor communities in the rural communal areas. Where scarcity does not exist, i.e. where there are sufficient water resources for every user, resource rents do not exist.

It should be made clear that where a charge is levied on abstraction permits for the bulk water supplier, this will be partly, if not mostly passed on to the consumers of water; LA's then residents, businesses etc. Furthermore, any charge for the use of water will have to be volumetric in order to evoke desirable efficiency outcomes, which will require metering of water use by the government or the individual user. Lastly any charge, be it volumetric or otherwise will need to be transparent and clearly justifiable.

RECOMMENDATIONS:

The recommendations are as follows:

- **Administration fee**: initially an administration fee should be introduced for water permits and the payment made directly to the issuing division; Law Administration at present.

- **Volumetric charges**: fees for irrigation should be levied on a volumetric basis in order to promote efficiency. This will require the metering of water consumption. This will be especially relevant along the Orange River.

- **Resource Rent charge**: in time, water should be rationed by price to the constraints imposed by sustainable resource use or international obligations. This will require significant information about the demands for water and may be better achieved by water markets (see section 4.1.3 below). This fee can be used to ensure the maintenance of a constant capital base in keeping with the requirements for sustainable economic development, provided the fee is invested in reproducible capital (see section 4.3 below). It can also be used as a transfer of economic benefits from the user of water to the owner, the Government, and can therefore promote equity. There should be provision for such a charge in the new Water Act.

4.1.3 Allocation of Water

For economic development to occur requires that scarce resources are allocated efficiently. Efficient allocation means that resources will be used in its highest value uses and hence contribute the most to economic development. In Namibia it is imperative that the scarce water resources are allocated between competing uses in a manner which maximises economic productivity whilst users are encouraged to use water efficiently.

4.1.3.1 Productivity of Water

Section 2.2.2 has illustrated the comparative values of water in the productive sectors of the economy through an analysis of water use and contribution to GDP (value added). This provides some insight into the **opportunity cost** of water. Such information can be useful from a multi-sectoral policy perspective, from an allocation and pricing perspective and from a sustainable economic development perspective.

Allocation Mechanisms

There are a variety of economic instruments available which can be used in order to facilitate the allocation of scarce water to higher value uses. Economic analysis measures the value of a resource largely through the willingness to pay for that resource and as such equity issues may not be addressed by strict efficiency criteria. The issue of equity is dealt with more in section 4.2 and should be seen as separate to, but equally as important as efficiency.

OPTIONS:

a) **Resource Rent/Opportunity Cost Pricing**: Inclusion of the **opportunity cost** in the price for water can improve efficiency of allocation. In addition to the supply cost components of the efficient price of water described above, the inclusion of the opportunity cost of water in the price would enable water to be directed to higher value uses since by definition only the higher value uses would be able to afford the water. This could be achieved by charging the resource rent.

b) **Water Markets**: Markets for water allow the opportunity costs of water to be assimilated through the interaction of willing buyers and willing sellers of rights to use water. An owner of a right to use water will be willing to sell that right (either in perpetuity or for a fixed time period) if another potential user can offer more returns than is expected from his own use of water. Often the creation of a water market can be a more efficient way in which to allocate or re-allocate water to higher value uses in the face of growing demands. There are several examples of working water markets throughout the world. See **Box 4.5**. Water markets require the existence of clear property rights to water and the absence of restrictions on trading (transactions costs). The separation of water rights from land rights is also necessary for water markets to function properly. Also the ability of water markets to re-allocate water is dependent upon the infrastructure that exists.

c) **Water Auctions**: Another market mechanism which can allocate water between competing users is that of an auction. Auctions are uncommon in the field of water resource management at present however this mechanism has been tried with some degree of success in Alicante, Spain and in Australia. In effect the distribution of water rights between competing users is determined by competitive bids in an auction. The design of the auction is crucial if collusion between bidders is to be avoided and incentives to provide real valuations in the auction are to be upheld.

d) **Policy Prioritisation**: Water can be allocated on the basis of general policy recommendations. At present water allocations is prioritised on the basis of the WASP of 1993. There is nothing particularly optimal or allocatively efficient about such a policy however and economists prefer market instruments rather than centralised control

Box 4.5 Water Markets

Examples of water markets include the water market in the Colorado Water Conservancy District, USA, and the market for water established in Chile.

Colorado, USA: The market for water was created with the understanding that water demand would vary between the local districts both annually and seasonally. In light of this the market mechanism has been ideally suited to distributing water between districts on a willing buyer/willing seller basis. The trade of water rights occurs through the government, farmers have distinct and enforcable user rights, information is freely available and hence the market can function relatively freely. Cost recovery is also achieved.

Santiago de Chile: Individuals receive private water rights for water on application to the government, by bidding for the use of new water or through outright purchase in the market. These rights are secure, tradable and transferable. A distinction is made between consumptive and non-consumptive rights, where the latter state that the user is legally bound to restore the water to a stipulated quality after use.
The legal and institutional framework under which the market for water operates involves both government departments and organized user groups. The user groups are very important in the enforcement of water rights, fee collection and general management of the infrastructure. Planning and

regulation is undertaken by the government departments, this includes adequate provision for the needs of third parties affected by externalities. Trading of water permits occurs between sectors, e.g. between agriculture and industry (hydro-electricity). Indeed, some cities in Chile have been able to purchase water from the rural farmers. This encourages the abandonment of inefficient water use practices by farmers and the adoption of new efficient technologies.

Efficient allocation of water resources at a price that reflects the scarcity of water has been the major success of the TWR in Chile. This arrangement has been partly responsible for the turn around in the agricultural balance of trade from deficit to surplus

South East Asia: In India it is estimated that 14 million groundwater pumpsets are engaged in water trading. In Pakistan 21% of all well owners trade water. In general these markets are entirely informal and therefore can be subject to third party effects (externalities) such as over pumping of groundwater. However, it has been found that the existence of water markets has increased the availability of water for those who do not own water pumps or have access to canals. The area under irrigation has been increased as a result.

South Africa: On the lower Orange River water markets have arisen as a result of water scarcity and the differing pumping costs that arise in farms further from the river. Those farms with high pumping costs can be expected to make lower profits from water use than those nearer the river. This fact and the recent increase in demand for water to supply the export market for table grapes has given rise to the trade of water permits.

Australia: Trading of water rights has been introduced on top of the existing riparian framework allowing the transfer of water rights from one user to another both within specific sectors (e.g. agriculture) and between sectors. It has been estimated that the marginal value of water has doubled since water markets were introduced in Australia.

In the economic gains from water markets include the improved efficiency of water pump management, reduced conveyance losses and improved in-farm efficiency. Because water wastage can be sold in the market there are significant incentives to reduce wastage and improve efficiency.

SOURCE: Winpenny 1994, O'Riordan 1997, Easter et al 1999.

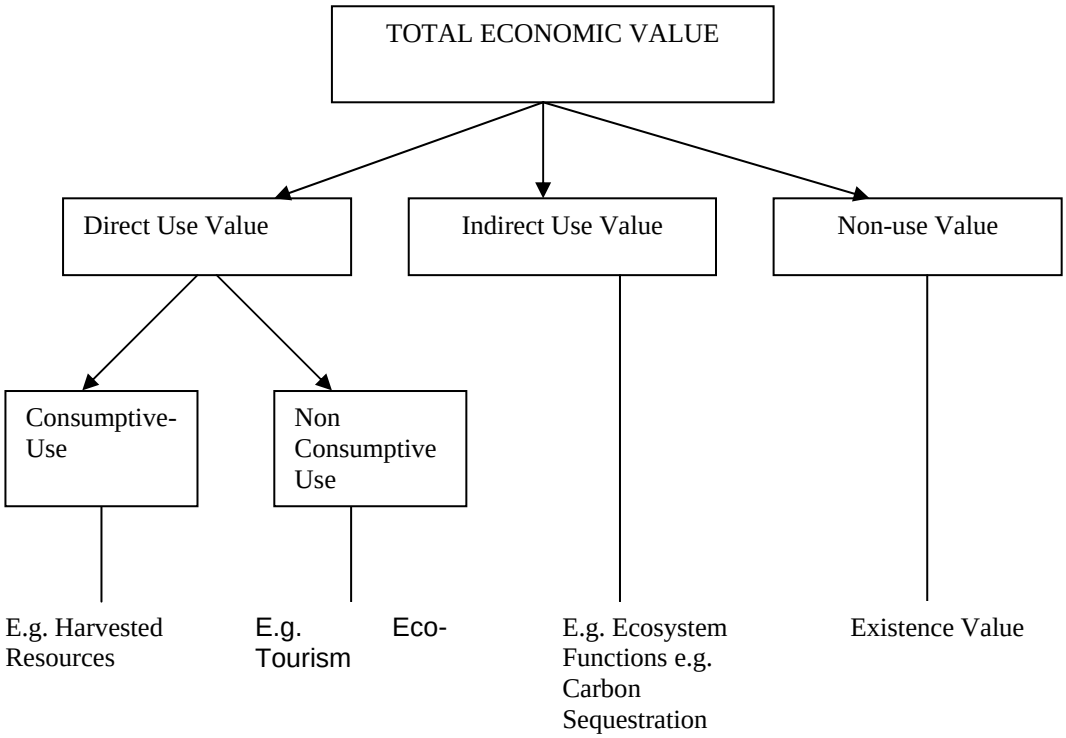
Opportunity cost pricing is information intensive and would be a centralised policy open to political and other manipulations. Water markets on the other hand would allocate on a willing buyer/willing seller basis and hence the responsibility for allocation would be devolved to a consumer level. The use of water markets will require a separation of water rights from land rights and a movement away from the riparian ownership of water as stipulated in the Water Act f 1956 and as used as a means of allocating permits by the DWA in areas like the Orange River. The role for government would be largely regulatory and would include ensuring that equity goals are upheld, that externalities are kept to efficient levels and that sustainability is maintained. The possibility of trading water internationally should be considered where rights to water have been established and higher value uses of water are likely in other countries.

4.1.3.2 Total Economic Value

The value of water is not simply represented by the economic productivity from consumption by industries and residential areas. In addition there are environmental values, ecological values, use values and non use values. In essence decisions regarding the allocation of water should be mindful of the **Total Economic Value** of water. This concept is described in **Figure 4.1**.

Figure 4.1. The Total Economic Value of Natural Resources[70].

[70] Adapted from Munasinghe, 1994 as shown in Barnes et al 1998)



Direct use values are derived from the direct income generation that arises from consumptive and non-consumptive activities such as:

- Water consumption: drinking and hygiene purposes
- Water as an input into other activities such as irrigation and livestock production
- Fishing
- The use of riparian plants
- Tourism

Indirect use values derive from the functions that water and associated ecosystems may provide such as:

- assimilative capacity for human waste
- contributions to the hydrological system such as groundwater etc
- the global ecological values: carbon sequestration, climate control etc.

Non-use values are those associated with the existence of water resources or associated habitats and these values are by definition held by people who do not use the resource.

In an ideal world the management of water resources would be undertaken with direct knowledge of the values shown in Figure 4.1. However, in reality many of these values are difficult to measure particularly those associated with ecosystem functions and existence values. Similarly there is often no mechanism to transfer these values from those who hold them to those making the management decision. However, this framework for analysis is useful for making economically rational decisions about water allocations and management.

The valuation of environmental values and the establishment of linkages between consumptive uses and environmental damage is required in order for environmental costs to appear in the water tariff.

RECOMMENDATIONS

- **Full cost pricing**: as recommended in section 4.1.2 should be recommended for its allocative efficiency qualities

- **Water Markets**: there are only certain contexts within which water markets and tradable water permits will be a realistic way in which to allocate water. Any such system will have to be monitored by a regulatory agency/government in order to minimise externalities and ensure equity. At this stage the most sensible Recommendations are:

    - **The new Water Act should make provision for water markets in the future**

    - **The possibility for the implementation of water markets should be investigated**

- **Policy regarding water allocation should consider the TOTAL ECONOMIC VALUE of water e.g. the economic productivity of water, equity considerations and environmental values**: the opportunity cost of water should guide policy makers in prioritising water across sectors such that scarce water contributes optimally to economic development. This could involve charging the resource rent in certain circumstances.

At present it is expected that there are several areas in which water markets may be a viable option. These include:

- **The Lower Orange River**: there is evidence to suggest that is being valued and speculated upon through the sale of land along the Orange River. At the same time permits have been issued which are not being used to their full extent. For example the Aussenkehr farm holds a permit for 13.2Mm^3/a abstraction from the Orange River but only uses approximately 3Mm^3/a. This could potentially preclude the use of that water by another farmer. It is speculated that the existence of a water market could release water for other users an dtherby increase the economic activity along the Orange River

- **Central Areas**: Water is currently being transferred from the north (Berg Aukas mine) to Windhoek. Similarly the Tsumeb aquifers are considered to be another supply augmentation option for Windhoek. A water market could be set up to ensure that a) the water transfer was economically viable and b) the previous users were compensated for their loss.

- **Hardap**: Water could be traded between irrigators at Hardap to improve seasonal and annual water allocations. Furthermore, the possibility of transferring water from Hardap to Windhoek could be enhanced by the use of a water market.

4.1.3.3 Property Rights

Even with the ownership of water resources vested in the state, the property rights to water use can yield perverse incentives for resource abstraction efficiency and sustainability. Where groundwater is an open-access resource depletion can be accelerated. Where control and enforcement of the permit conditions is lacking there are perverse incentives for water use. It is clear that the issue of user rights is of paramount importance if the ownership of water by the state is to ensure sustainable and efficient use of water.

Private property rights provide better incentives for the efficient use of water. However, where private property rights exist, potential externalities and equity considerations should be monitored.

RECOMMENDATIONS:

- **A review of the current property rights regimes in Namibia**: particular areas of concern are:
    - So called ‘private water’ i.e. water outside of the groundwater control zones

- The ‘use or lose’ aspects of water rights on the Orange River, which may encourage low value uses of water
- The link between land ownership and water rights could be inequitable and inefficient

4.1.3 Sectoral Economic Policy

The example of agricultural policy (see section 2.2.3) shows that any progress in the field of water resources management can be undone by the prevalence of sectoral policies which ignore the scarcity of water resources. However, the existence of a comprehensive, largely excellent, but unused drought policy shows the importance of the implementation side of policies.

The arguments against food self-sufficiency are persuasive (see Section 2.2.3). These arguments suggest that Namibia should rather import cheaper grains and concentrate on its comparative advantage in the export markets. Importing grains can be seen as an import of ‘virtual water’, allowing water that would have been used in the production of grains in Namibia, to be used in higher value sectors.

RECOMMENDATIONS:

- **Compatibility of sectoral policies with water sector management strategies**: Currently this will involve the following changes in the agricultural sector:
    - **Removal of the protection of low value crops (agricultural liberalisation)**: the current welfare effects of this strategy are highly inequitable.
    - **Rejection of Food Self Sufficiency as a viable agricultural policy**: this argument has been popularised by the use of the term ‘virtual water’.
- **Industrial/mining/trade policies should continue to be mindful of water scarcity**: water prices should not be used as a strategy to attract investment to a region. Wet industries should be subject to water audits
- **Consistent implementation of the existing Drought Policy**

4.1.5 Future Water Supply and Water Demand Management

Section 2.4 uses Windhoek as an example of the situation facing many of Namibia’s urban centres at present. Water consumption is increasing and the conventional supply options are becoming more expensive as the cheapest most practical options have been used already. The focus has turned to water demand management as a means of using existing resources more efficiently rather than tapping new sources of water.

In Windhoek however, the use of both supply side and demand side measures has proven to be a highly effective means of improving the efficiency of water management. The combination of demand and supply side measures, which monitors water from the source to the consumer is the back bone of an integrated approach to water resource management. The principles of Integrated Water Resource Management (IWRM) should be embraced throughout Namibia.

Water Demand Management
The history of under pricing of water and supply orientated approaches to water management has given rise to a paradigm shift in the water sector. Managing demand has become the focus of this shift in many water scarce countries in both the developing world and the developed world. As has been shown in Section 2.4, there are many dimensions to water demand management. Many of these facets have been discussed above under a different name, and are repeated here for clarity.

OPTIONS:

a) **Pricing**: in economic terms the full cost pricing of water, as described in section 4.1.2, is one of the main water demand management tools. This is especially so in places where water has historically been subsidised as is the case in Namibia. Aside from the financial benefits that such a strategy affords, and the subsequent improvements in service quality and institutional sustainability that arise, full cost pricing can reduce demand and allocate water to higher value uses. This alone can eliminate the need for water supply augmentation

b) **Water Markets**: In so much as water markets can re-allocate water from one user to another, and improve the economic returns from a given supply of water, water markets can be considered to be useful water demand management tool. In many cases reallocating water from one user to another will be a much more efficient strategy than supply augmentation. Auctions can also be used to this end.

c) **Moral Suasion**: Encouraging consumers to be frugal in their water consumption can be an effective strategy to reduce water demands. Public campaigns, the use of the media, and information regarding the extent of water supplies can be effective strategies. In reality, moral suasion is rarely effective in isolation and must be backed up with measures such as pricing, fines for wasteful use, regulations etc.

d) **Technical Measures**: retrofitting of water inefficient devices, the reduction in water system pressures, the introduction of meters etc, are all considered technical measures to reduce water demand. Again measures such as retrofitting will be best encouraged through the parallel implementation of pricing, moral suasion and fines for wasteful use. There must be an economic incentive in place for consumers; residents, businesses and industry, to invest in such strategies.

e) **Demand Projections**: section 2.2.6 illustrates how demand projections have generally been erroneous in the past. Demand predictions which attempt to predict when future supply augmentation may be necessary should be mindful of the effects of WDM: pricing, moral suasion and the like, if they are to offer any real guidance for decision-makers. Pricing can be a powerful tool to help curtail demand and potentially diminish the need for water supply augmentation.

Any strategy that is introduced should be subjected to a cost benefit analysis in the same way as supply augmentation schemes should because there is nothing about WDM that is intrinsically desirable. In the past WDM has been implemented as a crisis measure in response to drought. There is a strong case for many of the facets of WDM to be implemented on a day to day basis to encourage efficient water use at all times.

Water Supply Management

Water supply management can describe the efficient usage of current supply infrastructure and the implementation of 'unconventional' supply techniques such as artificial aquifer recharge.

OPTIONS:

a) **Reduction in Unaccounted for Water**: reduction of leakages, illegal connections, faulty meters and accounting errors can improve the efficiency of current water supply infrastructure. In NamWater and many local authorities it is likely that targets should be set for unaccounted for water.

b) **Improvements in Operational Efficiency**: current examples include:

   - evaporation reduction in the three dam system
   - conjunctive use of groundwater and the three dam system in Windhoek

   The extent to which similar improvements can be realised in other parts of the country needs to be investigated.

c) **Unconventional water sources**: the unit cost of many of the so-called unconventional water sources described in section 2.4 is lower than the current bulk supply price and the future supply augmentation cost. The use of these types of sources: artificial recharge, recycling and re-use of effluent need to be investigated further.

d) **Supply Augmentation**: if demands (backed by a willingness to pay) continue to grow it is likely that supply augmentation will become economically viable.

e) **Full Costing of Water Supply Options**: Whether or not unconventional water resources are competitive on the long-run when compared to water supply augmentation will require a full cost benefit analysis into the various options. Given that many of the recycling options do not entail environmental costs like those associated with the large supply augmentation options there is a *prima facie* case suggesting that unconventional sources will have the competitive edge. For this edge to be realised will require a full analysis in to the full economic costs of each option.

Integrated Water Resource Management

The Rio Earth Summit of 1992 and the resultant Agenda 21 described IWRM as follows:

'Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilisation'.

Planning for water resource management needs to be integrated across the relevant supply institutions and stakeholders, from the supply side to the demand side, from the source to the consumer. In Windhoek the management of water resources and water demand has required the integration of the Windhoek Municipality with NamWater on the issue of artificial recharge. Similarly, the Windhoek municipality is aware of the need for water demand management and reductions of unaccounted for water as a result of clear information supplied by NamWater on the extent of available resources.

On the coast however, there appears to be a lack of integration between NamWater and their bulk clients. Some potential participants in the desalination scheme have up to 40% unaccounted for water. It is possible that in this instance supply augmentation is not the correct way forward. This example illustrates the need for integration across institutions and a general need for integrated planning of future water resources.

OPTIONS:

Integrated Planning is required in the water sector including specifically:

(Integration in the water resources management literature refers to the concept that the water is an integrated part of the whole Eco/social system – surface water and groundwater are related by recharge, water's quality and quantity must be assessed in the context of economic, social and environmental impact, use of water in one activity may well impact others activities. (I.e. issues of water do not start and stop at the standpipe).

a) **Integration of Institutions**: in order for the most efficient water supply investments to be undertaken requires the institutions responsible for water supply to collaborate with those affected by their decisions: residential, industrial and other consumers, environment etc. This means inter-ministerial, inter-sectoral and consumer collaboration.

b) **Integration between Countries**: In the case of the shared perennial rivers, decisions regarding water use should be mindful of the international obligations and potential trans-boundary externalities.

c) **Consumer Demand**: In order for a bulk supplier to make economically efficient decisions regarding the scale and timing of supply augmentation requires clear knowledge of the strength of consumer demand. This essentially requires knowledge of what consumers are willing to pay for

water. Knowledge of consumer demand is another level of integration required in order to make decisions regarding water supply augmentation and management. The use of LRMC pricing will provide clear signals as to the strength of demand.

Only when the demand side and the supply side of the water equation are considered will an economically efficient outcome be likely. IWRM will help to provide residential consumers, businesses, industries etc, with clear signals as to the extent to which it is viable to invest in water saving devices given the best available information with respect to the future cost of water.

RECOMMENDATIONS:

- **Integrated Planning**: planning of significant water supply augmentation needs to be integrated on many levels:

    - Between water supply institutions: local authorities, NamWater, the Department of Water Affairs

    - Between stakeholders: customers, environment, third parties etc

- **Water Demand Management**: WDM should be promoted in many water scarce regions as a alternative to supply augmentation. Of the various facets of WDM, full cost pricing as recommended in section 4.1.2 should be implemented along side the institutional changes recommended in section 4.1.1. In combination these practices should improve the efficiency of water supply and demand. Sectoral strategies should also be developed.

  WDM should be the constant thrust of water resource management and not just a crisis measure. In sum the promotion of WDM in Namibia should be crystallised in a national WDM policy.

- **Supply Augmentation**: When major supply augmentation is considered it should be subject to a full cost benefit analysis. The decision to invest should be dependent upon the strength of consumer demand as measured by the willingness to pay. Although the current focus of water resources management is focussed on WDM at present, it should be noted that in situations in which the demand for water is increasing, supply augmentation is likely to become desirable at some stage.

4.2 EQUITY

Given the stark income inequalities that exist in Namibia the issue of equitable access to water resources is of paramount importance.

4.2.1 Willingness and Ability to Pay

In isolating the key issues a distinction has been made in Section 3 between rural and urban areas. This reflects the different management policies in place in urban and rural areas, the different issues that arise and the different tools available to address the issues.

4.3.1.1 Willingness and Ability to pay in RURAL Areas.

The CBM policy in for rural water supply may be unaffordable to many communities. Evidence suggests that contributions based on 5% of median incomes would not be sufficient to cover the costs of operations and maintenance of water supply points in many regions. This also implies that the ultimate goal of full cost recovery (including capital costs) may not be a feasible proposition. This may be compounded by the inability of the community to mobilise resources or to enforce payment. Therefore the CBM strategy may not be a sustainable institutional arrangement to ensure equitable access to water.

However, the actual willingness to pay in rural areas has not been established. I.e. how much people are willing to pay for water. Similarly, payment for water which reflects the income disparities within rural areas has also not been investigated broadly. Cattle owners for example, could value water supply much more than the 5% median income measure may suggest on account of the value of their cattle. Furthermore the issue of gender is likely to play a strong role in determining equitable access to water.

Given this it may be necessary for the government to subsidise water to certain rural communities where ability to pay is a problem.

OPTIONS/RECOMMENDATIONS

a) **Livestock Tariffs**: A tariff based on the number of cattle owned by a particular person should be introduced. Livestock numbers are a reasonable proxy for wealth/income and as such acts as reasonable grounds for price discrimination. Such a system has been implemented in the Omaheke region where a fee of N$2 per head of cattle per month is levied. This may enable some **cross-subsidisation** between the richer and poorer members of the community and improve access to water supply for the poorer sections of the community.

b) **Gender orientation**: given that women are often most closely involved with water in many rural areas, it is most often women who benefit the most from improved access to water. However, women are often not in possession of cash resources and therefore may not always be able to register their willingness to pay for these improvements. This element of Willingness to Pay needs to be investigated.

c) **Willingness to Pay study**: as suggested in section 4.1.1.4, a willingness to pay study would be a useful tool to determine:

   - the economic benefits from the provision of water to rural communities
   - whether the CBM policy will be a sustainable way in which to ensure access to water
   - determine where future investments in water supply in rural areas are economically viable
   - give guidance on where subidisation may be required/justified.

d) **Subsidisation**: whether subsidisation should be implemented by the government should be analysed. The use of government funds to ensure access to water in rural areas should be measured against other potential uses of these funds; education, health, etc. It may be that the encouragement of a movement to more concentrated centres of population would be beneficial in the long run, and would ensure that access to water is ensured at a lower cost to the economy.

   Where currently subsidised water is being used by wealthy communal farmers, it is clear that this is not undertaken for reasons of social equity. Subsidies should target the poor. Where cattle or livestock ownership is not high, the scope for cross subsidisation is reduced and the potential need for government subsidisation, with the proviso's above, is increased.

The ability of a community based water point committee to charge discriminatory prices for water will depend in large part on their institutional power and legal status. The ability to exclude non-payers and charge users from inside and outside the community will depend strongly upon institutional strength.

4.2.1.2 Willingness and Ability to Pay in URBAN Areas

The extent to which access to water can be improved for the urban poor rests largely in manipulation of the water tariff at a local authority level. The discussion of tariffs in section 4.1.2 above suggested the use of a rebate system for addressing the issue of equity whereby a rebate is given to water consumers if they consume less than a specified amount of water per month. Those who consume more water do not receive the rebate. Although this system is not common it removes the universality of the subsidy associated with a lifeline block of an increasing block tariff system.

Some of the problems associated with block tariffs remain with the rebate system, but until there are clear ways in which price discrimination in water tariffs can perfectly reflect the incomes and family

sizes of water consumers, the rebate system provides a more appropriate tariff system to ensure access to water. Ultimately there are likely to be extreme cases where the urban poor are not able to afford even the subsidised water tariff of the rebate system.

Where non-payment is a problem the roots of the problem need to be analysed to determine whether ability to pay or willingness to pay is the cause. Where willingness to pay is the issue, often the remedy may be addressing transparency, or enforcement. The issue is strictly concerned with equity where ability to pay is in question.

RECOMMENDATIONS:

- **Tariff Structure**: The recommendations for equity in urban areas as addressed by the tariff structure are therefore the same as those in section 4.1.2.2.

- **Cross Subsidisation**: given the inequalities in urban areas, the potential for price discrimination, i.e. charging the rich higher prices to subsidise the poor needs to be investigated. This will require knowledge of WTP and incomes.

- **Social Security Vote**: In cases of extreme poverty it is recommended that subsidisation should be effected through the social security vote such that the water consumption decision is still based on a volumetric price and the culture of payment for a service is maintained. This is in line with the WASP 1993.

4.22 Water and Poverty Alleviation

Water is often seen as the key constraint to economic development and poverty alleviation. In fact water is just one dimension of poverty in Namibia. The discussion on agriculture in section 2.2.6 and water and poverty in section 2.3.5.1 suggest that this may not be the case, and that a variety other constraints to development and poverty alleviation exist. These constraints include: the carrying capacity of land for livestock, the existence of markets for agricultural goods, lack of skilled labour, high transport costs for inputs and outputs etc (World Bank 1996). In certain cases the supply of water can lead to a reduction of income generating possibilities through the encouragement of concentrated grazing in areas where water becomes available. This can lead to irreversible environmental degradation in the vicinity of water points and the termination of income generating possibilities . The link between water and poverty is not clear in general and should be established before this presupposition enters into a poverty alleviation policy.

Drought, however is one clear example of the link between water and poverty/reduced income generating possibilities. Indeed GDP is often reduced as a result of drought, particularly contributions from the agricultural sector (MAWRD, 1999) . At present the incidence of drought is dealt with by the government on an ad hoc basis. One response has been the emergency siting of boreholes in rural areas in order to provide water for cattle and people. This crisis response has had detrimental environmental effects and reduced the livestock carrying capacity of particular areas. The implementation of the drought fund which has regular budgeting for drought rather than ad hoc expenditures, is likely to improve public expenditure management and the governments response drought to poverty alleviation (NEPRU 1999). Similarly, and in line with the drought policy, income generating activities should become less dependent upon uncertain rainfall.

In urban areas the use of an increasing block tariff system has been motivated on many grounds including income re-distribution. The extent to which income can be redistributed, and hence poverty alleviation impacted, by such a tariff system is often small. Box 2.6 suggests that the maximum possible subsidy may amount to 8% of income, however, this requires significant water consumption and also a significant outlay of 20% of income. In this scenario income redistribution is tied to water consumption and can be dependent upon the ability to pay for water in the first place. There could be adverse effects in terms of water conservation also.

In general there are much more efficient ways in which to redistribute income than through the water tariff regime e.g. general taxation policy; pensions, social security etc, all of which may be able to target poverty more precisely.

Historically, access to water resources has been denied to the poor. Very often the ownership of water rights was and is tied to the ownership of land. This already biases access to water in favour of those who can afford private land. The CBM strategy is attempting to overcome this issue by placing the ownership of water points in the hands of the communities. Whether this strategy is sustainable is open to discussion (see above). Equitable access to water is a clear goal for government policy in the water sector, however how this is to be most efficiently achieved is not obvious.

RECOMMENDATIONS:

- **Water Tariffs**: the use of increasing block tariffs of the rebate system recommended in section 4.1.2 should be implemented under the rationale that access to minimum levels of water consumption are desirable on the basis of water being a merit good. The extent to which water tariffs are used to redistribute income should be limited to a level which can give effect to this.

- **The link between water and poverty needs to be established**: The availability of access to safe water for basis needs and the requirements for subsistence agriculture is of essense. The extent to which improved access to water supply will alleviate poverty is unclear. Whether there is a clear link or not will depend upon:

    - the economic uses for improved water supply (industry, livestock, irrigation etc)
    - health benefits from improved water supply
    - the opportunity cost of time spent collecting water (particularly women)

  investigations into these factors should be undertaken to determine how and where water should be supplied in the most effective manner to achieve poverty alleviation.

- **The Drought policy**: responses to drought should be planned for, sustainable and in line with the current drought policy.

- **Economic Development**: there is a strong link between income growth and poverty alleviation. In this sense it is advised that poverty alleviation strategies should focus on increasing incomes rather than upon water provision *per se*. Increasing incomes will also address the other equity problems such as willingness and ability to pay.

4.3 SUSTAINABILITY

A choice has been offered in section 2.5 between **sustainable resource use** and **sustainable economic development** as decision rules for water resource management[71]. Sustainable resource use guarantees that the natural water resource capital base is maintained, and conforms to constant capital rule for sustainable economic development. However, higher levels of economic development may be possible from depleting water resources and substituting them for other types of capital. Here sustainable economic development can be achieved in the absence of sustainable resource use in cases where water is not seen to be 'critical capital' i.e. an irreplaceable resource.

In reality the constant capital rules for sustainable economic development are rarely taken to their theoretical conclusion i.e. the valuation of all environmental capital is rarely undertaken due to its data intensity, its inherent subjectivity and also theoretical criticism about the desirability of a particular level of capital in an economy. However, estimates of this indicator of sustainable economic development do exist (Pearce and Atkinson 1993, Pearce 1993). It has been calculated for Namibia that the 'genuine savings' (i.e. the change in the overall capital stock taking into account the depreciation of natural and man-made capital) were +1.5% in 1997, indicating a non declining capital stock. (Hamilton 1999). Similarly, in economies largely dependent upon natural resources, as is the case in Namibia, analysis is often undertaken to ensure that the economic benefits from particular sectors e.g. mining,

[71] The latter allows depletion of water resources provided they are replaced by some other capital resource.

are used to foster development countrywide. Often this means ensuring the rents derived from the resource are invested rather than consumed.

The analysis of sustainability/sustainable economic development from the constant capital standpoint provides some insights for the water sector into how to manage water resources sustainably whilst contributing as much as possible to economic development. These insights can be broadly summarised.

Natural Resource Accounting
In order to analyse the sustainability of water resource usage requires distinct knowledge of how and where water resources are being used in direct conjunction with data on the availability of renewable and non-renewable water resources. The contribution to economic development can be judged partly by analysis of the contribution to GDP resulting from these uses. Only when these data are known with certainty will water managers be able to make clear judgements of whether specific patterns of resource use are a) sustainable from a sustainable resource use basis and b) contributing significantly to economic development.

There is a clear rationale for accounting for water use and the availability of water resources for the pursuit of sustainable resource use and/or sustainable economic development.

Non-renewable Water Resources
Where water resources are non-renewable, sustainable resource use is impossible. Continued abstraction will result in depletion. In such cases it is unlikely that a sustainable resource use management rule will be a beneficial strategy. In such cases, or in any cases where water resources (groundwater mainly) is being depleted, it makes more sense to consider the insights of the constant capital approach to sustainable economic development.

Maintaining a constant level of capital requires that the rents from resource depletion (usefully thought of as the profits attributable to water) are reinvested in reproducible capital. In situations such as the Koichab Pan, where water is being mined, the price of water should reflect the amount of money required to build a fund sufficient to replace the mined water with some equivalent man-made human or social capital. It is important to identify the substitutability of water and the existence of 'critical water capital'.

Critical Capital
Water can be thought of as critical capital where its *in situ* role is the support of functions vital to the global ecosystem and/or because it is critical for human life. Where water is critical capital, sustainability requires sustainable resource use limited to the extent to which its critical *in situ* values are maintained and to the extent that its critical human values are maintained over time. In general this means sustainable resource use is required and certain water resources must be maintained.

One way in which this has been addressed is through the imposition of an **ecological reserve** which stipulates that the environmental requirements of watercourses receive a priority allocation of water such that the ecological functions are preserved. Reference to an ecological reserve appears in the latest South African Water Act.

It is clear that the establishment of an ecological reserve should be subject to economic analysis such that the balance or the between environmental and development objectives is addressed. The concept of **Total Economic Value** should be applied to water when decisions are to be made as to its exploitation or preservation. **Figure 4.1** in section **4.1.3** describes this concept.

RECOMMENDATIONS:

Given the complexities of maintaining a constant capital base for the economy as a whole, the initial focus for sustainability should be on the water sector alone. This does not preclude substituting water resources for other forms of capital such as water efficient devices etc, but rather advocates that however water is used, the usage should be limited to the sustainable yield. Indeed, the following principles have been recommended for the use of natural resources to ensure sustainable economic development (in Schiffler 1998):

- **Renewable resources should be harvested within their regenerative capacity**: this strategy must be mindful of the need for groundwater overdrafts in times of drought. A suitable length of time over which abstractions should equal recharge needs to be developed.

- **Non-renewable resources should be depleted at a rate which does not exceed the rate at which renewable substitutes are developed**

The following recommendations follow from this:

- **The extent of renewable water resources in Namibia needs to be established**:

    - recharge of groundwater aquifers
    - allowable abstraction from perennial rivers

- **Thorough accounting of water abstraction needs to occur**

- **Ecological Reserves should be developed**: as incorporated into the latest South African Water Act, an ecological reserve for perennial rivers, groundwater and should be established.

- **The Natural Resource Accounting program of the Department of Environmental Affairs, Ministry of Environment and Tourism should be wholly participated in and used as a decision making tool for water resource allocation**