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**AN OVERVIEW OF
BRITISH AID FOR WATER IN
DEVELOPING COUNTRIES**

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BRITISH AID FOR WATER IN DEVELOPING COUNTRIES SUMMARY

Purpose

This paper draws together ODA's recent water related work, builds upon the lessons learned and highlights the contribution that water related projects can make in advancing ODA's aims. It provides an overall framework to assist country programming.

Coverage and structure of the report

The report restricts itself to freshwater resources as they affect domestic use, agricultural and industrial use and also the coastal interface where freshwater interacts with the marine environment.

Chapter 1 sets water in the context of ODA's aims while Chapter 2 looks at available water resources and access to water in a global context and the problems that confront the sector. Chapter 3 examines how aid has been used for water related projects and how these promote ODA's objectives; the lessons that have been learnt; and, the challenges that remain. Finally, Chapter 4 describes how ODA might build on the experience and strengthen its interventions in the sector.

Highlights of the report

Support for the water sector is an essential component for the promotion of sustainable economic and social development; water projects underpin three of ODA's aims, but notably enhancing productive capacity and conserving the environment; and, helping people achieve better education, health and opportunity, particularly women.

Freshwater resources are increasingly under pressure and large numbers of poor people are still deprived access to minimal amounts of clean water and adequate sanitation. Competing needs of agriculture, industry and the environment must also be met. Sound policies and capable organisations are required to manage the resource effectively, ideally on a hydrological basin basis. ODA and other donors have done much to address these needs and put in place sustainable water management practices but much remains to be done.

ODA finances a diverse range of water projects which bring services to the poor, strengthen utilities, increase production from irrigated agriculture and fisheries, support industry and protect the environment. The portfolio of water projects reflects well the importance of targeting activities on the poor and promoting participation, institutional development and the role of the private sector.

UK NGOs have a growing involvement in the sector and an enviable reputation for supporting communities develop sustainable services. Environmental protection projects are attracting an increasing number of concessional loans. An active research programme is developing better ways of assessing and managing water resources worldwide, investigating appropriate technologies, promoting more effective organisational structures and a better understanding of the social, health,

institutional and technical interactions in sustainable water resource development. A number of channels for coordination with other donors have been established.

The pressure on water resources does however present a growing challenge. A number of options are identified to improve the effectiveness of future assistance.

Conclusions

ODA has extensive experience of water sector projects and community development. The UK has a strong resource base to build on this work. Assistance in water is crucial in promoting sustainable development. ODA should publicise the wide range of activities it supports in the sector and the role these play in alleviating poverty and promoting sustainable development, and encourage public debate and investments in this sector.

There is increasing concern over the allocation and management of water resources. A number of donors, including ODA, have identified the need for a more strategic and comprehensive approach to address these concerns. There is a need to focus attention on sector programme approaches in a limited number of countries, where intervention in the water sector can contribute to achieving country strategies.

This report suggests that ODA should place increased emphasis on:

***integrated water resource management including:**

- water resource assessments
- sector policy development
- a shorter list of focus countries
- increased donor coordination

***sustainable water supply and sanitation provision including:**

- greater efficiencies in utilities
- decentralisation of management responsibilities (community management with particular attention to the role of women)
- expanding the role of non-government organisations
- co-financing opportunities

***water for sustainable food production including:**

- greater efficiencies in water use
- decentralisation in irrigation management (involvement of user groups)

***protection of water resources**

- appropriate environmental controls
- greater re-use of water.

In order to take these suggestions forward and provide a focus for water spanning the disciplines, it is proposed that a "water focus group" comprising representatives of relevant Advisory Groups is established to coordinate and monitor activities in the sector. A cross-section of key target countries should be identified in discussion with geographical desks and sector targets jointly agreed.

CHAPTER 1 WATER IN RELATION TO ODA'S AIMS AND OBJECTIVES

Water-Essential to Life and Development

1.1 Water is essential for life and health. All human beings have a basic right of access to clean water and sanitation at an affordable price. Its availability also contributes to a wide range of economic activities, many of them undertaken by women.

1.2 Water is important for agriculture, industry and energy generation. It is also a core part of the environment and home to many forms of life which are sources of nutrition. Water resources are under increasing pressure from rapid population growth, urbanisation and industrialisation in many developing countries which are also home to over seventy percent of the world's irrigated crop land.

Box 1.1

This essential role for water is internationally endorsed:

"Some for all rather than more for some"
Global Consultation on Safe Water and sanitation for the 1990s, New Delhi, 1990

"..it is vital to recognise the basic right of all human beings to have access to clean water and sanitation at an affordable price"
Dublin Statement, International Conference on Water and Environment, Dublin, 1992

Challenges

1.3 The vital role of water for development is recognised world-wide. There is now a growing consensus that current practices for managing water are unsustainable from both an economic and environmental point of view. Demographic pressures, over-exploitation of freshwater resources and pollution are rapidly reducing the quantity and quality of available water. This competition for finite water resources and the risk of water-borne diseases are growing threats to security.

1.4 The United Nations Conference on Environment and Development (UNCED) highlighted the importance of integrated water resource management, universal access to drinking water supply and sanitation, management of water for sustainable food production, and rural development. It recognised that utilisation today must not undermine the developmental and environmental needs of present and future generations.

Water and ODA's Aims

1.5 Water, by its essential nature and variety of uses, is a cross-cutting issue that can contribute to development on a number of fronts. ODA's programmes of assistance recognise this and include projects that improve access to water and sanitation for rural and peri-urban communities; improve the operations of water utilities; contribute to irrigated agriculture and fish production; protect the environment; and result in improved water resource management.

1.6 As such, water projects are an essential and high priority component in ODA's strategy for reducing poverty and promoting sustainable development. Table 1.1 shows the contribution to the ODA aims from 350+ bilateral water related projects in 82 countries between 1990 and 1995 with a total expenditure of more than £190 million.

1.7 Reflecting this essential role, water projects are recognised both as principle and significant activities that contribute to a wide range of ODA's policy objectives. This spread of recognised activities establishes direct links between improved water resource management and the three aims that describe ODA's aid programme and, hence, to the purpose of ODA's aid programme, the promotion of sustainable economic and social development.

Table 1.1 THE CONTRIBUTION OF WATER RELATED PROJECTS TO ODA'S AIMS AND OBJECTIVES

ODA Aims	Recognised Projects	ODA Policy Objectives	Recognised Activities Related to water
1. To encourage sound development policies, efficient markets and good government	63	1.1 Economic Reform 1.2 Good Government	Restructuring and privatisation of parastatals (privatisation of utilities). Enhancing legitimacy of institutions through support for democratic and participative processes; promoting greater accountability for performance and use of resources (regulatory and legislative reforms).
2. To help people achieve better education, health and opportunity, particularly women	320	2.1 Direct Assistance to Poor People 2.2 Human Development: Health, Education and Children by Choice 2.3 Women in Development	Social needs (enhancing access by the poor to water and sanitation services) and income generation (access to productive assets). Priority health problems (reduce suffering from communicable diseases through disease control initiatives and improvements in environmental health). Women as active participants in project implementation and in institutional arrangements.
3. To enhance productive capacity and conserve the environment	406	3.1 Enhancing Productive Capacity 3.2 Environment	Water utilities (promotion of capital investment, productivity, technical progress, skills and technical transfer). Policy and environmental management (resource management and sectoral policies), and environmental activities (including improvements in water management and sanitation and waste management practices).

- Notes:**
- Analysis is based on 350+ water related projects undertaken in 82 countries over the last 5 years
 - Recognised projects are those water related projects where achievement of the policy is marked down as a 'principle' or 'significant' objective of the project
 - The fourth aim "to promote international policies for sustainable development and to enhance the effectiveness of multilateral institutions" is not generally applicable to individual projects
 - Definitions taken from ODA's Policy Information Marker System (PIMS) Guidelines, May 1995

CHAPTER 2 WATER- ISSUES AND NEEDS

Definitions and Coverage

2.1 For the purpose of this paper, water is taken to comprise that freshwater that is available in the hydrological cycle for human consumption, productive activities and other natural processes. This limits consideration to freshwater resources, both on the surface and under the ground, and the effect of freshwater run-off on coastal zones. Chapter 18 of Agenda 21 on Freshwater Resources which was adopted at UNCED defines these to include:

- * integrated water resources development and management, including systems for water resource assessment and flood and drought control;
- * rural and urban water supply and environmental sanitation;
- * water for sustainable food production and rural development;
- * protection of water resources, water quality and aquatic eco-systems.

The scope of this paper also includes the interface of freshwater systems with seawater and measures to protect coastal environments recognising the pressures on water resources from the concentrations of developing country populations that live near the coast.

The Resource Available

2.2 The renewable resource, or the water available for consumption on a regular annual basis, is a function of the hydrological cycle of evaporation and transpiration, precipitation and run-off. Of this amount, it is estimated that only about 9,00-14,000 cubic kilometres may be ultimately controlled, of which some 4,000 cubic kilometres are presently utilised. However the distribution of this water is skewed temporally, spatially and socially.

2.3 It has been proposed (Falkenberg), and widely recognised, that regular shortages of water (**water stress**) will occur when the annual renewable freshwater available per person falls below 1,700 cubic metres. Below 1000 cubic metres/capita/year (**water scarcity**) lack of water begins to hamper health, economic development and human well-being; while less than 500 cubic metres/capita/year (**absolute scarcity**) is the level at which water availability is a primary constraint to life. The spread of scarcity is linked to population growth, rising living standards and domestic, industrial and agricultural competition. It is estimated that twenty countries were experiencing water scarcity in 1990; and that by 2025, based on UN medium levels of projected population growth, about thirty countries will be water scarce and absolute scarcity will affect such major African population centres as Kenya, Somalia and Malawi as well as much of the Middle East (see Annex 1). These estimates are based upon normal hydrological years and do not reflect the risks of possible consecutive drought years.

Access to Water Supply and Sanitation

2.4 Lack of clean water, inadequate sanitation and poor hygiene practices are a major cause of death and illness in developing countries and particularly affect childrens' health. Where access to water is limited, it is invariably women who have to expend precious time and energy to fetch and carry water that often is not safe for use (see Box 2.1). Lack of access to water in urban areas often results in the poor having to pay many times more than the more wealthy serviced urban populations for small quantities of poor quality water. The World Summit for Social Development held in March 1995 highlighted the fact that the condition of those 1 billion people in absolute poverty is characterised by the deprivation of basic needs, including that of safe drinking water and sanitation facilities. Ensuring adequate access will assist in alleviating the effects of poverty, particularly for women, and contribute to improving health and productivity.

2.5 According to the World Health Organisation (WHO), global efforts during the "International Drinking Water Supply and Sanitation Decade" resulted in an additional 1.2 billion persons gaining access to water supply and 770 million to sanitation. However, progress fell far short of the goal of universal access. At the beginning of the 1990s, about 1.3 billion people in rural areas, cities and peri-urban slums of developing countries lacked access to safe drinking water and 1.9 billion had no access to appropriate sanitation. Annex 2 gives details of country access to clean water and adequate sanitation in 1994. Less than half the population in 31 countries had access to clean water. However, in several low income countries including Bangladesh and India, strong political will and adoption of appropriate strategies have contributed to good progress. The coverage rates for sanitation are generally lower, except in the countries where priority has been given to this area.

2.6 WHO estimates that during the 1980s about \$13 billion was spent annually in developing countries for water supply and sanitation; of this, only one quarter was spent in rural areas. Most past investment has favoured more wealthy urban areas, primarily providing high levels of service at costs as high as \$550 per capita for water supply and sanitation, which are rarely fully recovered. In contrast, appropriate technologies in rural and peri-urban areas costing less than \$30 per capita can extend rapid coverage to a much larger population. Sustainable use of local groundwater resources is particularly important for rural populations.

2.7 To achieve universal coverage by the year 2000, taking into account projected population increases, roughly 2.2 billion people have to be provided with water supply and 2.9 billion with sanitation (of which about 1.7 billion and 2.2 billion people, respectively, are in rural and peri-urban areas). Progress will only be made if the lessons from past experience are taken to heart regarding lower-cost approaches to reach the largest numbers, backed by political will, appropriate strategies and resource allocations directed to reach the unserved populations in rural and peri-urban areas.

2.8 High costs and low efficiency and reliability have characterised public utility services across much of the developing world. While privatisation may bring benefits in terms of incentives for efficient service delivery, it is not necessarily a

comprehensive solution and risks further marginalising the poor. It is dependent on effective regulation of price and service quality for which good governance is a prerequisite, and in many parts of the world this remains weak.

Box 2.1:

WOMEN AND WATER

A woman balancing a heavy bucket and clambering down a slippery slope to the bottom of a 6 metre deep excavated pit so that she can collect water from a pool - a common sight in rural India.

The provision of water is a priority in meeting women's day to day practical needs. It can give women more time for leisure often improving their health at the same time and providing opportunities for taking on additional productive work if they so wish, or for education. One of the main reasons women give for not attending literacy classes is that they are too busy. And many girls drop out of school because they are needed to help with the chores at home. These are important links between girls' education and population levels.

Well-designed water projects can also help women feel more confident about themselves. In maintaining water systems and protecting water sources from damage so that health is not affected, women are always keen to be involved. After all they have the greatest interest in keeping the supply of water going. In the ODA-supported Maharashtra Rural Water and Sanitation Project (see Annex 3) women are key members of village water communities and women politicians involved in local government are being trained about water issues. It is important that when skills are being taught and job opportunities provided that it is not just men who seize the opportunities. In the Lesotho Village Water Supply Project, women are trained as latrine builders as well as health workers.

In Nepal the micro hydros which power the pumps to pipe water into hundreds of villages cost £20 per villager. A small project at a small cost, but with an enormous dividend. It saves village women walking up to six hours a day to fetch and carry water.

But fetching water is not all drudgery. Wells and rivers have provided social meeting places since time immemorial. In projects, such as the CARE funded programme in Mozambique, villagers have built shelters so that those collecting water can take a bath at the collection point - to save reserving water for this at home. The drought in Mozambique in 1992 meant that provision of water was, of course, literally a matter of life and death. Here and elsewhere in Southern Africa ODA was able to help during this time of emergency. Drought relief projects developed in Zimbabwe have been built upon in the post-drought period through sound management practice involving women as key actors (see Annex 3).

As well as the provision of water and sanitation for household activities, water is also important to women for agricultural purposes. In collaboration with the HR Overseas Development Unit at Wallingford, ODA is looking at the development of methods for increasing the involvement of women in smallholder irrigation schemes (see Annex 3).

The provision of water is at the heart of sustainable development, and ODA will continue to work with women to achieve this objective.

2.9 Government institutions should ensure equity in the allocation of water and give the poor priority of access to basic levels of service. At the local level, rural

and peri-urban communities can play a key role in acting as guardians of their own water environment.

Water for Food

2.10 Over 70 percent of the world's irrigated crop land is in developing countries and about 70 percent of water withdrawals worldwide are by agriculture. Withdrawals in Asia and Africa are over 85 percent. Rapid growth was achieved in irrigated agricultural production in the 1960s and 1970s. Crop yields from irrigated land can be twice that of dryland farming. However, these successes are threatened by poor control of water and deterioration in water quality and soils (salinity and waterlogging). Fisheries are also suffering through loss of productivity due to pollution and habitat changes. Inefficiencies and over-abstraction affect the quantity and quality of water available for downstream consumption, both from surface and groundwater sources and cause unforeseen social, health and environmental problems. There is, therefore, pressure for more efficient management of agricultural water use and, in the case of shortages, reallocation between users diverting water for low value uses to higher value uses such as domestic and industrial use (more food from less water and less land- see Box 2.2).

Water for Industry

2.11 Industry also needs water and accounts for an overall 20% of global water demand. Discharges of industrial effluents can have particularly serious impacts on the quality of receiving bodies of water and can effectively make unusable far greater quantities of water. Efforts are therefore required to ensure adequate wastewater treatment in the context of an appropriate and enforceable legislative framework and the principle of the polluter pays.

Water for Environmental Protection

2.12 There is an increasing priority placed on ensuring that water is available to preserve eco-systems by maintaining minimum flows in rivers, wetlands and coastal habitats. This restricts the water available for other uses (see Box 2.3).

Basin Management

2.13 With global demand for water increasing at a rate of 2.3% per annum and water resources distributed unevenly across the globe and no longer in balance with demand, the management of the resource is increasingly critical. Agenda 21 has highlighted the need for an integrated approach based on human relations with the environment, including freshwater and waste management and the importance of partnerships and behaviour change. Comprehensive water resources management includes the rational intersectoral allocation of water, taking into account its economic value, control of withdrawals from aquifers and demand management measures to conserve water, as well as pollution controls to protect water quality. The natural unit for managing the resource is the hydrological basin (river and groundwater). For this to function effectively, institutions need to be structured around hydrological basins or where these cross national boundaries, international commissions need to be active and empowered to ensure that the resource is allocated in the interests of all consumers and the environment (see also Box 4.1). Capacity-building, including the development of appropriate

institutions, and the adoption of appropriate economic and regulatory instruments are central themes in achieving the goals of improved integrated water resources management.

Summary of Water Related Problems in Developing Countries

2.14 The main water-related problems that are encountered or are emerging with reference to developing countries are summarised in Box 2.4.

The only way to feed the increasing world population (projections suggest 1960- 3.016 billions; 2000- 6.251 billions) is by increasing the land and water productivity of agriculture; **more food from less water and less land.**

- * **The recent past**
Between 1950 and 1984 the world grain harvest expanded some 2.6 times or nearly 3 percent per year raising per capita grain production by more than one third. But between 1984 and 1990 the output rose scarcely 1% per year. While this six year period is obviously too short to show a trend but suggests an unsettling slow down. With increasing population and consumption, the world grain carry over stocks are beginning to decrease.
- * **The sustainable yield of oceanic fisheries**
More than 20 years ago FAO estimated that the oceanic fisheries could not sustain an annual yield of more than 100 million tons. In 1989, the world fish catch, including that from inland waters and fish farming, reached exactly that number. During the following years it has fluctuated between 97 and 99 million tons, but taking the population increase into account, has resulted in the per capital amount decreasing by 8% in four years. It looks certain that this reduction is likely to continue indefinitely, at least as long as the population continues to grow.
- * **The amount of fertiliser that the existing crop varieties can effectively use.**
Worldwide fertiliser use increased tenfold between 1950 and 1989, when it peaked and began to decline. While some countries like Argentina and Vietnam can still substantially expand their use of fertiliser, the major food producing countries are close to the limit with existing grain varieties. The decrease or potential flattening of fertiliser use coupled with the reduction in grainland area per capita contributes to the potential problem.
- * **Nowhere to grow**
Until around 1950 growth in the world's cultivated area more or less kept pace with that of population. After that point the growth in the cultivated area has slowed to a crawl stabilising around 1500 million hectares.

Each year millions of hectares are lost either because of severe erosion and thus loss in productivity, or because of conversion to nonfarm uses. Losses are pronounced in the densely populated rapidly industrialising countries in East Asia. Non-farm uses still claim more than a million acres of cropland every year.

While a few countries such as Brazil will be able to add new cropland, on balance, gains and losses for the nineties will off set each other as they have during the eighties. The food for the 960 million additional people to be added during the 90s will have to come from raising land productivity.
- * **Prospects for increasing irrigated area**
After growing slowly during the first half of this century, the irrigated area expanded from 232 million acres in 1950 to 615 million acres in 1980, increasing the irrigated area per person by 56%. Since 1980 the growth in the world irrigated area has slowed dramatically and fallen behind population growth. Several countries including United States and China are losing irrigated land as water tables fall and as water is diverted non-farm uses.
- * **Water for irrigation**
Today two thirds of all the water extracted from rivers and underground aquifers is used for irrigation. In parts of the world where all the available water is now being used such as USA or large areas of Northern China, satisfying future growth in municipal and industrial demand has to come at the expense of agriculture.

On a per capita basis, the amount of runoff produced annually by precipitation in India is one fourth the world average. Most rainfall comes during the monsoon season thus necessitating massive storage schemes. By the late seventies the government has invested some \$12 billion in 1554 large dams. Yet, water tables are now falling in several states including much of Punjab, India's bread basket, Haryana, Uttar Pradesh, Gujarat and Tamil Nadu; states that together contain 250 million people. Tens of thousands of villages across the sub-continent now with water shortages. Even large parts of Delhi is experiencing water shortage.

With 21% of the world's people but only 8% of its renewable freshwater, China faces obvious water constraints. Already more than 200 major cities lack sufficient water and a quarter of these face acute shortages. The situation is especially dire in the North China Plain, the location of Beijing, the important commercial city of Tianjin, and the millions of acres of flat fertile farmland. Water table beneath the capital continues to drop by 3 to 6 feet per year. A third of its wells have gone dry. Planners project Beijing's water needs will increase by 50% by 2000; in Tianjin the demand is projected to more than double. Projections for Beijing's water budget suggest that farmers in the vicinity could lose 30 to 40% of their current supply. The ultimate question is how much water China can divert from agriculture without jeopardising its long term food security.

During the eighties the supply of irrigation water per person has shrunk by around 8%. Although the cropland area per person has been falling steadily for decades, the eighties were the first decade in which both cropland area and irrigation water per person declined.

Box: 2.3

WATER FOR ENVIRONMENTAL PROTECTION

Average annual rainfall over land is 110,000 cubic km of which evaporation accounts for 70,000 cubic km leaving potentially 40,000 cubic km available for human use.

This available water is distributed very unevenly and two thirds runs off as floods. That leaves around 14,000 cubic km. A substantial share of this supply should be left to follow its natural course in order to safeguard wetland, deltas, lakes and rivers. For example, some 6,000 cubic km of water is needed to dilute and transport the estimated 450 cubic km of waste water now entering the world's rivers each year.

Conclusions drawn from the GEMs assessment include:

- * the nature and level of freshwater pollution strongly depends on socio-economic development;
- * the most common water pollutant is organic material from domestic sewage, municipal waste and agro-industrial effluent;
- * the high water nitrate levels found in Western Europe and United States are a result of the nitrogen fertilisers and manure used for intensive agriculture; the assessment also noted a dramatic increase in the use of fertilisers in developing countries.

UNEP estimates irrigated area suffering from salinisation at 100 million acres; about half of this in India and Pakistan.

Other conditions highlighted include deforestation, eutrophication, suspended particulate matter. Soil erosion is an important environmental impact of improper water/land management. About 24 billion tons of topsoil washes or blows off the land annually. Cropland left without protective vegetative cover or situated on steep slopes is subject to erosive power of rain. As a result, at least 825 million acres of rainfed cropland are losing their productive potential. The eroded soil settles downstream where it is not always wanted; reservoirs in South Asia are silting up at around four times the design rates.

BOX 2.4 DEVELOPING COUNTRY WATER-RELATED PROBLEMS

Scarcity, Shortages and Lack of Access

- *water is a scarce resource in large parts of many developing countries;
- *rainfall, and hence river flow, is often unreliable, both temporally and spatially;
- *competition between domestic, industrial and agricultural use will intensify as populations grow;
- *water shortages and lack of access are already common with associated health and environmental problems (at least 1.3 billion people or a quarter of the world's population do not have reasonable access to clean water or sanitation).

Absence of Policies, Legislation and Planning Capability

- *few countries have clearly defined water policies with agreed priorities for water use;
- *appropriate legislation to manage water use efficiently is often missing at municipal, national and international levels;
- *water resource planning is insufficiently integrated, and is too often carried out in an ad-hoc manner to which institutional fragmentation contributes;
- *there is a dearth of reliable long term hydrological data.

Inadequate Valuation of Water Resources

- *water is rarely treated as an economic good with an appropriate accounting system;
- *as a consequence water is frequently wasted;
- *charges often do not cover the cost of operations and maintenance;
- *pollution reduces water quality, with ill effects for downstream users, but the polluter rarely has to pay.

Technical Constraints

- *inadequate or inappropriate institutional frameworks;
- *water supply and wastewater treatment systems are frequently based on inappropriate designs from the developed world;
- *severe pollution due to poor, or absent, sewage treatment;
- *need to increase the effectiveness of water use in irrigation;
- *lack of sufficient local technical expertise;
- *lack of appropriate methodologies and procedures to assist planners and decision-makers.

Lack of Participation

- *centralised and sectoral (top down) approaches are invariably insufficient to address local water management issues;
- *decisions should be taken as close to the root of problems as possible (at the lowest appropriate level such as water committees and irrigation user groups);
- *participation of users, especially women, is often neglected in the design, operation and maintenance of water projects.

Vulnerability of the Environment

- *insufficient priority is given to prevention of environmental degradation linked to water resource exploitation;
- *watershed degradation (farming of fragile land increases soil erosion rates and sedimentation);
- *water quality deterioration (marginal area ecosystems can be disrupted and water courses and aquifers polluted with human, industrial or agricultural waste);
- *deterioration of irrigated land through waterlogging and salinity.

Shortcomings in Education and Training

- *education on the origin and use of water and hygiene linkages is often missing from school curricula;
- *professional education lacks a multi-discipline approach;
- *no local technical colleges or other arrangements for training of operatives.

CHAPTER 3

WHAT IS ODA DOING IN THE SECTOR- RECENT PERFORMANCE

Channels Used

3.1 ODA's assistance to the water sector is deployed through a number of different channels. These include:

- bilateral country programmes;
- Aid and Trade Provision;
- support through the Joint Funding Scheme and other channels of aid to NGOs;
- technology development and research;
- contributions to multilateral agencies;
- financial support for CDC activities.

Sectoral Approach

3.2 ODA produced a document in November 1993 entitled "A Fresh Approach to Water Resource Development" which reviewed water related problems in developing countries and how ODA should tackle them. This document has since provided guidance for both ODA's bilateral and technology development and research (TDR) programmes.

Overall ODA Expenditure on Water

3.3 Table 3.1 provides an overall picture of ODA expenditure on water related projects since 1988/89. The figures include expenditure on bilateral country programmes; aid under the Aid and Trade Provision (ATP); assistance to non-government organisations (NGOs) under the Joint Funding Scheme (JFS); and, research. The spending has been grouped into the programme areas identified under Agenda 21. These figures enable ODA water related expenditure to be set in context but are based upon a number of assumptions (see footnotes to Table 3.1) and should not be used for detailed comparisons. They do not include contributions to the multilaterals and financial support to the Commonwealth Development Corporation (CDC) and others.

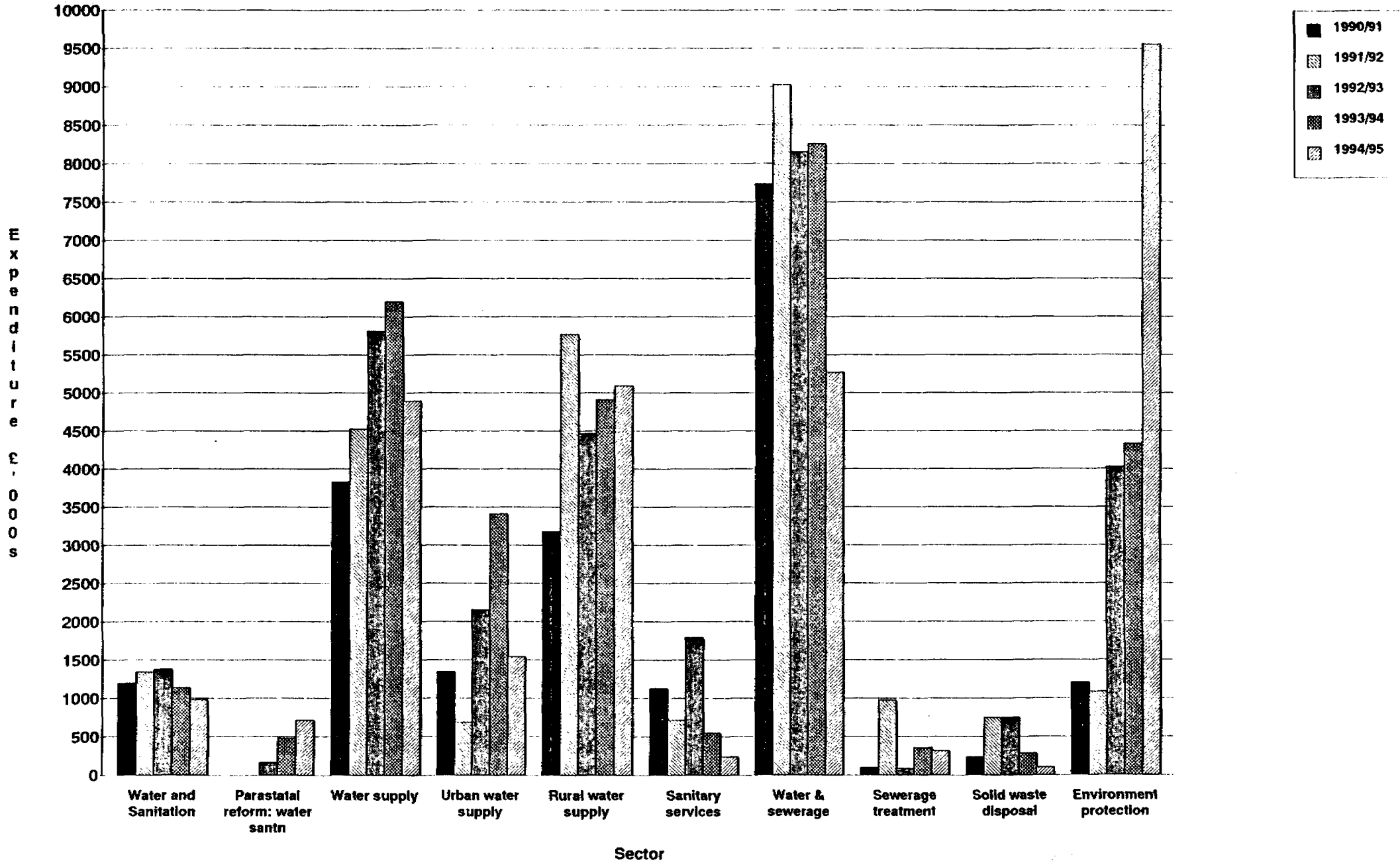
Water Related Expenditure Characteristics

3.4 The proportion of allocated bilateral aid spent on the sector over the last 5 years has declined slightly and in 1994/95 stands at 3.1%. Apart from the increasing squeeze on bilateral country resources, the following points are of note:

*Part of the decrease is due to reduced spending on irrigation projects (mean expenditure on water for food supply was 33% in 1988-92 and 20% in 1993-95); in part this reflects the move from financing of new irrigation projects to an emphasis on rehabilitating existing schemes and management improvements (which cost less).

*Rural water supply as a proportion of the total has shown a steady increase over this period; this reflects the increased involvement of NGOs in this area and increased funding through JFS.

Graph 3.1 Water & Sanitation by Sector by Year



Destination of Assistance

3.7 Graph 3.2 shows expenditure under water and sanitation by region over the last 5 years. There were projects in 82 countries. Graph 3.3 shows the breakdown by region in 1994/95. Again, while expenditure in the broad sector has been reasonably constant over this period, various regional trends are evident:

- *addition of expenditure in CEE/FSU from 1992/93 with steady increase since; this now represents 11 percent of the total and concentrates particularly on environmental protection and health;

- *expenditure in Africa has shown a slight decline; it now accounts for 26% of total sector expenditure, most of this in water supply (examples are given in Annex 3, case studies 1.2 to 1.7);

- *Latin America has experienced a steady increase until 1994/95; the region accounts for 11% of broad sector code expenditure;

- *Asia has experienced steady growth and accounts for highest regional spending (43% of total) with 25% of this under environmental protection in 1994/95; these include the Gomti project in India (see Annex 3, case study 2.4) and a number of environmental projects in China including those mentioned in Annex 3, case study 2.7.

Contribution to ODA Policy Objectives

3.8 Graph 3.4 shows the contribution of projects under the water and sanitation sector code to ODA's policy objectives for 1994/95. The pattern for 1993/94 is similar. It only reflects those projects where the contribution to a policy objective is recognised as a principle objective of the project. Information is available elsewhere for projects where a significant contribution is recognised. The graph shows:

- *principal contributions to all ODA policy objectives but predominately to environmental protection, enhancing productive capacity and health;

- *significant contributions to ODA policy objectives are (in order for 1994/95) women in development, health, environment, direct assistance to poor people, enhancing productive capacity and good government;

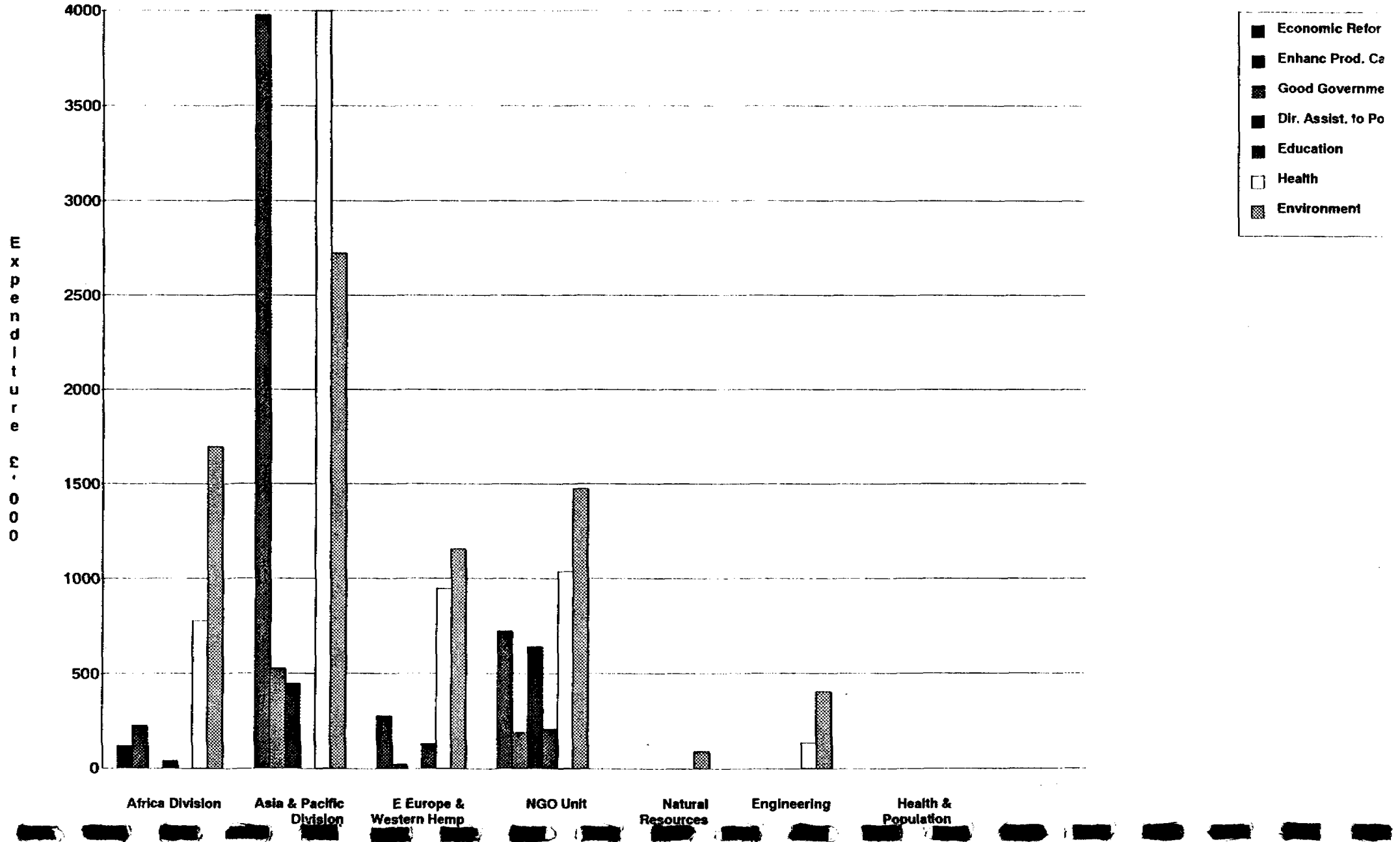
- *Asia shows high contributions to enhancing productive capacity, health and environmental protection; the emphasis in Eastern Europe is on health and environmental protection; the same emphasis is noted for Africa with little attributed under the bilateral country programmes to directly assisting poverty; under the NGO projects direct assistance to poverty also features with enhancing productive capacity, health and environmental protection.

JFS Sector Expenditure Characteristics

3.9 The water sector presently accounts for 8% of total Joint Funding Scheme (JFS) expenditure. The scheme is responsible for 10% of bilateral expenditure

Graph 3.4

**Water & Sanitation
Principal Expenditure
By PIMS Marker for 1994/95**



within the sector. Expenditure is split between block grants and other accountable grants. In recent years expenditure has moved away from the block grant system towards the award of individual grants. Major recipients of JFS funds include Oxfam, Save the Children Fund and WaterAid (case studies 1.4-1.6). JFS expenditure in Asia has decreased since 1992 whilst that for Africa region has increased and currently stands at 75% of the total. Latin America expenditure currently accounts for less than 1% of the total. Table 3.3 shows JFS expenditure for the geographical regions over the past three years.

**TABLE 3.3 - JOINT FUNDING SCHEME:
EXPENDITURE ON WATER PROJECTS BY REGION AND YEAR**

(thousands £)	92/93	93/94	94/95
Americas	103.2	99.8	17.9
Asia	701.7	378.8	682.5
Africa	1686.1	1805.0	2060.5
Total	2491.0	2283.6	2760.9

Aid and Trade Provision (ATP) Sector Expenditure Characteristics

3.10 Some 85% of ATP expenditure is on infrastructure and production. Recent ATP guidelines which limit the use of tied aid credits benefit the water sector, particularly environmental sanitation projects, where benefits accrue significantly to the community as well as users, and rural water schemes. Water projects worth £61.7 million with an ATP component of £15.8 million are in progress or accepted. A further £231 million of water projects with an ATP content of around £60 million are under consideration; more than 85% of this to be spent in Asia. These projects comprise both urban and rural water supply and sewage schemes. Technical cooperation projects are often agreed in support of ATP projects where the appraisal has identified additional capacity building as desirable. Associated technical cooperation projects underway or accepted total more than £6 million.

Technology Development and Research (TDR)

3.11 Table 3.4 summarises expenditure on technology development and research (TDR) under ODA Engineering Division and other water related research by Natural Resources Department. Expenditure is grouped in theme areas similar to those used in Agenda 21 for freshwater.

3.12 £4.5 million was allocated to sector research in 1994/95. The research programme benefits from well established centres of excellence to carry out this work spanning the engineering, agriculture, health and social specialisms. 23% of the programme was spent in the areas of integrated water resource development, water resources assessment and climate change studies laying the foundation for better resource management in the developing world. A high proportion (55%) is also spent in the area of water for food with particular emphasis on improving irrigation and drainage efficiencies. Examples of Engineering Division TDR are given in Annex 3, case studies 1.10 to 1.11 and 2.8 to 2.17.

3.13 Water related research is also funded by Health and Population and Social Development Divisions and under the Economic and Social Research Council (ESCOR) programme. This includes study of hygiene interventions to reduce the incidence of diarrhoeal disease, several studies on health hazards through the reuse of wastewater in agriculture and two health research work programmes with substantial components associated with water (see Annex 3, case study 1.12). An ESCOR programme is looking at the role of government in adjusting economies including the case of urban water supply, another is researching the socio-economic impacts of groundwater resources degradation (Annex 3, case study 2.13).

Programme Area	Annual (£m)			Percentage of Total		
	1988-92 Mean	1993/94	1994/95	1988-92 Mean	1993/94	1994/95
A Integrated WR development	0.2	0.4	0.4	5%	7%	9%
B WR Assessment	0.7	0.3	0.4	19%	6%	9%
C Protection of sources/aquatic systems	0.9	0.8	0.2	25%	16%	4%
D Rural WS&S	0.2	0.7	0.3	5%	14%	7%
E Urban WS&S	0.4	0.2	0.5	12%	4%	11%
F Water for food supply	1.1	2.1	2.5	31%	43%	55%
G Climate change study	0.1	0.4	0.2	3%	8%	5%
Total	3.6	4.9	4.5	100%	100%	100%

NOTE: Data from NRI collated research statistics and ODA Statistics Department Economic Sector Data.

Private Sector Role- Commonwealth Development Corporation (CDC)

3.14 CDC is the major bilateral channel for British aid to support the private sector in developing countries. CDC's share of the bilateral aid programme in 1994/95 amounted to 18%. CDC seeks to work where it can provide a catalytic impact for private sector foreign capital. Africa historically has been a key area although inflows have declined in recent years (investments are currently 34% in Africa against 47% for Asia and the Pacific).

3.15 At the end of 1994, CDC had investments and commitments totalling £1.7 billion. Utilities comprised 20% of this portfolio with power and telecommunications dominating recently (14.3% and 3% respectively by 1994). Given the current policy environment these two utilities are seen as growth areas, particularly in Asia. Water sector investments currently amount to £65 million (3.8%). There is scope for growth in this sector given a more conducive policy environment for private sector investment.

3.16 There are also opportunities for ODA to promote greater use of build, operate and transfer (BOT) and other contract forms to expand water service provision, particularly in urban areas. Experience in this sector is limited but that gained in other sectors, both in UK and overseas, is of relevance.

Multilaterals and Donor Coordination

3.17 Nearly 50% of the Aid Budget is channelled through multilateral organisations. The overall proportion spent in the water sector is not readily available. Figures for World Bank expenditure within the water sector have remained at approximately 5% of total Bank expenditure over the past 10 years.

3.18 ODA encourages better donor coordination, both to promote more effective aid delivery and assist in policy change covering issues such as the poor's access to basic services and the role of the private sector. Given the pressures on water resources and the importance of sound national sector policies and consistent approaches, donor coordination in the water sector is especially important.

3.19 At the international level ODA is active in the sector. We support the work of the WHO Water Supply and Sanitation Collaborative Council and fund the Global Applied Research Network in Water Supply and Sanitation (GARNET). We contribute to the International Programme for Technology Research in Irrigation and Drainage (IPTRID) and to activities under the World Bank/ UNDP Water Supply and Sanitation Programme. We are active participants at international meetings including the European Commission Expert Meeting on the Water Supply and Sanitation Sector. This has enabled close consultation on water projects to take place, particularly with the World Bank, and promote collaboration and co-financing on projects in areas such as maintenance, rehabilitation and institutional strengthening.

3.20 Other bilateral donors recognise the importance of this sector in contributing to sustainable development and allocate considerable proportions of their bilateral aid to water and sanitation projects (Austria 28%, Belgium 21%, Denmark 10-

15%, Netherlands 8-12%). Each has drawn similar lessons from past experience to ODA and has adopted similar approaches placing emphasis on the need for sound water policies, an integrated approach, commitment from government and beneficiaries, cost recovery, environmental concerns and the need for increased donor coordination. The EC is now drawing some of these experiences together with the intention of preparing a water policy document in 1996. A number of donors, such as Denmark, are explicitly targeting a limited number of countries to focus on the sector in a coordinated way with emphasis on policy development and capacity building rather than isolated projects.

Impact of Sector Assistance

3.21 Evidence on the effectiveness of aid comes from project completion reports, evaluation studies and evaluation syntheses.

3.22 A synthesis of 118 project completion reports covering the period between August 1991 and July 1993 was conducted in 1994. 12 of these were attributed to the water sector. These provide information on project implementation after completion. The delivery of water project inputs was deemed to have been appropriate, timely, adequate, well coordinated and efficient in 58% of cases, marginally below the average performance for all sectors (62%). Better performance was obtained in the percentage of projects where the realisation of outputs at the completion of the implementation phase was satisfactory (83% against an average for all sectors of 96%). The assessment in terms of sustainability of water projects was above average (78% against 73% for all sectors. Two thirds of water projects (67%) were considered at completion likely to achieve the immediate objectives defined for them at appraisal against an average figure of 68%. This average performance is very credible for a sector where sustainability is difficult.

3.23 Since 1993 three formal ex-post evaluation studies have been conducted on the operation of projects in the rural water sector in Uganda, Sierra Leone and Nepal. The findings of the Uganda and Sierra Leone projects are compared in Annex 3, case study 1.8. A synthesis report for rural water supply projects is currently under preparation based upon these three evaluation studies, strengthened by an output to purpose review of some similar ongoing projects in order to draw on more recent experiences.

3.24 An evaluation study has also been conducted on a large urban wastewater project (Cairo Wastewater, 1993). This highlights the experience that physical achievements have often been offset by weak institutional development (see Annex 3, case study 2.3). This aspect has been given greater emphasis in recent projects.

3.25 Evaluation studies have also been conducted on a number of irrigation and integrated rural development projects (EV 474 Salinity control and reclamation project, Pakistan; EV 476 Kosi Hill area rural development programme, Nepal; EV 500 Northern Plain Irrigation, Mauritius).

Summary of Lessons Learned

3.26 Donor experience, including ODA's, in water related project assistance has resulted in a number of lessons being learned in recent years. Box 3.1 summarises the key principles that have evolved to guide effective and sustainable water resource utilisation:

BOX 3.1 - SUMMARY OF LESSONS LEARNED IN THE WATER SECTOR

An Integrated Approach

Water projects must be set in the context of improvements in water resources management (assessment, equitable distribution of scarce water resources, protection against depletion and pollution) and water supply schemes must include environmental sanitation and hygiene education. A multidisciplinary approach is required that integrates these elements.

*Water projects will fail unless they are based on adequate assessment of the water sources and unless arrangements are in hand for protection of these sources.

*In regions where water is becoming a scarce resource, ad-hoc project-based, single sectoral planning leads to inefficient investment decisions, growing water conflicts, inefficient resource use, environmental degradation, and an inability to respond expediently to changing conditions.

*Expectations of health benefits from rural water supply enhancement have been unrealistic. Social preconditions for health gains are hygiene education, improved sanitation, increased quantities - and then improved water quality. Ideally, water and environmental sanitation efforts should be linked to other social services and development activities. They are key in the social change process.

*Interplay of technical, economic, political, environmental and social dimensions in water supply and sanitation programmes must be recognised to design effective programmes.

*Drainage is an essential component of irrigation; adequate measures including funding are required to ensure adequate agricultural production and counteract health risks from irrigation schemes.

Organisational Development

Central government agencies are often not able to respond to local issues which require local initiatives by local people. Decentralisation of responsibility to the lowest possible levels supports optimal service delivery.

*The national government role should be to assume primary responsibility for water sector management, including to develop sector policy, establish and enforce legislation and standards and plan donor coordination.

*National government must address water related issues in an integrated manner and build the institutional capacity and capability to adopt this more comprehensive approach.

*Governments should focus more on promotion, facilitation and coordination of services rather than their provision.

*Governments need to focus more specifically on the goal of universal access to water and sanitation and to establish the process for developing, implementing and monitoring action towards these goals.

*At the local level the capacity of autonomous decentralised agencies in managing water supply, sanitation, irrigation and drainage schemes needs to be developed.

*Community involvement is an essential element of sustainability of water supply and sanitation schemes in rural and peri-urban areas and in irrigation schemes. Responsibility for facilities should be shared between agency and community in a well balanced partnership during the entire project cycle.

*There should strong government support for community management, including a legal and administrative framework.

*Special attention should be given to the active involvement and empowerment of women as they are the providers of health care and have the motivation and knowledge to contribute significantly to the implementation and operation of sustainable water supply and sanitation services.

*NGOs can play a catalytic role as champions of the poor and agents of change; their role is most effective if it is enacted in the context of national development plans.

BOX 3.1 - SUMMARY OF LESSONS LEARNED IN THE WATER SECTOR (Contd)

Financial Sustainability

Adequate incentives must exist for water users to economise and avoid polluting the supply, and for providers to ensure adequate operation and maintenance. Cost recovery by user charges is therefore essential for sustainable services.

- *Pricing of water - ultimately at full opportunity cost - should be encouraged. Users should bear charges in relation to the social costs of abstraction or discharge, with due regard to ability to pay and wealth inequalities. Subsidies should be limited to the provision of basic services to the poor who should at least pay full operation and maintenance costs. There is a requirement for appropriate means to charge for irrigation water on a volumetric basis.
- *Schemes in rural and peri-urban areas should be administered by local communities. Credit facilities for low income families may assist in the construction of on-site facilities such as latrines and house connections.
- *Waste disposal fees should be based on the principle of the polluter pays.
- *Private entrepreneurs should be encouraged where potential and opportunity exists.

Appropriate Technology

Technology choice should be based on technical, sociological and financial studies and environmental impact assessments. The resulting level of service must be sustainable locally. Appropriate technologies have a vital role to play and will reduce both investment and recurrent costs to levels that are affordable to users.

- *Increased urban domestic water must proceed alongside improved sanitation; low cost sewerage technologies are an option to consider.
- *Greater equity in access to services will accelerate progress towards universal coverage.
- *Irrigation and drainage systems must be designed to enable maintenance in small systems to be carried out where possible by beneficiaries. Design of larger systems must ensure that maintenance can be funded from irrigation service fee revenues.
- *Large improvements in the efficiency of water use in medium and large scale agency managed irrigation schemes are essential. Improved technologies are needed to enable systems to be managed effectively by beneficiaries or autonomous decentralised agencies.
- *Technology development and research has improved efficiency of irrigation water management and design of irrigation systems for sustainability and promoted the use of on-site sanitation, slow sand filters, handpump development and recycling etc.

Environmental Protection

- *All water use changes will have an environmental impact which should be investigated before development. Donors need to ensure that uncertainties concerning environmental risks are reduced as far as possible, and should not support projects where governments ignore the interests of vulnerable (including unrepresented) social groups.
- *Use or reuse of low quality water for irrigation can provide large improvements in efficiency of water use but has significant environmental risks.
- *Groundwater is vulnerable to over-exploitation and to long term pollution and hard to remediate.

CHAPTER 4 HOW TO STRENGTHEN ODA'S INVOLVEMENT

Current Portfolio

4.1 Overall spending in the sector has remained reasonably constant but the type of projects undertaken and the pattern of that expenditure has undergone progressive reshaping over the last five years.

4.2 ODA's evolving cross-cutting approaches to better address policy objectives and make effective use of ODA aid are well reflected in the trends and design of recent projects in the water sector:

-Targeting the poor: support for basic services includes provision of clean water and safe sanitation; water supply and sanitation projects in the rural and peri-urban areas specifically target the poor; such provision should be part of a coherent and financially sustainable sector policy that promotes the better provision of basic needs and the participation of the poor in development; projects increasingly adopt a participative, process approach; techniques have been employed to ensure involvement and participation of local institutions and beneficiaries at all stages of the project process; NGOs are particularly active in the sector.

-A cautious approach to large individual new projects: where appropriate ODA should participate through cofinancing arrangements with other donors, concentrating particularly on technical assistance inputs. This is taking place both within bilateral country programmes (see case studies 2.2 and 2.7) and on smaller NGO projects (see case study 1.4). Apart from ATP projects, there has been a significant move away from large individual new projects and a corresponding increase in technical assistance. This is reflected in the decrease in the average value of projects. Greater emphasis is placed on the use of aid for rehabilitation and maintenance of existing capacity and in strengthening the management and institutions that operate these facilities.

-Institutional development: poor performance of projects frequently results from inadequate institutions and management. The institutional framework, strengthening and possibly reform must be fully considered before making aid commitments. Policy and institutional reform is particularly important in the water sector with its links to sustainable growth, poverty reduction and improved welfare and resource competition. ODA encourages water organisations to be more participative and responsive to the needs of those they serve. Sector focused packages are best provided in tandem with other donors such as in the case of South Africa (see case study 1.3). New projects increasingly address institutional development through capacity building such as in the training programme for senior public health officials in India (see case study 2.1).

-Aid for private sector development: the private sector can play an important

role in the provision of public services, particularly those services that can be covered by user charges and ODA is assisting in establishing the policy, regulations and institutional environment that encourages this role.

4.3 Other notable trends in the sector portfolio include the growing NGO involvement in water supply and sanitation projects and the growing number of ATP projects especially in the areas of water supply and environmental protection. A significant proportion of Emergency Aid also goes into drought relief work. This work has two elements; efforts to ensure food security and provision of emergency water supplies. Analysis following the 1992 drought in Southern Africa indicated that water is much more difficult to provide in an emergency and that development of water sources should take more account of the risks from drought and water resource management issues. Research work is being undertaken in drought management (see case study 1.11). This should be extended and strategies developed in a systematic manner in the drought prone countries where ODA is active.

Challenges for ODA

4.4 Recent developments have improved the effectiveness of ODA aid to the sector and the focus on ODA's priority objectives. However, while project design has improved and implementation strategies have been refined, water related projects still tend to be addressed in an ad hoc manner. As demand on the resource and competition between uses increases, it is important that rigorous water resource assessments are carried out; policies for sustainable resource development are put in place; and, the resource is managed in an integrated manner. Similarly, it is important that the community based approaches successfully used on NGO projects are endorsed and reflected in government policies (case studies 1.3 and 1.6).

4.5 The ODA document "A Fresh Approach to Water Resources Development", November 1993 sets out to help define policy for the sector and determine priorities, but the overarching importance of addressing ODA's overall aims has meant that underlying water resource management issues and water shortages are often not adequately addressed. There has resulted a significant mismatch between recipient needs and ODA support.

4.6 As an example, despite access to clean water and sanitation in many African countries being below that experienced elsewhere and water scarcity making effective water allocation essential, Africa only received 26% of ODA bilateral aid expenditure on water supply and sanitation during both 1993/94 and 1994/95. This was just 2% of our total Africa bilateral country programme expenditure in 1993/94. By contrast, NGOs through the Joint Funding Scheme spent 68% and 70% of their Africa programmes on the sector in 1993/94 and 1994/95. This reflects the demand for water and sanitation services from the poor but, by the nature of these projects, most are implemented without the benefit of a country water policy framework. The water resource management challenges confronting Southern Africa are outlined in Box 4.1.

4.7 Although projects are selected to target country development objectives, a clear link is often not apparent with overall water resource assessments, policy and institutional reform. This is particularly the case with the NGO projects and those under ATP and Emergency Aid which account for a large proportion of sector expenditure.

**Box 4.1 International River Basins in Southern Africa:
Crisis or Opportunity**

- * **An African problem.** Most of the continent's international borders, relatively recently drawn, take little account of basin boundaries (one of the imperatives that have served over centuries to provoke dispute and border redefinition in many parts of Europe and Asia). About 70 of Africa's rivers are shared by at least two countries, and the region has about one third of the world's major international river basins (basins > 100,000 sq km).
- * **A particular feature of the political geography of Southern Africa.** Of the 12 countries in the Sub-Saharan region sharing more than 4 basins, 7 are members of the Southern Africa Development Community (SADC). South Africa is a co-riparian, and in most cases an upstream riparian, on 5 international river basins: the Imbuluzi, Incomati, Limpopo, Maputo and Orange. Of its immediate neighbours, Mozambique shares 8 international basins (no country in the region shares more), Namibia and Zimbabwe 5 basins and Botswana 4 basins. The more the number of shared basins, the greater the potential problems for a state.
- * **A growing problem?** The SADC region is characterised by growing water demand, linked to growing aspirations and economies. In South Africa, current policies and water consumption patterns, coupled with demographic and economic growth, imply a "business as usual" scenario of water demand exceeding total water availability by 2020-2030, with industrial and municipal demand projected to grow at almost 4% per annum. In other countries there is growing awareness of the scarcity of water and the threat to 'water security' implied by shared water resources. This awareness will grow over the coming few years.
- * **Crisis or opportunity?** Increasing demand and consequent growing scarcity can (and has) caused conflict between riparian states on a river basin; on the other hand these same factors can provide strong incentives for regional economic cooperation and joint management of water resources. The challenge is to build the opportunity. Collaborative international research (as well as more specific studies) on the hydrology of shared basins, rights and allocations, joint management principles, institutions and practices, and the economic opportunities afforded, will build capacity and confidence.

Source: ODA consultant's report, 1995

4.8 There is therefore a need to focus more on:

Integrated water resource management

*Place greater emphasis on addressing strategic issues and building policy frameworks including assessments and modelling, legislation on water rights and appropriate environmental standards;

Central African countries including Zimbabwe.

Country Focus

*ODA should concentrate efforts in water on a reduced number of countries and possibly regions to assist and ensure that the right policy framework and capabilities are in place to support water related projects.

*The new Southern Africa regional programme strategy notes the importance and opportunity to strengthen water resource management.

Improved Donor Coordination

*ODA should seek opportunities in certain countries and regional programmes to combine efforts to develop the right policies and institutional framework to support integrated water resource management and where appropriate support the World Bank's broad sector approach to lending.

*Coordination will be increasingly important if a programme approach in a limited number of countries is followed by donors.

*At the global level ODA should continue active involvement in international fora such as the Water Supply and Sanitation Collaborative Council and the Global Water Partnership. We are looking at the possibility of seconding a water resources professional to the EC as part of an appropriate TDR project.

***Water supply and sanitation service provision**

Improved management of utilities

*Within the urban context, emphasis should be placed on building capacity in utilities to manage existing resources effectively (typically the cost of a cubic metre of water saved or recycled is one third that of gathering and supplying new water). This would include assistance on leakage control, tariff restructuring and wastewater reuse.

*UK water companies have considerable expertise to offer in these areas and partnership arrangements and attachments should be encouraged.

*ODA should continue research of least-cost approaches and technology options that can be brought to scale and sustained at the community level.

*The slum improvement projects in India and Pakistan contain significant water and sanitation components and demonstrate how services can be integrated to benefit the poor (see case study 1.9).

Cofinancing

*In respect of new capital works, the cofinancing of technical assistance on projects funded by the multilaterals represent good opportunities to utilise available UK expertise. ODA should continue to look for appropriate inputs.

*In the light of the Helsinki guidelines, there are also good possibilities for ATP financing of facilities such as water treatment and wastewater treatment works. ODA should continue to encourage ATP projects in this sector providing the policy and institutional environment is sound. Further guidance is under preparation.

*ODA should develop and support the use of build, operate and transfer (BOT) and other contract forms in water supply.

Expanding the role of NGOs

*In rural and peri-urban areas the experience of UK NGOs should continue to be tapped.

*New rural water projects in Africa are proposed in Ghana, Uganda and Nigeria that will involve use NGOs. The existing project in Senegal (case study 1.2) has been extended.

*ODA should support the building of capacity of local NGOs, NGO partnerships, advocacy and the reflection of community based approaches in government policies. Water represents a good entry point for broader social development and for local NGOs to contribute to the strengthening of civil society. ODA has recently funded a study on NGO partnerships and should extend this in respect of the water sector.

*New projects in South Africa and Zimbabwe are assisting government promote community based approaches and similar opportunities should be pursued (case studies 1.3 and 1.6).

*The current evaluation synthesis and output to purpose study of rural water supply projects will provide new guidance by mid 1996 (case study 1.8 gives initial findings).

***Water for sustainable food production**

Irrigation efficiency

*Irrigation is a user of large quantities of water. ODA should continue to give priority to the rehabilitation, operation and management of inefficiently run schemes, both in project and research activities (case studies 2.11. 2.12 and 2.15).

*We should continue our support for the International Programme for Technology Research in Irrigation and Drainage (IPTRID).

***Protection of water resources**

Treatment and reuse

*The portfolio of environmental protection projects is growing, particularly in Asia. Case studies 2.4 and 2.7 illustrate recent projects in India and China.

***UK research centres and universities have expertise in water quality modelling while the water companies and consultants have wide experience in process design and management.**

***Guidance on the protection of surface and groundwater sources is available from recently completed ODA research (case studies 2.13, 2.14 and 2.17 for example).**

***The lessons of recent changes in the UK regulatory structure are also available.**

***The preservation of aquatic ecosystems and pollution control measures including recycling is increasingly important as demand on water resources grows.**

***Country programme managers should be encouraged to utilise these resources and develop appropriate projects in these areas.**

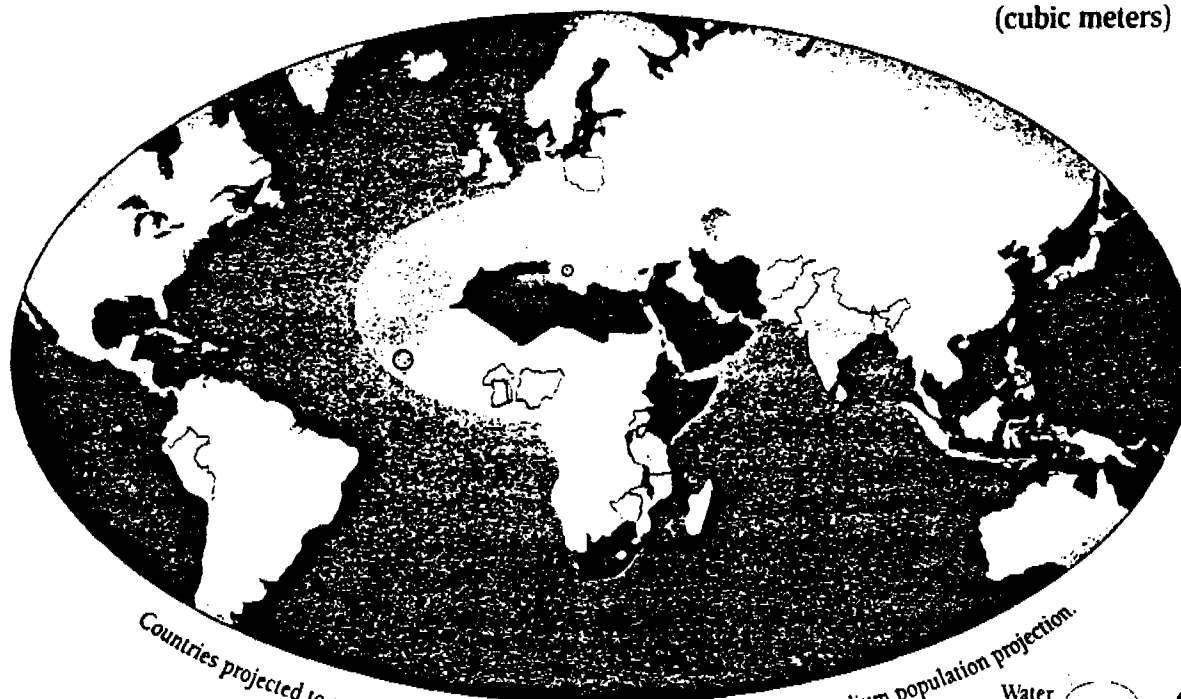
4.11 The options to take a more strategic but comprehensive approach to the water sector in a reduced number of countries; the need to consider water resource availability and allocation between competing uses; and, the multidisciplinary nature of water projects strongly suggest the need for a water focus or theme group within ODA that meets on a regular basis to ensure that strategies are developed and taken up, base-line data is collected and sector performance is monitored and kept under review.

4.12 If the need for a sector focus group is accepted, a terms of reference should be drawn up as an initial task. A cross section of key target countries should be identified in discussion with geographical desks.

ANNEXES

- 1. Annual Renewable Freshwater Available per Person**
- 2. Access to Safe Drinking Water and Sanitation (1994)**
- 3. Case Studies**

(cubic meters)



Countries projected to experience water stress or water scarcity by 2025, UN medium population projection.

Water Stress 

Water Scarcity 

Country	1955	1990	2025 medium	Country	1955	1990	2025 medium
Djibouti	147	23	9	Iran	6,203	2,025	816
Kuwait	808	75	57	Mauritius	3,854	2,047	1,575
Malta	96	85	69	Syria	6,500	2,087	732
Qatar	1,427	117	68	United Kingdom	2,344	2,090	1,992
Bahrain	672	179	89	Ethiopia	5,073	2,207	842
Barbados	221	195	164	Lesotho	5,039	2,290	1,057
Singapore	459	221	181	Zimbabwe	7,061	2,312	1,005
Saudi Arabia	1,266	306	113	China	4,597	2,427	1,818
United Arab Emirates	6,195	308	176	India	5,277	2,464	1,496
Jordan	906	327	121	Sri Lanka	4,930	2,498	1,738
Yemen	1,098	445	152	Germany	2,843	2,516	2,384
Israel	1,229	461	264	Denmark	2,928	2,529	2,529
Tunisia	1,127	540	324	Dominican Rep.	7,306	2,789	1,747
Cape Verde	1,184	551	258	Nigeria	8,304	2,838	1,078
Kenya	2,087	636	235	Spain	3,801	2,849	2,733
Burundi	1,339	655	269	Tanzania	8,525	2,924	1,025
Algeria	1,770	689	332	Afghanistan	5,137	3,020	1,091
Rwanda	2,636	897	306	Korea, North	7,386	3,077	2,010
Malawi	2,839	939	361	Burkina Faso	6,980	3,114	1,237
Somalia	2,500	980	363	Italy	3,845	3,243	3,325
Libya	4,105	1,017	359	France	4,260	3,262	3,044
Morocco	2,763	1,117	590	Thailand	7,865	3,274	2,477
Egypt	2,561	1,123	630	Cuba	5,454	3,299	2,694
Oman	4,240	1,266	410	Madagascar	8,476	3,331	1,185
Cyprus	1,698	1,282	996	Togo	8,485	3,398	1,280
South Africa	3,249	1,317	683	Jamaica	5,383	3,430	2,365
Korea, South	2,940	1,452	1,253	Ghana	9,204	3,529	1,395
Poland	2,053	1,467	1,279	Turkey	8,509	3,626	2,186
Belgium	1,906	1,696	1,706	El Salvador	8,583	3,674	1,952
Haiti	3,136	1,696	838	Uganda	11,880	3,759	1,437
Lebanon	3,088	1,818	1,113	Pakistan	10,590	3,962	1,803
Peru	4,612	1,856	1,071	Mozambique	8,601	4,085	1,598
Comoros	5,256	1,878	620	Trinidad and Tobago	7,073	4,126	2,867

ANNEX 2 ACCESS TO SAFE DRINKING WATER AND SANITATION (1994)

SELECTED COUNTRIES - AFRICA			SELECTED COUNTRIES - ASIA/PACIFIC			SELECTED COUNTRIES - LATIN AMERICAN CARIBBEAN		
	% WATER	% SANITATION		% WATER	% SANITATION		% WATER	% SANITATION
Eritrea	16	-	Afghanistan	12	8	Haiti	28	24
Central Africa Republic	18	46	Bhutan	21	21	Paraguay	35	62
Chad	24	21	Papua New Guinea	28	22	El Salvador	55	68
Ethiopia	25	N/A	Yemen	36	65	Bolivia	55	41
Madagascar	29	15	Viet Nam	36	21	Peru	59	46
Liberia	30	18	Cambodia	36	14	Honduras	65	65
Mozambique	32	N/A	Myanmar	38	41	Ecuador	70	64
Angola	32	16	Lao PDR	39	24	Dominican Republic	71	78
Uganda	34	57	Nepal	44	20	Brazil	71	55
Mali	37	31	Iraq	44	36	Argentina	71	68
Nigeria	39	36	Sri Lanka	46	52	Colombia	76	63
Zambia	43	23	Pakistan	60	30	Venezuela	79	58
Malawi	45	53	Indonesia	62	51	Panama	83	86
Guinea	49	21	Oman	63	76	Mexico	83	67
Tanzania	50	64	China	69	21	Chile	85	68
Senegal	50	58	India	74	26	Costa Rica	92	92
Cameroon	50	74	Thailand	77	74	Cuba	93	66
Benin	50	20	Iran	83	67	Trinidad & Tobago	97	79
Sudan	51	32	Syria	85	56	Jamaica	100	89
Burundi	52	51	Philippines	87	78			

Note: % WATER is percentage of population covered

Source: WHO/UNICEF Joint Monitoring Programme (1995)

CASE STUDIES QUOTED

AIM: In support of ODA's aim to help people achieve better education, health and opportunity, particularly women.

- 1.1 India: Maharashtra Rural Water Supply and Sanitation Project
(wider benefits of catalysing institutional change)
- 1.2 Senegal: Village Water Supply
(promotion of community involvement and more integrated objectives over time)
- 1.3 South Africa: Capacity Building to Support Community Managed Water Supply and Sanitation
(importance of appropriate government policies)
- 1.4 Ghana: Village Hand Dug Wells
(integration of water supply and health education; co-financing)
- 1.5 Tanzania: Dodoma Region Water Supply
(integration of NGO and government roles)
- 1.6 Zimbabwe: Bikita Water project
(transition from drought relief to development)
- 1.7 Lesotho: Rural Water Supplies
(involvement of women, links with health)
- 1.8 Evaluation of Rural Water Supply Projects Implemented through NGOs
(part of a wider rural water synthesis study)
- 1.9 India: Water Supply as Part of Slum Improvement Projects
(integration of improvements targeting urban poor)
- 1.10 TDR: Basement Aquifer Study
(take up of research and benefits to rural poor)
- 1.11 TDR: Groundwater Management in Drought Prone Areas
(better management of drought)
- 1.12 TDR: Environmental Health Research Programmes
(linkages between water, sanitation and health)

AIM: In support of ODA's aim to enhance productive capacity and conserve the environment AND to encourage sound development policies, efficient markets and good government.

- 2.1 India: Management Development for Urban Public Health Officials
(promoting institutional change)
- 2.2 Ghana: Two Regions Water Project
(importance of institutional development)
- 2.3 Egypt: Cairo Wastewater Project
(importance of institutional development)
- 2.4 India: Gomti River Pollution Control
(environmental sanitation interventions)
- 2.5 Bangladesh: Communal Freshwater Fisheries
(enhancing livelihoods)
- 2.6 Egypt: Environmental Standards
(pollution control and auditing)
- 2.7 China: Environmental Projects
(typical examples plus cofinancing)
- 2.8 TDR: Assessment of Global Water Resources
(improving knowledge of water resource availability)
- 2.9 TDR: Groundwater Information Management
(improved planning of groundwater use)
- 2.10 TDR: Water Resource Planning in Developing Countries
(improving integrated water management)
- 2.11 TDR: Productivity Improvements through Management
(increased irrigation efficiency)
- 2.12 TDR: Minor Irrigation
(appropriate small scale irrigation design)
- 2.13 TDR: Groundwater Resources Degradation: Socio-economic Impacts and their Mitigation (multidiscipline research)
- 2.14 TDR: Impact of Urbanisation on Groundwater
(protection of water resources)
- 2.15 TDR: Irrigation/Drainage Environmental Check List
(mitigating environmental impact)

2.16 TDR: Efficient Village Irrigation for Women
(enhancing women's lives, multidiscipline approaches)

2.17 TDR: Hydrology of Great Lakes in Africa
(research into practice)

CASE STUDY 1.1 INDIA: MAHARASHTRA RURAL WATER SUPPLY AND SANITATION PROJECT - The Wider Benefits

ODA is currently supporting a water supply and sanitation project in the Indian State of Maharashtra, which will serve 187 villages as part of four regional schemes, each scheme having their own treatment plant, pumping stations, distribution networks etc., in Jalgaon and Nasik Districts. One of the key requirements of the project is that institutional and community participation issues for O & M (operation and maintenance) and cost recovery should be addressed and adequate arrangements in place before the village people begin receiving water. The problem for the GoM (Government of Maharashtra) is that if they provide adequate arrangements for the ODA schemes, there will be considerable pressure for them to provide similar changes to the present set up elsewhere in the State, which has a population of 80 million people. Such changes often involve tough decisions about reallocation of resources, slowness to change is often the result.

This constraint from ODA's point of view can be turned into an opportunity. The Indian Government increasingly view donor supported projects, as opportunities to innovate, to do pilot projects and to contribute to policy development. As part of the Maharashtra Project, ODA in collaboration with the GoM, local and foreign consultants, have developed initiatives in the following areas that influence State-wide policies:

- * **Community Participation & Health Education** - as part of an integrated approach. The project involves a programme of developing the skills of Government staff so that they are enabled to interact constructively with the village communities. While this is a more challenging enterprise than the usual method of working through local NGOs, it offers more sustainable and replicable benefits.
- * **Institutional & Financial Arrangements** - ODA is supporting a review of institutional and financial arrangements by GoM, by utilising consultants, facilitating workshops etc. This has contributed to proposed organisational changes at State level including the creation of a Water Supply and Sanitation Department to improve accountability and the resolution of water resource management problems. District level arrangements are still to be finalised. Significant additional medium term funding to meet the predicted high O & M costs of the ODA schemes has been agreed by the GoM.
- * **Training** - in collaboration with the World Bank, who have a similar project in 10 other Districts, sector wide training needs are being assessed and courses developed that utilise more participative techniques. Fragmented water sector organisational arrangements in the past have hampered the development of comprehensive training programmes. Organisational changes should reduce this constraint.
- * **Water Quality Monitoring** - in collaboration with the World Bank, ODA is supporting the development of a State WQM strategy and systems that will increase accountability of the rural water supply organisations for the delivery of potable water supplies, with appropriate WQ surveillance.
- * **Sanitation** - in collaboration with UNICEF and consultants, a 5 Year State Sanitation Strategy is being developed. ODA is also supporting a Pilot Sanitation Project to explore how the Government can best promote sustainable sanitation in its two project districts.

Such initiatives as these improve the dissemination of lessons learnt from the project and replicability. ODA is able to participate in these activities because it is a significant stakeholder with a sizeable project, NGOs are unlikely to have the same opportunity. Rural water supply and sanitation involves a wide range of organisations and groups, more so than many other types of projects. While this is a constraint from the point of view of achieving the specific project objectives, it can be an opportunity for wider benefits if the project is viewed as a vehicle for change.

CASE STUDY 1.2 SENEGAL VILLAGE WATER SUPPLY (SVWS)

Project Objectives

Improve the health and well-being of people in rural villages in Senegal through improved access to potable water and hygiene awareness. This is achieved by increasing the population served from existing borehole schemes and the provision of hygiene education and community management.

Project Development

ODA first embarked on a Senegal Village Water Supplies (SVWS) project in 1984. This consisted of separate schemes in 18 groups of villages. For each group of villages a pump was installed in a new or existing deep borehole which pumped to an elevated tank. From this tank water gravitated to standpipes in villages within a 5km radius of the borehole through a network of pipes. Drawing on experience in other parts of Africa the idea of a self help component was put to villagers whereby they were offered a supply if they were prepared to dig trenches, lay pipes and back fill under the supervision of skilled supervisors.

The concept was strange to the heavily centralised systems prevalent in Francophone Africa but after a slow start the enthusiasm of villagers for this approach grew.

Following the completion of the original project in 1988, various extensions to the pipe network were undertaken using locally purchased pipes and standard fittings. This work has continued with further extensions being carried out not only to schemes funded by ODA but to other schemes previously funded by others.

The ongoing programme which is being funded under the British Partnership Scheme is now completely community demand driven. The Ministry of Water Affairs identifies places where it would be possible to provide extensions from existing schemes but from then on the project requires the community to form a Water Committee and make a commitment to provide the unskilled labour to carry out the work. Up to 100 people are involved in digging trenches at one time. A local non-government organisation is involved in the community management and hygiene awareness training. The Ministry of Water Affairs is keen to expand this low cost approach to increasing water supplies (£10-£20 person served).

CASE STUDY 1.3 SOUTH AFRICA: CAPACITY BUILDING TO SUPPORT COMMUNITY MANAGED WATER SUPPLY AND SANITATION

The Department of Water Affairs and Forestry (dwaf) issued a White Paper on Water Supply and Sanitation in late 1994 that sets out the principles of how basic needs in water and sanitation for rural households in South Africa will be met. Within this framework, a number of donors including ODA, are now assisting DWAF to meet this goal.

ODA has recently commenced a project to assist poor communities in the 2 provinces, Northern Province and Eastern Transvaal. The purpose of the project is to assist in establishing the institutional framework and capacity to support community managed water supply and sanitation in these two provinces and provide guidance for application elsewhere. It includes the funding of local organisational development officers and technical assistance and training in management, strategic planning and programming. Assistance is provided to emerging and existing Water Boards to improve their coverage and scope of services and to support local water committees in the provision of services at the local level. The project also includes the development of small community based schemes and research initiatives where these will provide useful demonstration benefits.

This project shows how community based initiatives can be scaled up to provide widespread benefits given strong support and appropriate policies by government. It also illustrates the benefits of a sound policy framework under which a number of donors can coordinate and assist.

CASE STUDY 1.4 GHANA: VILLAGE HAND DUG WELLS PROJECT

The programme was an integrated water supply & health education project for 200,000 people, managed by the community, leading to:

- * improvements in health through a reduction in water related diseases
- * reduction in burden of work involved in water collection
- * extension of indigenous capacity for further water supply & health education projects

Five key elements were identified in the development of the programme:

1. Community mobilisation leading to:

- * establishments of Village Committees before commencement of well construction
- * implementation of operation plan of maintenance by Village Committees

2. Provision of safe water sources

- * construction of 804 hand-dug wells by March 1995
- * development of sustainable technologies

3. Operational Health Education programme

- * recruitment and training of 2,409 Village Health Co-ordinators by March 1995
- * development, printing & distribution of health education materials for Village Health Co-ordinators

4. Institutional capacity extended by:

- * supporting 5 newly formed NGOs
- * training 90 NSS Personnel as well construction supervisors and assistance in gaining employment in the water sector
- * co-ordination and funding an annual National Conference for agencies in the water supply & health education sector

5. Programme Co-ordination of the project, offering:

- * professional and technical advice
- * logistic support
- * monitoring and evaluation facilities

Costs:

£516,951 over three years from 1992/93 to 1994/95 [ODA/JFS 271]. Total cost of the project was £1,794,000. The European Community also contributed £320,000 through their co-financing scheme.

CASE STUDY 1.5 TANZANIA: DODOMA REGION

An integrated approach involving community development and health workers; an NGO and government departments.

WaterAid, in collaboration with the Ministry of Water in Dodoma Region, has established an innovative community-managed water supply programme. Key community development and health extension staff have joined water department staff at a district level to create an integrated approach in order to promote and implement the National Water Policy.

The work is carried out by teams known as WAMMA. In order to facilitate the integration of inputs into water supply schemes, teams of staff from WaterAid, the Ministry of Water [Maji], Ministry of Community Development [Maendeleo] and Ministry of Health [Afyā] have been formed.

Four district teams are responsible for co-ordinating a village-by-village programme of new and rehabilitated water points, and initiate discussions at the village level through joint visits. The teams meet monthly to co-ordinate plans and manage the allocation of transport. They produce quarterly work plans and sector annual plans. All four district teams meet twice a year for training, information, exchange and sharing "good practice" experience.

A recent consultancy report commented that the WAMMA team model offered a significant opportunity for creating institutional sustainability. It was recommended that the responsibility of the district teams should be gradually and sensitively increased, and the WaterAid staff member should begin to adopt a more advisory role.

ODA has supported this programme through the Joint Funding Scheme.

£415,140 between 1991/92 and 1993/94 [ODA/JFS 523]

£237,417 between 1994/95 and 1996/97 [ODA/JFS 987]

WaterAid's budget for the programme in Dodoma in 1995/96 is £670,000.

WaterAid in 1995 received an international award for innovation in community based projects based on its work on this and other similar projects.

CASE STUDY 1.6 ZIMBABWE: BIKITA WATER PROJECT

From drought relief to development

Under the ODA - funded Bikita Emergency Water Supply Project which was initiated in response to the 1992 drought, improved water supplies were installed. These included deepening of 96 existing wells; rehabilitating 47 boreholes; rehabilitation of a piped water scheme; drilling of 67 new boreholes; and water and storage tanks at 21 schools and clinics. The project was managed by Bikita District Council through its Water and Sanitation sub-committee with support from the NGO Wateraid which was already established in the area (working of the National Family Wells Programme also funded by ODA-JFS). There were clear advantages during this emergency in working through a District Council rather than the national water department and using known contacts and procedures. The Government of Zimbabwe highly commended the Bikita Emergency Project.

The Bikita Integrated Rural Water Supply and Sanitation Project follows from the Emergency Water Project. It will assist local communities in the Bikita District to plan and construct additional water points and latrines for domestic use, with the aim of meeting national minimum standards for the district by 1999.

The project builds on ODA experience which has indicated that previous rural water and sanitation projects have generally failed through excessive costs, inadequate maintenance and poor use of facilities due to scant involvement of the community in siting, technology choice and management. The project will therefore establish a system of community - based planning, management and maintenance of water facilities based on use of the new extractable version of the Type B bush pump, field tested during the Emergency project. The project will also include a programme of health education to ensure that health benefits from increased access to water and sanitation facilities are maximised. It will promote sound environmental practices.

The project forms part of a National Water and Sanitation Programme currently operating in 35 of Zimbabwe's 58 districts, coordinated by a National Action Committee (NAC) in the Ministry of Local Government Rural and Urban Development. It will be implemented by the Rural District Council through its District Water and Sanitation Sub-committee.

CASE STUDY 1.7: LESOTHO RURAL WATER SUPPLY

"Since the mid 1970's, ODA, together with the government and other donors, has supported the provision of safe and regular water supplies to rural communities in Lesotho. This programme has been successful in providing some 65% of rural communities with water through simple, robust and low maintenance systems. Despite some systems being over 20 years old, over 90% of the ODA financed schemes are still functioning. A new programme to extend water supplies to the remaining 35% of communities is being developed.

Rural communities in Lesotho are characterised by the low numbers of males of working age and a high percentage of female headed households (54%). This reflects the tradition of male migrant labour travelling to South Africa to work in the mines. Returns from agriculture are very low and remittances from migrant workers are essential if rural families are to avoid living in poverty.

Water supply schemes rely upon communal labour which is traditionally "women's work", is unpaid and is in addition to their normal activities. Women are perceived as major beneficiaries by the community because it is their role to fetch water for household purposes and improved access will facilitate this. Women show high levels of commitment to water supply schemes, providing labour willingly and taking lead roles in Village Water Committees. These activities are time consuming and as a result women are constrained from seeking wage employment or income generating activities. This exacerbates poverty when a household does not have access to remittances.

The potential health benefits from improved water supplies have not been achieved. This is because of the poor coverage of health education outreach services, a reflection of poor management and scarcity of personnel in the Ministry of Health. The prohibitive cost of VIP latrines is a further constraint. The new ODA programme seeks to address this by utilising NGO service providers under contract to MoH."

CASE STUDY 1.8 EVALUATION OF RURAL WATER SUPPLY PROJECTS INITIATED AND IMPLEMENTED THROUGH NGOS

The ODA have recently carried out evaluation studies on two rural water supply and sanitation projects co-funded by ODA but undertaken by Non Government Organisations (NGOs). Both projects addressed the problem of water and hygiene related diseases through providing access to a clean water supply and improved sanitation supported by health education.

The Busoga project in Uganda was initiated and implemented by WaterAid. It planned to rehabilitate boreholes and install handpumps suitable for a village level operation and management system (VLOM). The Moyamba project in Sierra Leone was initiated and implemented by CARE. It provided assistance to communities in the construction of hand-dug wells and ventilated improved pit latrines, combined with a programme of community-based environmental health education.

Lessons learnt:

1. project design: In order for rural projects to be successful in achieving a reduction in morbidity and mortality due to water and hygiene related diseases, three vital components are required to be implemented in parallel. First, an effective, carefully designed and culturally appropriate health education programme is required. Second, widespread household latrine provision is essential in order to improve the village standard of hygiene. Third, a potable water supply must be provided, designed in such a way that it is technically appropriate, cost-effective, and accessible and which can, to the maximum extent practicable, be maintained solely by the villagers.

2. institution building: Developing new institutions at community level takes time, and requires substantial resources. Success depends on physical work not outstripping the pace at which social mobilisation can be achieved, plus continuing support to capacity building after completion of the physical work.

3. community ownership: To ensure the sustainable VLOM management of an improved water source, transfer of ownership to communities is required through publicly acknowledged, formalised mechanisms.

4. baseline survey: In order to design, monitor and evaluate the impact of rural water supply and sanitation projects adequately, a well designed and detailed baseline survey of selected villages is required which will define the starting point for the project. When the project has been completed, the baseline survey should be repeated in each selected village in order to assess the impact of the project and the extent to which the project has achieved its objectives.

5. measurable indicators: Although it may be very useful to understand the broad pattern of disease in a community so that the project can be tailored to meet reduction in certain disease rates, behavioural change is in general a more practical and reliable measure of the impact of this type of project than disease rates, the latter often being difficult and expensive to collect accurately.

6. NGO advantage: In countries where the economy and Government alike is in a state of near collapse and where the British Government's bilateral aid programme has been forced to run down due to the ineffectiveness of the government in implementing sustainable programmes of reform, carefully selected, well organised NGOs with specific skills and experience can provide ODA with an effective way of delivering aid to the poorest groups.

CASE STUDY 1.9 WATER SUPPLY INPUTS ON SLUM IMPROVEMENT PROJECTS

Background

Over the last ten years ODA has provided support to the Government of India's slum improvement programme by funding projects in Hyderabad, Visakhapatnam, Vijayawada, Calcutta and Indore. This has involved a total financial commitment of £68.5 million. Preliminary phases of two more projects have recently started in Cuttack and Cochin.

These two new projects represent a shift in emphasis for ODA and its project partners: away from a focus on slum improvement to a city wide urban poverty reduction programme.

The main aim of the projects is to integrate the slum communities into the economic, social, health and physical networks of the cities.

Project objectives include:

- improving the health of slum families
- improving education and literacy levels
- improving access to employment and income generation opportunities
- improving environmental, sanitation and housing conditions.

Project physical improvements include among other components:

- sewer lines or individual low cost sanitation units
- storm water and sullage drains
- water supply through a piped or deep borewell system.

Water Supply Inputs

Water supply inputs in Hyderabad, Indore and Calcutta have been restricted to "in-slum" improvements to existing systems. In the remaining cities, where existing capacity is insufficient to meet the demand from project slums, ODA is also contributing towards improvements "external" to the slums.

The type of water supply improvement required varies from city to city.

- the cost of water supply is 11% of the total Rupee budget (allowing for exchange rate variations this is equivalent to £7 million).
- cost per capita of water supply is Rs 50 to Rs 350 (£1-£7).

Indore has reasonable existing water supply systems within project slums. The cost of water supply improvements is 3% of the total Rupee budget.

Visakhapatnam (Chinagadili) has no existing water supply system. As this is a planned relocation area, where designs can be optimised, the cost of water supply improvements is 8% of the total Rupee budget.

Calcutta has a large variation in existing water supply systems serving, and within, project slums. The cost of water supply improvements is 10% of the total Rupee budget.

Vijayawada and Visakhapatnam (Main Project) have poor existing water supply systems serving, and within, project slums. Hence, contributions towards improvements "external" to project slums have been necessary. The cost of water supply improvements is 15% and 16% of the total Rupee budget in Vijayawada and Visakhapatnam respectively.

Hyderabad has very poor existing water supply systems within project slums. The cost of water supply improvements is 19% of the total Rupee budget.

Cuttack and Cochin main phase projects will have both "in-slum" and "external" water supply improvements. The likely costs of these activities is not yet known.

CASE STUDY 1.10 TDR: BASEMENT AQUIFER STUDY

In 1988 BGS completed a five year multi-disciplinary study of the groundwater resources of the weathered basement aquifers. The project was financed by ODA, and was intended to help improve the water supply for millions of villagers who live over such rocks throughout the developing world.

Collaborating Organisations

Public Works Department, Malawi. Institute of Hydrology
Sri Lanka Water Resources Board
Ministry of Energy, Water Resources and Development, Zimbabwe

The Need

In the arid to semi-arid regions about 30 per cent of the developing countries are underlain by massive igneous or metamorphic rocks. Surface water supplies are not available and significant perennial groundwater supplies are difficult to locate. It will never be economically possible to provide piped water supplies to the dispersed villages situated in these areas. A local groundwater supply is essential.

Results

1. A greater understanding of the groundwater system was obtained.
2. Better means for exploiting the aquifer were developed and tested. These included collector wells (improved traditional dug wells) and hydrofracturing of boreholes.
3. Improved methods of siting of water supplies was developed.

Dissemination

The project was widely publicised by workshops, a book was written summarising the advances made.

Take-up

ODA have funded development projects in Sri Lanka and Zimbabwe which have utilised the funding. Other countries e.g. Botswana and Ghana are unilaterally applying the results.

Costs

£776,000 was spent over the 5 years of the project. Twenty-one UK scientists were involved. Two international workshops were held.

CASE STUDY 1.11 TDR: Ground Water Management in Drought Prone Areas of Africa

An ODA funded project.

The project is operated as a partnership between:

The British Geological Survey, Hydrogeology Group

The Malawi Ministry of Irrigation and Water Development

The Ghana Water and Sewerage Corporation/Ghana Water Resources Research Institute

The Institute of Hydrology

The project goal is to alleviate the impact of groundwater drought on vulnerable communities.

The purpose of the project is to provide a strategy for the improved management of groundwater resources in drought prone areas.

The products that the project will produce are:

Reports on the evaluation of regional drought experience

Drought sensitivity analysis reports and maps

A system for predicting the occurrence and impact of groundwater drought

Groundwater management plans

A workshop in Central Africa to disseminate findings and recommendations and to attract NGO funding for implementation work.

Summary

Groundwater drought is severe, it is the final stage of surface water drought when people rather than food have to be moved. This is an increasing problem due to reducing recharge and increased demand. Many boreholes and wells, and some areas of geological terrains, are more vulnerable to groundwater drought than others. Assistance for groundwater drought is provided as crisis input on the assumption that groundwater drought is a short term shock rather than a recurring event. However, prediction and planning will enable better targeting of limited resources to vulnerable areas and ensure timely and effective assistance when groundwater drought occurs.

CASE STUDY 1.12 TDR: HEALTH AND POPULATION DIVISION

1. Environment Health Work Programme, London School of Hygiene & Tropical Medicine - £1.181m over 5 years 1990 - 1995

Aim: To undertake research on the design and implementation of cost-effective environmental health interventions; the dissemination of knowledge about environmental health among practitioners and policy makers in developing countries and external support agencies. Work included: hygiene behaviour associated with water supply and sanitation; epidemiology and health impacts of water, sanitation and waste refuse; improvements of urban environmental health infrastructure (eg drainage, sanitation, and solid waste management); epidemiology and control of vector-borne disease.

2. The Health Impact of Development Projects Work Programme, Liverpool School of Tropical Medicine - £935,000 over 5 years 1990 - 1995

Aim: To research the health hazards of development; to develop research procedures for impact assessment and mitigation; to refine analytical tools; to advocate the need for health impact assessment. Main focus : on vector-borne diseases associated with water resources development projects (irrigation, hydropower, flood control).

CASE STUDY 2.1 INDIA: Management Development for Urban Senior Public Health Officials

No major city in India receives comprehensive 24 hour water supply and only 8 out of the 3,000 plus cities and towns have adequate sewerage. This project aims to improve the management of urban water supply and sanitation services. This is undertaken at 3 levels:

- through the direct training of senior officials in technical and management issues related to the delivery of urban public health engineering services and the development of the ability to analyse their own institutions and initiate change;
- through the development of the capability of a selected Indian Management Training Institute to run similar training programmes for practising sector professionals;
- and through the strengthening of the management content of existing post graduate courses in Public Health Engineering.

The programme targets senior professionals who will be in a position to promote institutional development. The training comprises a short period at a UK university to review the theoretical ground and recent developments in the UK. This is followed by a short in-India Field Study of a suitable urban organisation to apply the analytical knowledge under Indian conditions and also establish individual action plans. A follow-up module some 4 to 6 months later is held to review subsequent developments in participants' own organisations (benchmarking) and reinforce learning. An Indian Management Training Institute is becoming progressively more involved in this programme and will eventually take over the running of an all-India activity.

CASE STUDY 2.2 GHANA: TWO REGIONS WATER PROJECT

As part of a wider World Bank-led programme for municipal water supplies improvement, ODA is rehabilitating pumps, pipework and control equipment in 11 towns in Ashanti and Brong Ahafo regions with a view to increasing the output of water by 45%. More people will thus have access to treated water. Training is being provided in hygiene awareness and in operations and maintenance. ODA has also been assisting in strengthening the overall technical and management capacity of Ghana Water Supply and Sewerage Corporation (GWSC).

The Government has a clearly stated policy on water supply. However, despite donor support, GWSC remains institutionally weak. Management is highly centralised; supply does not meet demand but the debt burden is overwhelming; tariff levels remain too low and although progress has been made on manpower planning much remains to be done. Discussions are taking place between GWSC, the World Bank and other donors, including ODA, looking at the possibility of inviting outside utilities to manage certain parts of the business. Separately, moves are being made to transfer responsibility for rural and small town supplies to local communities and local authorities.

CASE STUDY 2.3 EGYPT : CAIRO WASTEWATER PROJECT

ODA has spent £66 million between 1978 and 1992 on part of a major sewerage and wastewater treatment programme in Cairo. The project took much longer, and was much more expensive, to build than anticipated, but the streets are no longer flooded with raw sewage. The project is notable for the extensive donor coordination involved. Planned physical structures, including a deep tunnel, were completed, but the project's parastatal owner remained underfunded and bureaucratic. It had taken few steps to raise tariffs to the level needed to cover the higher operating and maintenance costs of the new system. The project has highlighted the need for policy development and institutional strengthening to complement physical works. ODA is now continuing to assist in institutional strengthening.

CASE STUDY 2.4 INDIA: GOMTI RIVER POLLUTION CONTROL PROJECT

ODA is working with municipal, state and national institutions in Lucknow, Uttar Pradesh, on Phase 1 of a project to improve sanitation, drainage and solid waste services for the city of 1.7M people.

The original feasibility report presented the project as part of the National Rivers Conservation Directorate - Ganga Action Plan Phase II to reduce pollution in specific tributaries of the river Ganga.

This basic project has been strengthened by focussing on Lucknow rather than the Gomti river catchment as a whole. The approach is aiming to deal with the difficulties that the municipal corporation faces in delivering urban services. It will look to work in low-income areas where provision of services is inadequate and develop mechanisms for bringing those neighbourhoods into the city-level planning process.

By working towards a preventive rather than curative approach to the more narrow objective of river clean-up and focussing on environmental health issues in poor areas the project is advancing ODA's priority objectives of Human Development (Health) and Environment.

CASE STUDY 2.5 BANGLADESH: COMMUNAL FRESHWATER FISHERIES

Up to half of the land area of Bangladesh is flooded during the monsoon season. Millions of families rely on the freshwater capture fishery and aquaculture to improve their livelihoods.

ODA support for freshwater capture fisheries and aquaculture has seen:

- farmers in the north west increase fish production by 250%;
- landless women achieve empowerment and livelihoods through the adoption of small-scale cage culture;
- in a project managed by the non-government organisation CARE, over 1000 farmers introducing fish farming to their rice fields have found the average rice/fish system to be 106% more profitable than irrigated rice alone, and 26% more so than rain fed rice. In collaboration with the European Commission and World Bank, the production system is now being extended to 83,000 rice farmers including 20,000 women;
- to counteract the decline in fish numbers on the floodplains of western Bangladesh due to flood control measures, young carp have been released into open floodwaters. This is resulting in an average of 7 tonnes of fish caught for each tonne of fish stocked.

CASE STUDY 2.6 EGYPT: ENVIRONMENTAL STANDARDS

In order to pursue newly defined national environmental standards and to combat water pollution, Egypt needs to develop the environmental auditing capabilities of Egyptian consultants and identify opportunities for better pollution control. ODA is supporting environmental audit with Egyptian consultants of three industrial sectors - textiles, food processing and the manufacture of oils and soaps - which have been demonstrated to cause high levels of water pollution. The audits will focus specifically on the identification of low cost/no cost options for pollution control, as well as those that have been demonstrated in the UK to achieve financial paybacks. This will involve waste minimisation, energy efficiency, solid waste management and efficient utilisation and recycling of resources. The project focuses on private sector industrial operators.

CASE STUDY 2.7 SOME EXAMPLES OF ENVIRONMENTAL PROJECTS IN CHINA

1. WUXI SEWERAGE MASTER PLAN (WUSE) (JIANGSU) (1990 to 1993)

At Wuxi ODA undertook a Sewerage Master Plan Study. The study helped with the provision of a long term pollution plan to meet declared water quality objectives for the Grand Canal and associated waterways within and adjacent to the urban areas of Wuxi. It covered the interception, transfer, treatment and disposal of wastewaters. The effect of identified options on the quality of the waterways, including the transfer of water from Lake Tai to improve flow circulation within the waterways of the old city, was investigated and quantified by the use of a water quality mathematical model. The consultants also assisted the Wuxi Municipality to prepare for a World Bank Appraisal Mission in June 1992. The World Bank infrastructure project is under way.

2. COASTAL ZONES ENVIRONMENTAL ENHANCEMENTS (COZEE), (HAINAN AND FUJIAN) (1994 to 1998)

ODA is assisting the National Environmental Protection Agency (NEPA) with a Demonstration Study of Environmental Planning in Coastal Special Economic Zones. The lack of environmental planning has led to worsening of the quality of the environment and frequent pollution accidents with the rapid increase in economic growth and increase in pollutant discharges. The project will aim to establish a demonstration model and provide guidance for environmental planning in economic zones. It will be based on four cities in the Provinces of Hainan and Fujian. The project is expected to commence in May 1995.

3. YUNNAN PROVINCE PLAN FOR THE ENVIRONMENT (YUPPE) (YUNNAN) (1994 to 1997)

A group of consultants and institutions is assisting the World Bank and Yunnan Provincial Government with the Yunnan Environment Project (estimated cost to World Bank \$150 million). The World Bank project will focus on financial and policy reform to support market pricing for municipal services, institutional strengthening of the organisations delivering the services, and investments aimed at environmental recovery and sustainable use of natural resources (primarily water). The objectives of the ODA consultancy are to review the completeness of existing data, studies and designs, develop the Yunnan Dianchi Basin Environment Management Plan, supervise environmental master-plans for each project city (Kunming, Gwiju, Oujing and Dali), arrange engineering studies of the identified priority investments, prepare bid documentation, address a wide range of institutional, economic, financial and social development aspects, assist with the preparations to establish the Yunnan Environmental Information System and Yunnan Environmental Training Centre, and prepare the World Bank project up to the final design stage.

CASE STUDY 2.8 TDR: Assessment of Global Water Resources

The lack of precise knowledge of the availability of water resources within a country, region or river basin often restricts development potential. A study by the Institute of Hydrology and the British Geological Survey, funded from the Engineering Division TDR Programme aims to build on existing country-based reviews of water resource availability. Modern computer capabilities allow different levels of spatial information to be combined. These provide the platform for the application of predictive models of water resource vulnerability. The software system produced at the end of the project will run on standard desk-top PCs. Key issues addressed are:

- * Groundwater will often play a critical role in mitigating or multiplying the impact of water scarcity within a region. The identification of suitable hydrogeological indicators is important.
- * Assessments of water scarcity need to take account of year-to-year and seasonal variability in water use and availability.
- * Country-wide aggregates are of restricted use since they mask regional (within country) vulnerabilities. Some countries may appear well-watered at an aggregate level, but, in reality, be under extreme stress because of the relative locations of supply and demand. Thus, spatial variation in resource availability and stress need to be incorporated.
- * The logical unit for examination and management of availability and stress is the river basin. This is particularly the case where major transfers of water (surface and groundwater) occur between countries.

The project will work on a GIS (Geographical Information System) framework, with the major objective of developing a desk-top global water resources assessment package which would allow the user to examine the current surface and groundwater potential of a country, region or basin, and determine the regional implications of a variety of change scenarios.

CASE STUDY 2.9 TDR: Groundwater Information Management

Planning the delivery of efficient water resource supply, and increasing demands for environmental monitoring require access to accurate information on the occurrence and movement of groundwater.

The principal repository of information available is the collated reports of the behaviour of existing wells and boreholes, both during their drilling and during subsequent operation. A research project has been carried out to review contrasting groundwater data management experience from different countries, with the objective of preparing guidelines for project managers and water resource planners. Initial results of the project have highlighted several key elements that lead to the successful setting up of a groundwater information system.

Further work will be carried out to review and update specific groundwater data management systems, and the lessons learnt will be presented in a manual.

CASE STUDY 2.10 TDR: WATER RESOURCE PLANNING IN DEVELOPING COUNTRIES

ODA's move towards improving integrated water management is underpinned by on-going research of procedures and practices in water resources planning. Under TDR funding, a series of Case Studies of Water Resource Planning are being undertaken in semi-arid, water scarce developing countries; including Zimbabwe, Ethiopia, China (Henan Province), Turkey and Morocco. The studies have highlighted the strengths and weaknesses of current planning practices and identified the key issues to be addressed in moving toward integrated water resource planning. The studies consider institutional aspects, legislative frameworks and human resource capabilities as well as mechanisms for consultation, participation and conflict resolution.

In many countries the water sector is under a process of change in response to the need for a new approach. For example, in Zimbabwe a National Water Authority is being introduced to help promote planning and management on a catchment scale. In 1988 China issued a Water Law giving clear guidance on agency mandates, responsibilities and regulatory authority. Such changes reflect an awareness that water is a key infrastructure sector needed to support overall social and economic development. However, such institutional changes do not guarantee sustainable resource development and this remains heavily dependent on commitment to change, adequacy of enforcement mechanisms, human resource capabilities and coherent policies. In addition, new methodologies are required to assist planners and decision-makers.

Findings from the on-going research are being used to improve integrated water management through the development of a procedural framework for planning sustainable water resource utilisation. Development and trial applications are being undertaken in the Vellar Basin in Tamil Nadu, India, in collaboration with the Institute of Water Studies, Madras. The procedures take cognizance of different disciplinary and sectoral interests and address socio-economic and ecological aspects plus the technical aspects of water resource planning, take a realistic account of the constraints to water use, and how other resource development activities impact on resource utilisation.

CASE STUDY 2.11 TDR: PRODUCTIVITY IMPROVEMENTS THROUGH MANAGEMENT INTERVENTIONS

Agriculture is the largest user of water in the developing world. As urban and industrial water requirements increase, irrigation is coming under greater pressure to utilise water more efficiently. Furthermore, irrigation users are expecting irrigation water providers to arrange for more reliable water services.

Research funded by ODA into irrigation operations has targeted these two objectives to develop a management system for assisting scheme operators in day-to-day decision making. By targeting supplies to identifiable management units comprising of around 50 farmers, quantifying water requirements, timetabling delivery schedules, and monitoring compliance, the inefficiencies and inequities that have characterised agricultural water management can be reduced.

In a scheme in Bangladesh, where the ODA financed research was applied, a 20% reduction in diverted water resulted and at the same time the disparity between the best and least well served reduced by 50%. The savings in operational cost resulting from these improvements were equivalent to about £0.25 million. Agricultural production also increased with direct benefits to water users.

CASE STUDY 2.12 TDR: MINOR IRRIGATION

Population growth is outstripping food production in 27 African countries. Irrigation must make use of available water resources with increasing efficiency to feed growing populations.

Small scale irrigation schemes are particularly suited to social conditions in many parts of Africa. With appropriate help from governments, particularly in the areas of technical support for development of farmers' proposals, in agricultural extension services and in advice on credit facilities, small schemes can become self-sustaining.

The ODU at HR Wallingford has undertaken research in three countries in Africa, determining the performance of small schemes and identifying technical and socio-economic factors necessary to sustain developments. Many farmer-managed schemes have been found to operate at efficiencies better than large Government schemes.

The project is producing guidelines for planners and engineers, based on the study of thirteen schemes. It was also found that shortage of trained and experienced irrigation designers in the public sector was a significant constraint on scheme development. MIDAS, a small scheme design software package, was therefore developed to meet the needs of local designers. It was adopted by Government irrigation departments in Zimbabwe and Kenya following the training of young designers in its use.

CASE STUDY 2.13 TDR: GROUNDWATER RESOURCES DEGRADATION: SOCIO-ECONOMIC IMPACTS AND THEIR MITIGATION

Funding agencies: Economic and Social Research Council, ODA

Aims and Objectives

The world's freshwater resources face an unprecedented crisis. Despite the fact that less than one per cent of these resources are renewable, water extraction greatly exceeds its renewal and the demand is likely to increase significantly as the world's population grows. To make matters worse, usable stocks are being polluted as urban areas expand and agriculture intensifies, increasing the marginal cost of supplying the water. This research is analysing the circular interactions between the growing demand for water and the socio-economic effects of its depletion and degradation. An underlying hypothesis is that the depletion and degradation of groundwater resources will create conflicts between the ways that water can be used and between the people who use it.

The main issues under examination include:

- * the links and interaction between socio-economic, demographic and hydrogeologic conditions and circumstances
- * the management of depleting and degrading resources
- * the strategic geopolitical issues arising from the scarcity and management of the world's fresh water

Study Design

The study brings together the social and natural sciences by building on the natural resource databases held by the British Geological Survey and existing research on trade-off and groundwater management conducted by social scientists at the Natural Resources Institute. A variety of case studies, mostly in developing countries, are being examined to provide a representative spread of demographic, socio-economic, institutional and geological conditions.

Policy Implication

The results will help decision makers assess the efficacy of various policies and strategy options for sustaining water resources in the face of current and future threats.

CASE STUDY 2.14 TDR: The Impact of Urbanisation on Groundwater

Thailand, Mexico and Bolivia (1990-94)

By the year 2000 nearly 80% of the world's population will be in developing countries and of this close to half will be urban dwellers. Groundwater is an important source of water for city populations in many developing countries. Unfortunately, in many parts of the world, cities have grown at rates that outstrip the capacity of municipal services, leaving populated areas without mains sewerage or adequate wastewater or stormwater drainage. As a result shallow unconfined aquifers within or close to the city limits, are being polluted. In addition, increased pumping from city wells has stretched the groundwater resources. With the support of ODA and a number of national agencies, BGS has undertaken a study of the impact of rapid urbanisation in developing countries on both the quantity and quality of available groundwater. This has involved case studies in three cities, Hat Yai (Thailand), Merida (Mexico) and Santa Cruz (Bolivia).

The research undertaken in the three cities demonstrated:

- (1) that recharge to groundwater within urban areas is almost always significantly increased, largely as a result of leaking mains and seepage from on-site sanitation systems.
- (2) how, and to what extent the introduction of new recharge sources in urban areas, and especially the widespread use of on-site sanitation systems, may be expected to impact on groundwater quality. The studies demonstrated how the extent of the groundwater deterioration depends upon the vulnerability of the aquifer to pollution which in turn depends upon the geological and hydrogeological environment.
- (3) how, in certain groundwater settings, the disposal of urban wastewater to surface water, rather than to groundwater, reduces the risk of polluting aquifers, but that surface water bodies represent a potentially important source of recharge. In the urban centre of Hat Yai for instance, where seepage derived from canals accounts for more than 50% of the recharge, it is the principal cause of deterioration in groundwater quality.

The BGS study has enabled the Hydrogeology Group to develop extensive expertise in assessing aquifer vulnerability and the risk of groundwater resources in the urban environment. This has been harnessed to produce overview reports for both ODA and WHO-UNEP on the processes and likely impacts on water resources from increasing urbanisation.

CASE STUDY 2.15 TDR: IRRIGATION/DRAINAGE ENVIRONMENTAL CHECK LIST

Examples of the damage caused by unforeseen environmental impacts of irrigation, drainage or flood control developments are numerous. The complexity of environmental processes and systems is such that accurate prediction of the full spectrum of changes brought about by particular human activity is not generally easy. However knowledge and awareness are increasing.

With support from ODA, the Overseas Unit at HR Wallingford has, in collaboration with the International Commission on Irrigation and Drainage, produced an environmental check list and supporting software that is now widely used. The main purpose of the checklist is to provide a tool which will enable specialists and non-specialists concerned with irrigation and drainage development to improve their knowledge and understanding of the environment changes which such projects may bring so that adverse effects can be identified and if possible avoided.

Potential impacts are grouped under the following topic areas:

- * Hydrology
- * Pollution
- * Soils
- * Ecology
- * Socio-Economic
- * Human Health

The checklist has now been translated into five languages and provided the impetus for the guide that FAO has published in association with ODA and HR Wallingford.

CASE STUDY 2.16 TDR: Water-Efficient Village Irrigation for Women

Small scale vegetable production at the family or village garden level provides a vital addition to livelihoods which are based on more extensive arable or livestock agriculture. However, best vegetable yields, whether for family use or for trading in local markets, frequently require irrigation water. Working in Zimbabwe with village women and the national research service, the Institute of Hydrology (IH) and British Geological Survey (BGS) have brought about significant improvements in village garden irrigation. This programme has been funded from the Engineering Division TDR Programme and, more recently in the village extension phase, by Technical Cooperation funds.

The starting point was the development by BGS, working with national geological services in southern African countries, of the collector well concept. The water yield from hand-dug wells can often be increased if collector tunnels are drilled radially from the bottom of the well, and BGS developed a special horizontally-operating drilling rig to bore such tunnels. Taking advantage of the extra water yield from collector wells, IH and local irrigation agronomists have worked to improve the distribution of water over raised vegetable beds, typically three metres long by one metre wide.

In semi-arid climates it is vital to use irrigation water efficiently. When using a watering can or bucket, much of the water poured onto plant and soil surfaces may evaporate before it has a chance to benefit the crops. Of a range of small-scale irrigation systems evaluated, therefore, the most effective was one which reduced surface evaporation by using cheap perforated pipes laid underground to distribute the water.

Social and socio-economic assistance and assessments have been coupled with the technical evaluation of irrigation techniques, and there has been plenty of feedback from local women as to the effectiveness of the new approaches to village garden irrigation. News of the benefits from the research is spreading through Zimbabwe and southern Africa, aided by the TC-funded extension phase, and interested requests for information on the programme have been received from a number of other parts of the world.

CASE STUDY 2.17 TDR: Research into Practice on the Great Lakes in Africa

Although the hydrology of great lakes of Africa, such as Malawi and Victoria, is complex, accurate water balances are essential both for water resource planning, and for the correct prediction of lake levels for fishing and commercial navigation. Under a research project funded from the Engineering Division TDR Programme, hydrologists from Malawi and from the Institute of Hydrology (IH) have been working closely together on modelling the water balance of Lake Malawi. Sets of lake level data running back to the end of the last century have been combined with the most recent readings, and the model developed has drawn on results from other research projects funded at IH by ODA.

Senior hydrologists from Malawi have been so impressed by the accuracy of the model developed in predicting lake levels that they are currently using it to provide guidelines for the operation of a major control barrage, sited where excess water from Lake Malawi flows into the Shire river. The approach is now being extended to produce water balance models on a large river basin scale, starting with the Zambesi.

On Lake Victoria, IH has recently successfully completed a reassessment of historic data on lake levels and of lake level/discharge relationships, commissioned by ODA in connection with planned extensions to the Owen Falls hydroelectric plant, sited at the outflow of Lake Victoria in Uganda.