Global Water Partnership

ABSTRACTS

POSTERS

SIXTH STOCKHOLM WATER SYMPOSIUM

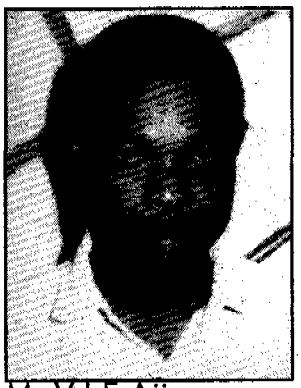
4 - 9 AUGUST 1996

Safeguarding water resources for tomorrow

New solutions to old problems

STOCKHOLM WATER SYMPOSIUM

A conference arranged by the Stockholm Water Company



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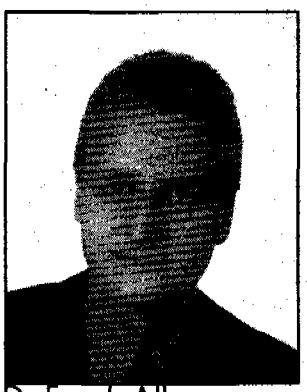

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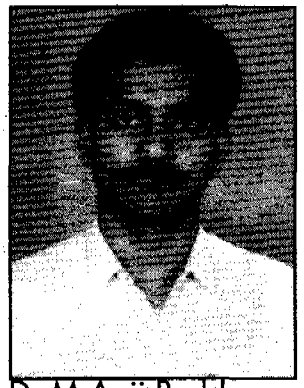

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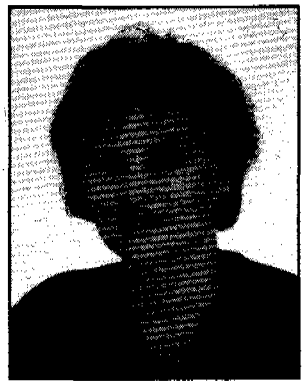

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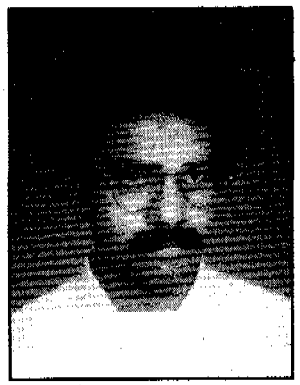

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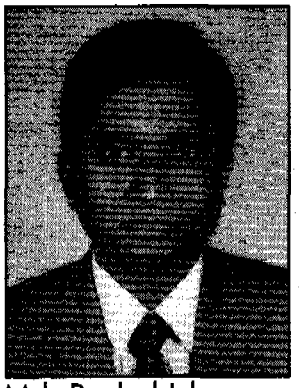

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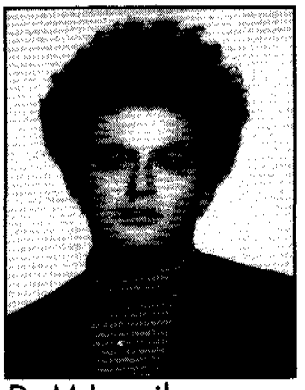

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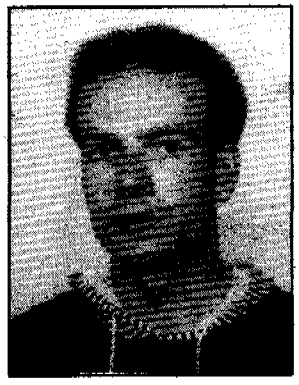

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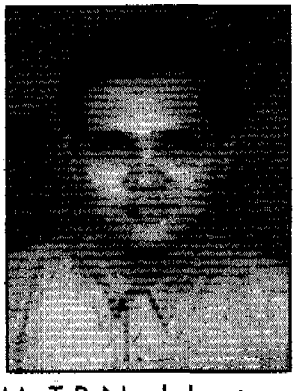

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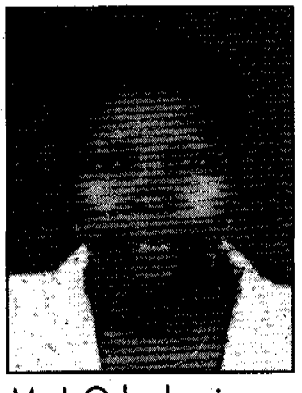

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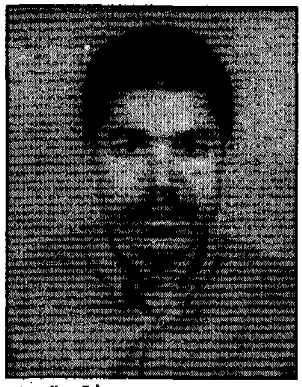

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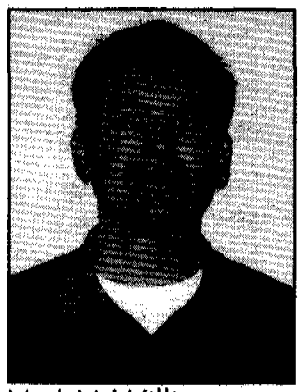

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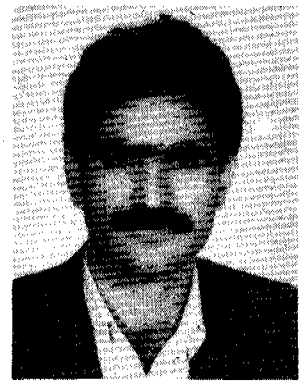

Mr N. Kalantari

DIFFERENT METHODS FOR BACTERIOPHAGE RECOVERY.

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For several years bacteriological parameters have been used to evaluate the presence of human pathogens as viruses. However the sensibility of the bacteria is lower than viruses and viruses can be isolated when the bacteriological parameters are normal.
The isolation of enteric viruses is time-consuming, expensive and sometimes the parameter is negative when the presence of viruses can be suggested. More recently, several Authors have been proposed the use of bacteriophages as model of the presence of viruses in the environment.
Several procedures have been developed for the phage recovery as direct isolation, polyethylen glycol precipitation, enrichment and adsorbtion-elution on membrane filters.
We have decided to evaluate several membranes to recovery bacteriophages from sperimentally seeded phages in a phosphate buffered salts (PBS).
In this paper we report the results of experimental recovery of the three different phages: T6 (somatic coliphage), MS2 (F-RNA phage) and B40-8 (phage of the *Bacteroides fragilis HSP-40*). All the phages were seeded at 10^4PFU/liter and for each experiment 100 ml (in total 10^3PFU) through different membranes. The absorbed phages were detached with 5 ml of different eluent. All the eluent were prepared at pH9.5 and before each filtration 10 ml were withdrawn to calculate the inoculum (T0).
The recovery was expressed in percentage as total recovery in 5 ml over total inoculum in 100 ml (T0).

All the results are reported in Table 1.
The best results for T6 coliphages were obtained with Anodisc using beef extract (65%). The glycine (31%) and glycine-beef extract (17%) showed a lower recovery using the same membrane. With all the other membranes used in different conditions the total recovery is very low.
About MS2 phage good recovery were obtained using Biotrace NT with beef extract (52.5%) and glycine-beef extract (57.5%) elution buffer. Similar values with the same buffers were obtained with HAWP Millipore (64.5% and 57.2% respectively) membranes but in presence of alluminum salts and pH 3.5.
About B40-8 the complete recovery was obtained using Sartorious SM11107 membranes in presence of $MgCl_2$ or $AlCl_3$ with all the elution

buffers but in presence of $AlCl_3$ and glycine elution buffer the recovery was just 53.5%. A good recovery was also obtained with Anodisc with glycine-beef extract (65%) and beef extract alone (59%).

Table 1. Recovery of the three bacteriophages.

					Sartorious			Millipore		
		Anod	Viros	Biotr.	W.S.	Mg	Al	W.S.	Mg	Al
T6	Gly	31	0	0	1	14	37	0	3	0
	Gly + B.E.	17	1.2	0	1	4.5	16	0	0	0
	B.E.	65	36	0	6	9.3	17	0	0	0.5
MS2	Gly	20	0	11	0	9	22.2	39	23.8	38.6
	Gly + B.E.	25	0	57.5	0	21	15	52	15	57.2
	B.E.	5	13	52.5	0	27	33	44.2	49	64.5
B40-8	Gly	20	0.7	0	9	100	67.1	3.5	2.3	2
	Gly + B.E.	65	8	6	22	100	100	6	3.2	2.6
	B.E.	59	8.6	4.4	26	100	100	4.9	2	2.3

All the values are expressed in percentage.
Mg= 50 mM $MgCl_2$; Al= 0.5 mM $AlCl_3$; W.S.= without salts. Gly= 0.25 mM pH9.5; Gly+B.E.= 0.05M Glycine + 0.3% B.E. pH9.5; B.E.= 3% Beef extract pH9.5.
Anod= Anodisc Whatman; Viros= Virosorb 1MDS; Cuno Div.; Biotr= Biotrace NT, Gelman; Sartorious SM11107; Millipore HAWP.

The B40-8 phage is the only phage of human origin and its presence can be used as indicator of human fecal pollution instead the other two bacteriophages can, in particular conditions, replicate in the environment. In conclusion the results here reported shown that only for B40-8 phage the recovery is complete using the Sartorious membranes in presence of $MgCl_2$, but for all the other phages we need to evaluate other methods.

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Singlet Molecular Oxygen Generation in Chlorinated Drinking Water: Theoretical Aspects

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Recent epidemiological study [1] has correlated the statistic of human cancer with use of chlorinated water supply. It has been suggested [2] the singlet oxygen generation in acidic environments might be in connection between chlorinated water and cancer.

What is the mechanism of the singlet ($a^1\Delta_g$) molecular oxygen generation in aqueous solutions ? What are the properties of the singlet molecular oxygen which can lead to diseases ? Should we really pay attention to this factor or it is comparatively negligible? The answers on these questions are given in this Poster.

There are a few possible chemical reactions which lead to formation of the singlet oxygen in chlorinated water :

$$HOCl + H_2O \quad ----> \quad HOOH + H^+ + Cl^- \qquad (1)$$

$$HOOH + OCl^- \quad ----> \quad {}^1O_2 + H_2O + Cl^- \qquad (2)$$

$$2HOCl \quad ----> \quad {}^1O_2 + 2H^+ + 2Cl^- \qquad (3)$$

where $^1O_2$ represents the singlet $^1\Delta_g$ or $^1\Sigma_g^+$ molecular oxygen.

The lowest excited metastable state of $O_2(a^1\Delta_g)$ is a reactive intermediate in many photoprocesses. Besides photooxygenations, it participates in quenching of fluorescence and phosphorescence of organic solvents. In this Poster a few general concepts regarding the properties of the $^1O_2$ are discussed:

(i) The role of spin-orbit coupling (SOC) between the ground $X^3\Sigma^-_g$ state and the second excited singlet state $b^1\Sigma_g^+$. This key idea explains the radiative rate constant of the $b^1\Sigma_g^+$-$X^3\Sigma^-_g$ transition (0.08 s^{-1}) and its great superiority upon the $a^1\Delta_g$-$X^3\Sigma^-_g$ transition (0.0002 s^{-1}) in free O_2 molecule. The same idea explains why the **a-X** transition is greatly enhanced by collisions through the intensity borrowing from the **b-a** (Noxon) band, which gains an electric dipole transition moment in collision complexes. The **b-a** transition enhancement is an attribute of any O_2-solvent molecule (M) collision through the orbital symmetry consideration of the $(\pi_g)^2$ open shell. At the same time the **b-X** transition has no sources of intensity borrowing by this concept.

(ii) The role of charge transfer (CT) states in SOC enhancement for the processes involving the $a^1\Delta_g$ species. An explanation of the singlet $a^1\Delta_g$ oxygen quenching by aliphatic amines [3] and rationalization of this phenomena in terms of a contact CT interaction taking into account the SOC occurrence are shown in this Poster.

(iii) The explanation of the experimental finding that the oxygen-solvent CT state is the $O_2(a^1\Delta g)$ precursor [4] is given in this Poster based on the *ab initio* calculation of the the O_2 + M collisions complexes.

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FRESH WATER AND HEALTH IN THE COASTAL AREAS OF THE GULF OF KHAMBHAT

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The coastal tracts of the Gulf of Khambhat exhibits variable hydrogeological regimes, which can be categorized in conjunction with the prevailing geomorphic and lithologic configuration and hydroclimatic variation. The occurrence of potable groundwater in the onshore areas of the Gulf to a large extent, influenced by the geomorphology and sediment characteristics.

Hydrogeologically, the coastal areas of the Gulf of Khambhat represent litho-stratigraphic units of Tertiary and Quaternary periods. The diversity in sediment characters and their depositional environments with prevailing recharge conditions have given rise to a variety of aquifer systems. The fresh water aquifers in the East (Mainland) coast of the Gulf have a depth range between 4 to 25 meters and are developed within the coastal dunal sands, fluvial and fluvio-marine sediments. In the North (Bhal) coast the aquifers are of shallow depth of 2 to 5 meters and are influenced by marine environment. However in the West (Saurashtra) coast the occurrence of fresh water is within the Deccan Trap, sandstone, miliolitic limestone and dunal sands having depth range of 5 to 35 meters.

A delicate balance exists between unconfined sweet water and the underlying saline water in this coastal areas, and the groundwater circulating in different lithologies have developed chemical characters conformable to the constituent minerals. Contamination of freshwater by sea water too has added significantly to the dissolved constituents which is ultimately reflected in the chemical quality.

Drinking water samples were collected from dug wells and ponds all along the coastline and were analyzed for their Cations, Anions, TDS and pH. It is found that the amount of Na, K, Ca and Mg are in the range of 30-5341 mg/l, 1-700 mg/l, 1-380 mg/l and 1-423 mg/l respectively. Whereas CO_3, HCO_3, Cl and SO_4 are in the order of 0-330 mg/l, 153-1980 mg/l, 70-5680 mg/l and 12-1484 mg/l. The TDS and pH values are between 256-5341 mg/l and 6.9-9.3 respectively.

The determined quantity of Na, K, Ca, Mg, CO_3, HCO_3, Cl and SO_4 exceeds the allowable limit as prescribed by the World Health Organization (Raghunath, 1987). But the TDS concentration and the pH value falls approximately within the permissible limits of USGS Classification (Heath, 1982). Excess of Na and Cl content of the drinking water gives the water a salty taste affecting the inhabitants with cardiac difficulties, hypertension and some other problems. The higher concentration of Ca, Mg, CO_3 and HCO_3 makes the water very hard. Higher concentration of SO_4 gives water a bitter taste.

Surprisingly, all along the coastline, ponds and dug wells constitute an important source of fresh water supply and these man made storage plays a very significant role in improving the living condition of the coastal population. Local inhabitants have astonishingly identified the right spot for constructing ponds, around which the villages have grown subsequently. Significantly a majority of dug wells are pond supported thereby exhibiting a unique example of a conjunctive utilization of water resource, and maximum harnessing of the seasonal rainfall.

Besides the existing man made storage of drinking water as ponds and pond supported dugwells, It is suggested that, shallow and big polyethylene layered ponds may be constructed at appropriate locations to receive seasonal rainfall. Evaporation loss may be reduced with the help of chemical treatment. Also coastal villages should be connected with pipelines and water tankers may be provided to improve the living condition of the coastal inhabitants in the extreme climate.

On the basis of observations and evaluation of the existing resources and future potential of potable water in the Gulf coast two main points have to be kept in mind while planning the proper management of groundwater resources along the Gulf of Khambhat coast:

- No single strategy could be adopted for the entire coast, because its various segments pose their own distinct geohydrological conditions and need individual strategies for management.
- There is an optimum beyond which the coastal terrain cannot sustain the interference with the natural conditions of freshwater availability.

Finally, the author would like to emphasize that the factor of sweet water availability specially the groundwater has to be critically evaluated in all its aspects before embarking upon ambitious developments activities. After all the coastal resources should not be strained beyond a limit otherwise it may generate unexpected environmental problems and hazards.

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URBANISATION AND DRINKING WATER SUPPLY IN IMPORTANT CITIES OF BENIN (WEST AFRICA) : WHAT POLICY FOR THE FUTURE ?

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ABSTRACT

In Bénin, a country of West Africa, the problem of water comes down in spite of the Government will to give to populations water of good quality in urban areas and in rural areas, for the urban areas have grown considerably since 1960. Thus from 1979 to 1992, the population of Benin increases from 3.331.210 to 4.915.555 inhabitants with respectively 883.685 and 1.756.197 inhabitants in the urban centres. The rate of urbanization increases at 27% in 1979 and at 36% in 1992, with an annual increase rate of 4 %. In 1992, the urban population was concentrated in three important cities:

* Cotonou : 536.827 inhabitants ;
* Porto-Novo : 179.138 inhabitants ;
* Parakou : 103.577 inhabitants.

Only 10,2 % use pipe supplied water. However, Benin has at its disposal enormous water resources which would be divided into three categories : groundwater, surface water and rain water. These water resources are partly polluted by human activities, and contain materials such as iron, manganese, fluorine, chloride. Improper to consumption and to household use, they are responsible of diseases such as dysentery, typhoid fever, diarrhoea, hepatitis virus and others waterborne diseases.

The governmental authorities have a care for supplying national population with drinkable water through a rural hydraulic equipment policy which aims at limiting waterborne diseases by water quality control. The protection norms for water quality are those recommanded by Word Health Organization and applied by the institutions devoted for water supply which are :

* the hydraulic service in rural areas ;
* the Beninese Society of Electric Power and of Water Supply in urban areas.

However, the national rate of satisfaction is just about 52 % in the rural areas, ie 12 litres per inhabitant per day.The lack is supplemented by ground water from wells (49,9 %) , surface water (20,7 %) and village pumps (15,1 %).

The Beninese Society of Electric Power and of Water Supply initiates social connection programmes to provide a great number of population with drinkable water. Although more than 60 % of cities are equiped with water supply network, the rate of private connections is less than 50 % of inhabitants :

* only 10 % only in Cotonou (29.293 subscribers) ; 50 % buy water from subscribers and 40 % use non - controled water;

Table 1 : Water supply in rural areas

Departments	Theoritical needs	Water supply points	Rate of satisfaction (%)
Atacora	1.100	858	78
Borgou	1.370	1.117	82
Zou	1.950	1.100	57
Mono	1.790	547	31
Weme	1.730	630	36
Atlantic	1.520	500	33
	9.440	5.352	52

Table 2 : Water supply in urban areas

Departments	Points to supply	Supplied points	Rate of satisfaction (%)
Atacora	13	6	46
Borgou	14	6	43
Zou	14	6	43
Mono	12	11	92
Weme	14	10	71
Atlantic	9	7	87
	76	46	64

* in Porto-Novo, 76 % of the urban population use drinkable water. The water consumption is 21,6 litres per inhabitant per day and the number of subscribers is 6.943.

* in Parakou, 10 % of the families use drinkable water, ie 3.712 subscribers. The average consumption is about 50 litres per inhabitant per day.

This low rate of satisfaction is linked with the low standard of life (the average salary is about 80 $US per month). This situation does not enable people to pay the charges of subscription (about 100 to 400 $US). Many families buy water from subscribers at a rate of 2500 %. Moreover the charges of connection are higher for the population living in the marshy areas where drainage network is difficult to realize. In addition to these difficulties, the Society has not always the necessary financial resources to buy and to maintain connection materials for extending the water supply network.

To resolve these problems and to face the increasing demand, a new water policy is necessary. Therefore, it is urgent to safeguard grownwater quality by environment protection measures such as:

* to forbid waste buring proceedings and to organize waste collection mainly in areas where the water table crops out as it is the case in Cotonou city area;

* the construction of drainage network to canalize waste waters and their collection and traitment in basins ;

* to equip cities with public fountains which should be managed by collectivities.

KEY WORDS : Benin, Water Supply , Urban Population, Life Standard, Water Policy.

WATER MANAGEMENT IN POLAND - POLICY AND FINANCING

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Poland is the country with rather limited water resources, lower then the Europian average.
The surface water resources amount to about 70 000 mln m^3. The inviolable surface water resources are at the level of 16 000 mln m^3 and the workable are 54 000 mln m^3. This amount of water is received annualy by the Baltic Sea - 99.8% of Poland's territory lies within the Baltic Sea basin. About 50% of the mentioned amount is carried by the Vistula river, 34% by the Oder river and 16% by coastal rivers.
The workable resources of underground waters are estimated for the whole country territory as ab.14 000 mln m^3 and there is a considerable differentiation between particular regions of Poland.
The quality of surface waters is affected essentialy by discharges of pollutants emitted along with liquid waste from the point and non-point sources of pollution: towns, villages, industrial plants, farms; linea-area sources and saline mine waters as specific pollution in Poland. A systematic increase in water consumption and wastewater discharge have led to a decrease in surface water quality. The graphical presentation of the recent state of river water quality will be shown in the poster.
The „National Environmental Policy of Poland" (1991) approved by the Government and Parliament maps out a strategy aimed at restoring water quality and usability for municipal, industrial and agricultural purposes.
The government policy for the management of water resources is based on:
- decentralization of management by the implementation of a river basin management system;
- reduction in allowable concentration of pollutants deposited into surface waters and ground; strengthening of economic instruments;
- continuous increase in the amount of reservoirs water;
- restrictions of deep groundwater use for industrial purposes;
- utilization of rivers for energy production and transport where it can be justified as environmentaly safe and economicaly sound.

Due to significantly limited financial possibilities and a huge needs the general priorities for environmental protection in Poland have been formulated, including water protection, within three different time horizons: near-term priorities (3-4 years period), medium-term (10 years) and long-term (for 25-30 years).
The particular objectives and tasks in water protection policy have been defined in the „Implementation Programme for the National Environmental Policy to the year 2000" approved by Government and Parliament in January 1995.
Based on this Document, provincial lists of priority projects relative to environmental protection and water management, and proposals of the Minister of Environmental Protection, Natural Resources and Forestry, the list of country priority tasks is prepared and verified every year.

As far as organization of water administration is concerned, the existing system based on the country territorial units (49 voyevodships) will be replace by more adequate hydrografical division. Poland's territory has been divided into 7 water management regions corresponding to major catchment areas. The competence of the voyevodship government administration, i.e. offices of environmental protection, will be adjusted through transfer of partial control to the Regional Water Management Authorities. The new Water Law Act which is curently under discussion in the Parliament will codify changes in water management administration and legalize water management regions already created.
The main sources of financing water pollution control investments in Poland are following:
- Central state budget - 10%;
- Investor's own budgets (local authority and enterprises budgets) - 40%;

- Ecological funds (National Fund forEnvironmental Protection and Water Management, Provincial Funds of Environmental Protection and Water Management, Communes Funds) - 45%
- Foreign sources - 5%

On the basis of the Environmental Protection Act , as amended in 1989, the National Fund for Environmental Protection and Water Management was separated from the state budged and established as a legal entity. On the basis of the other amendment in 1993, the Provincial Funds (49) for Environmental Protection and Water Management were established on the regional level. The revenues of the National Fund as well as provincial funds come from emission charges and financial penalties. These are collected by regional authorities according to the rates set by the Council of Ministers on an annual basis.
The National Fund for Environmental Protection and Water Management is to play a significant role in financing environmental protection, including water protection and water management. This fund is intended for both central and regional allocation. Thus, 60% of water supply charges and wastewater effluent charges and penalties are intended for regional allotment and 40% for central.

The National Fund for Environmental Protection and Water Management total revenue in 1995 amounted to 1,039.5 mln PLN (2,5PLN = 1 US$), the total expenditure - 1,016.8 mln PLN. The total number of agreements (loans and grants) concluded was 970 of value up to 1,186.1 mln PLN.

In the water protection and water management area, the number of agreements concluded was 263 of value up to 350.4 mln PLN.
For the implementation of water protection and management tasks in 1995 was allocated 270.6 mln PLN by the National Fund. Planned ecological effect as the result of this activity is as follows:
- wastewater treatment plants constrution of the total capacity 834.8 thousand m^3/day;
- collecting systems construction of the total length 347.9 km;
- pumping stations construction of the total capacity 5.5 thousand m^3/h;
- water treatment plants construction of capacity 146m^3/h;
- water supply systems construction of the total length 112.2km;
In water management area: - increase the reservoirs capacity of 15.1mln m3 and construction of flood control banks of the total length 59.6 km.

While time and financial means at hand are limited, needs in the field of water pollution control are great, especially since they include arrears in the construction of municipal and industrial wastewater treatment plants. A concentration of activity on priority tasks is necessary. The most impotant priorities are:
- improvement of quality of water supplied to households, - improvement of water quality in the coastal belt, - protection of lakes , dam reservoirs and their recultivation, - protection of the Vistula River basin agains the impact of saline mine waters, - construction of sewage treatment plants in cities of more than 10,000 residents, - elimination of the largest sources of pollution „hot spots", - water protection through villages and smallsettlements sanitation, - small retention programmes as part of regional agreements, - increasing of flood control, - increasing the availability of water resources by constructing multiple use water reservoirs.

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PARTNERSHIPS: COLLABORATION FOR BETTER WATER MANAGEMENT

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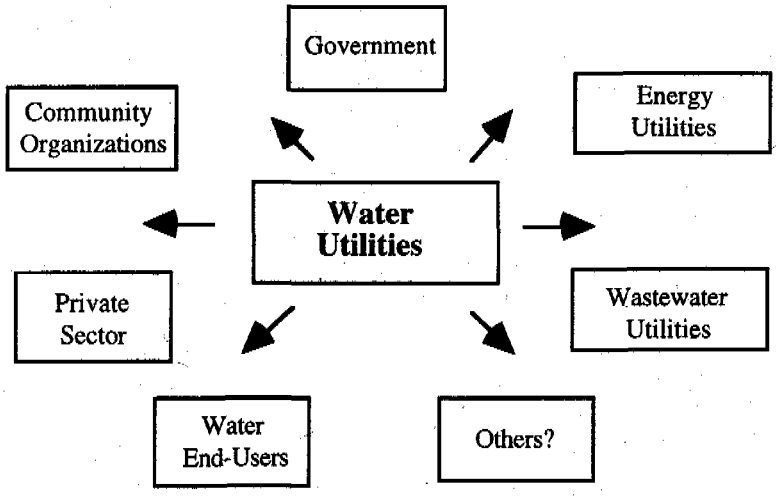
In the past, most water utilities carried on their business in relative obscurity. But as the world becomes smaller and resources more scarce, water utility managers, energy utility managers, business-people, community organizers, and government planners are finding significant opportunities for structuring "win-win-and-win" partnerships with organizations outside their walls. They are finding alliances with different groups to be more resilient, effective, and productive than working alone.



Partnerships can be divided into two general categories: project partnerships and planning partnerships. **Project partnerships** allow entities to split project costs while enjoying all the benefits. Below are two examples of such partnerships:

Seattle, Washington—"Home Water Savers" In 1992, the Seattle Water Department, along with Puget Sound Power and Light and Seattle City Light ran the largest collaborative residential water and energy efficiency program in the United States, with additional sponsorship from Washington Natural Gas, Metro (the regional sewer utility), and the Bonneville Power Administration (BPA—one of the largest electric wholesalers in the US). Conservation kits were distributed to over 300,000 homes in the Seattle area that included high-efficiency showerheads, faucet aerators, and other water and energy saving devices. For electric hot water customers, Puget Power and Seattle City Light covered the project's costs. For non-electric hot water customers, the Seattle Water Department (with support from the gas and sewer utilities) covered the costs. BPA reimbursed 75% of Seattle City Light's costs and supported the program with assistance in purchasing, evaluation, and marketing (Drury, 1993).

Los Angeles, California—Utility/Non-profit/Business Partnership Perhaps one of the most innovative and exciting multi-party partnerships comes from Southern California where the Los Angeles Department of Water and Power (DWP), worked with a for-profit business

and local non-profits to install thousands of toilets in low-income neighborhoods. The DWP along with the Central Basin Municipal Water District, and the Metropolitan Water District of Southern California, worked together with two local community organizations, the Mothers of East Los Angeles and the First African Methodist Episcopal Church, and with a private business, Cooperative Technologies & Services International (CTSI) of Irvine, California, to install approximately 15,000 toilets during the partnership's first year.

CTSI coordinated the partnership between the water agencies and the community groups by purchasing toilets in bulk and taking advantage of DWP's $100 per toilet rebate available to all customers. Since CTSI could carry out the project for approximately $70 per toilet, enough funds were left over to provide $375,000 to the local non-profits. For the Mothers of East L.A., these funds allowed them to create nine new jobs, give workers health insurance, and start new service programs, such as child care, graffiti removal, immunization, and youth scholarships (Craft and Sanchez, 1995).

Planning partnerships, unlike project partnerships, are formed before most major decisions regarding "what to do" have been made. In such a process, utilities are not seeking cost sharing opportunities so much as opinions and consensus. Today, more and more utilities are trying to involve the public in such collaborative decisionmaking processes. This shift in utility thinking is evident in both water and energy utilities and is perhaps best illustrated by the words of Peter Johnson, formerly of the Bonneville Power Administration (BPA). In a 1993 *Harvard Business Review* article, he described his experiences as the director of that enormous energy wholesaler. He concluded:

> *By first making decisions and then explaining them, we were essentially telling people that we knew what was good for them. Meanwhile, the people affected by our decisions were telling us... ...that the father-knows-best approach to decision making was completely unacceptable. Just when it began to seem that BPA was doomed to a future of litigation and hostility, we made an important discovery. We found that by inviting the public to participate in our decision-making process, our adversaries helped us make better decisions.... by involving the public in the decision-making process itself, we gained authority and legitimacy, avoiding costly lawsuits and political challenges, and arrived at creative solutions to seemingly intractable problems. Overall, our policy-making improved.*

Denver, Portland, and several other US water utilities have now implemented substantial public participation efforts in their Integrated Resources Planning processes.

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DESIGNING A PORTABLE PHOTOVOLTAIC CLOSED-LOOP AIR SPARGING SYSTEM FOR THE REMEDIATION OF CONTAMINATED WELL SAMPLING PURGE WATER

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Groundwater is one of earth's most precious resources. In an effort to protect the public from contaminated groundwater, the United States Congress has enacted legislation. Some of these Congressional mandates require a sample of the groundwater to be collected and analyzed for contamination. Before collecting a groundwater sample the well is purged of stagnant water. If the purged water is contaminated, regulations require the water to be discarded as a hazardous waste. Generally, contaminated purge water is placed into fifty-five gallon drums and transported off-site to be diluted and discharged into the public owned treatment works (POTW) at considerable expense and risk of transferring the contamination.

A portable, photovoltaic, closed-loop, air sparging system was designed to remediate volatile organic chemicals (VOCs) from the contaminated purge water on-site, providing an alternative to off-site disposal. The portable air sparging system follows the same physical principles as the analytical technique popularized by Grob in the early 1970's, called the closed-loop stripping analysis. Closed-loop stripping analysis is an efficient method for removing VOCs and some semi-volatile chemicals from the water (Coleman et al., 1983).

A design characteristic making my portable air sparging system unique is the utilization of a photovoltaic cell as a renewable and cost-effective power source. The photovoltaic cell converts sunlight to direct current (DC) powering a DC air-vacuum pump. An air-vacuum pump serves a dual purpose in a closed-loop system: (1) Force's air under the water surface to make bubbles; (2) Circulates the air through an activated carbon filter.

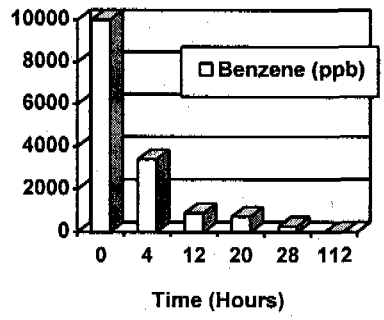
The closed-loop stripping process begins when air is forced under the water's surface to create bubbles. Bubbles facilitate the volatilization of VOCs from the water, transferring them to the vapor phase. An air-vacuum pump forces the VOC laden vapors through an activated carbon filter, where the VOCs are partially adsorbed. The VOCs that were not initially adsorbed onto the carbon are circulated back into the water, to be reabsorbed and extracted until the contamination is transferred from the water to the activated carbon (Grob, 1973; Grob & Grob, 1974).

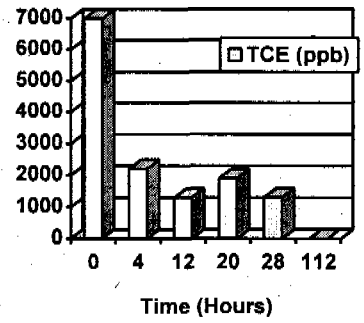
An evaluation of the portable air sparging system was conducted by spiking benzene and trichloroethylene (TCE) into tap water contained by a fifty-five gallon steel drum. Water samples were collected before and at specific intervals during the closed-loop stripping process. American Society for Testing and Materials (ASTM) and the United States Environmental Protection Agency (USEPA) methodology was used to collect and preserve the water samples. After collection, the samples were chilled to 4°C and immediately transported to an independent commercial laboratory for analytical analysis.

Experimental results indicate an exponential decline in the benzene and TCE concentration over time. Several problems were encountered during the experimentation: (1) Low percent recoveries for TCE were obtained when large amounts of TCE were spiked into the water; (2) Air sparging oxidized the steel drum; (3) Rust particles from the drum may have limited the liquid-air mass transfer for TCE.

The low percent recovery for spiking large amounts of TCE was probably due to a combination of variables: the relative insolubility of the contaminants with the water, non-ideal mixing of the contaminants with the water, volatilization, sampling, or analytical errors. When lower amounts of benzene and TCE were spiked into the water higher percent recoveries were obtained.

An example of air sparging high concentration of benzene and TCE is represented by Figures 1 and 2. Figures 1 and 2 show the decrease in contaminant concentration over actual air sparging time. Less time was required to remediate lower initial concentrations of benzene and TCE to final concentrations less than 0.5 parts per billion.





Figures 1 & 2. The remediation benzene and TCE with the portable air sparging system.

Experimentation shows that the portable air sparging system may offer a promising alternative to off-site transportation and disposal of contaminated well sampling purge water. The major advantages of the portable air sparging system are: inexpensive to build and operate, no contaminant releases to the atmosphere, durability, light-weight and ability to operate in remote locations.

Acknowledgment

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EXCHANGE CATIONS IN BOTTOM SEDIMENTS OF COASTAL LAKE

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The chemical composition of the Gardno Lake bottom sediments is differentiated along the course of the Łupawa Riwer flowing through this lake. The differences are on one hand due to the Łupawa River, and the other to the influence of sea water which connects the lake with the Baltic. Lake bottom sediments display a grest organic matter content (35.1%) which decreases in the direction of the Łupawa River outflow from the lake. Owing to the substantial content of organic matter, the sorption capacity of sediments is high (27.4-51.9 $mEg^{*}100g^{-1}$). The degree of sorption complex saturation with base cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) is ca. 95%. exchange sorption of these cations was examined (with consideration of sorption on sediment surface and of binding in the sorption complex) as a function of the vertical profile of sediments, kind of sediments and season. In was found that Na^{+} and K^{+} ions mainly bind with sediments via exchange sorption; Ca^{2+} and Mg^{2+} ions bind in this way in only 45%, whereas they bind with sediments at the outle from the lake to the Baltic in only 20%.

A decrease in pH of water above bottom sediments leads to a release of cations from sediments as a result of desorption. The Ca^{2+}, Mg^{2+} and Fe^{3+} cations are most sensitive to this effect.

GROUNDWATER PROSPECTS IN A RIVER BASIN: A STUDY OF SOILS TOWARDS GENERATING STRATEGIES FOR RECHARGING

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In the present study, an attempt is made to understand the groundwater conditions in the Ayyar river basin, Tamil Nadu, which is a designated drought prone area as well. The hydrological and geophysical study reported here has helped with a list of priorities for actions in groundwater regions. The study has visualized, from Indian Remote Sensing IRS IB, LISS II data different geomorphic unites and soil types and they have been interpreted with the help of available data and field checks. Low resistivity zone of the study area have been delineated by conducting Vertical Electrical Sounding (VES) for 85 locations. Multiple analysis like the curve matching, inverse slope and automated curve matching techniques were used for interpretation of the VES data. The results derived, which highly matched with bore hole details, have been taken into account in the interpretation. It was seen that low iso-resistivity horizon dies out as the depth increases, because of the unequal anisotropic behavior of subsurface. The movement of groundwater has been checked by conducting pumptests; the tests have clearly shown that the tranmissivity is directly proportional to traverse resistance. Even though the subsurface condition is good to avail groundwater throughout the year, and no slope in relief, thin layer of soil plays a major role in this area. There are 17 types of soils, designated based on quality, texture, occurrence and annotation as per the Soil Survey and Land Use Organisation, Tamil Nadu and its boundaries of distribution have been checked with satellite data. The texture is the main character which affects the permeability of the soils and based on this the basin is grouped into 6 regions. Samples are collected from the field and the permeability test is done to find out the co-efficient of permeability. The falling head method is followed, which the time take for the fall of water from the initial head to final head is formed out for determination.

SOIL TYPE	DEPTH in ft	MOISTURE CONTENT OF SAMPLES (g)	GEOMORPHIC STATUS	TDS (ppm)	CO-EFFICIENT OF PERMEABILITY (cm/sec)
UPM	2	1.51	Valley fill	500-1000	0.1036
GPM	2	4.89	Bajada and Buried ped.	>1000	low
TYR	3	4.47	Shallow and Buried ped.	500-1000	0.016096
TLK	3	1.28	Shallow Ped.	<500	0.000519
MLT-I	2	1.13	River Ped	500-1000	0.0412
MLT-II	2	5.64	Bajada	>1000	V.low

In the study area clay percentage play a major role in infiltration and the moisture content is directly proportional to clay percentage. The UPM soil permeability is 0.1036 cm/sec, which is the valley fill area and is a perfect recharge area, too. This permeability is more than that in the river soil (MLT II- 0.0412 cm/sec), because the river soil is a mix of clayey particles which fill up the spaces and seal it and it permits high run off in the area. GPM comes under the bazada zone where the presence of clay makes it less permeable, and its quality is poor. TYR and TLK fall under shallow pediments and shallow buried pediments with geomorphic regions having good to medium infiltration and the quality is good. MLT-II, which is also the typical bajada zone, has clayey accumulation, the permeability shown is very low . Quality of groundwater have been analysed seasonaly by statistical analysis, which shows there is no seasonal changes in the quality and it reveals the less permeability of the area. Since permeability of the soil is a major parameter in controlling the recharge of the groundwater, a socio- economic survey conducted to see how people depend on groundwater. It has been found that recharge methods through percolation ponds is essential in clayey area. Thus the paper highlights some of the basic plans towards the future groundwater management.

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ENVIRONMENTAL EDUCATION OF YOUNG PUPILS TO SAFEGUARD WATER QUALITY : AN EXPERIENCE FROM BENIN (WEST AFRICA)

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ABSTRACT

The training of young pupils in water quality management in Benin is based on considerations both theoretical and practical.. First, the teachers set a diagnosis in two steps. (1) water is considered as food constituent.It is used to cook infusions to relieve and to cure some diseases widely spread in hot and humid zones such as malaria and jaundice, and (2) all diseases are so reviewed, which could occur when one dinks polluted water. Other serious diseases are also related to contact with polluted water. Waterbodies can also shelter vectors of disabling diseases. Two cases should be distinguished :(i) the isolated villages which are not equiped with potable water suplly services, and (ii) the lake dwellings of which the inhabitants live in tight and permanent contact with water which could be polluted by their activities and behaviours.

The second part of the lesson points out, through theoretical aspects, and sometimes thanks to pictures, the most accessible methods of depollution of drinking water. A third part of the lesson is devoted to the role of water in nature ::(i) water as a constituent of human body, an absolutely necessary element for the cleanliness of our body and clothes, (ii) the necessity of water for food crops producing.

Then, the teachers specify some other utilizations for economic purpose, without insisting on the risks of pollution related to this economic utilization. Finally, the pupils learn some notions of sanitation related to good management of water points, and particularly to wells : (i) protection against surface water seepage, (ii) protection against dust and waste of all kinds, (iii) and the position of wells with regard to refuse dumps and cesspools.

This progress of environmental education for water quality safegauarding is certainly incomplet for more than one good reason : (i) the mechanisms of pollution are not specified. So the methods to fight against pollution are a little hazy, (ii) the water cycle is not integrated to the lessons to show the stage at which pollution by human activities may occur, endangering; human health, (iii) and finally, potable water is not considered as a restricted resource, and the methods for an efficient and affordable management of this resource are not pointed out. Therefore, the efficiency of these lessons is doubtful. They should be reformulated, by integrating methods of safeguarding water quality, and of fighting against pllution, in order to obtain more accurate impacts and more efficient feedback, to train young generations for safeguarding this resource which is indispensable for life on the Earth.

Key Words : environmental education, water quality, Benin, West Africa

GROUNDWATER SALINITY - AN IMPACT ASSESSMENT AND MANAGEMENT FOR FUTURE GENERATION ALONG SOUTH EASTERN TRACT OF COASTAL TAMILNADU, INDIA.

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ABSTRACT

Water is vital to the existance of all life as we know it is essential, either directly or indirectly to almost all activities of man. The tidal inundations and the generally believed gradual rise in sea level, had increased salt water intrusion in the coastal aquifers. In the present study, attempts are made to understand the groundwater conditions in Ramanathapuram district, Tamilnadu, which is incidently a drought prone district as well. The hydrological, geophysical and geochemical study reported here has helped in the making of a list of priorities in favour of groundwater regions and also to delineate fresh water-salt water interfaces.

To establish quality criteria for ground water, chemical constituents must be specified as well as standard methods for reporting and comparing results of water analyses. using the standard procedures prescribed water samples have been collected and analysed for major and minor ions. The areal distribution of the total dissolved solids, seems to be of highly mineralised in nature. The study area is underlined by water with contents greater than 3000 mg/lit whereas less than 1000 mg/lit is noticeable in the central part of the area. The determination of water type and classification made through in Stuyfzands classification based on cation and anion combination. The sum of Na,K and Mg in Meq/l correlated for a contribution of sea salt:

$$(Na + K + Mg)Corr. = (Na + K + Mg)measured - 1.0716\ Cl$$

It could be inferred that the entire area away from the coastline occupied by fresh-brackish water, brackish to salt water nearer to the coast and salt water along the coast.

Due to its synoptic viewing , multispectral, multitemporal and resist capabilities, the remote sensing technique is being widely employed for geology and geomorphological studies. The study has visualised from the satellite images, a set of paleochannels in the central parts of the study area, overlapped by a number of tanks. Tanks are in fact distributed in the study area and are enveloped by a narrow strip of beach ridges with a alternate swale systems.

Artificial recharge methods like percolation ponds is suggested. Deepening tanks will solve water scarcity, to a certain extent. Changes in agriculture patterns with salt resistant crops can be achieved through organising users' community and educate them in a comprehensive manner. Plantation of mangroves in the back waters and swales will help to prevent salt water intrusion into the inland. Enforcing and enlightening the legislative measures for avoiding pumpage of water for a distance of 10 km from the coastline can be achieved through the association and cooperation of the users community. By implementing new legislative measures for deep bore wells in the banned coastal zone for salt pan and marine chemical industries for avoiding further intrusion.

Both a scientific and a community point of view is taken into consideration with some of the basic plans towards the future groundwater quality management in the coastal district of Ramanathapuram, Tamilnadu.

THE IMPACT OF LOWER LAKE (BHOPAL, INDIA) ON THE HEALTH OF INHABITANTS OF ITS CATCHMENT AREA

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Bhopal and its beautiful lakes are two inseparable faces of the same coin. But most of these water bodies are gasping their last and the lower lake (surface area 1.297 Km^2 and mean depth 6.16 m) is no exception. The constant discharge of 1.3 million gallon of untreated domestic (there being no industrial or agricultural discharge) effluent from the point and non-point sources, has ruined the picturisque, bird shaped waterbody to such an extent that it has become the saviour of private medical practioners. In addition to domestic discharge, there are two major and several minor washing places around the lake where people wash their dirty linen and cattles (Bhoipura, north eastern side of lake). Bathing in the lake may be a hobby for some but 'no way out' for 80% of Routine Bathers due to the scarcity of Municipal water at home, especially during summer season. On the eastern side, there is a weir which takes away the oxygenated upper layer of water off the lake, leaving behind almost anoxic bottom condition. One may encounter the consequences in the form of algal blooms of Microcystis aeruginosa along with macrophyte Eichornia cressipes and the fecal pollution of Escherichia coli and Streptococcus faecalis. Fig.1 dipicts the pollutional status of the lake during March 1994 and February 1995.

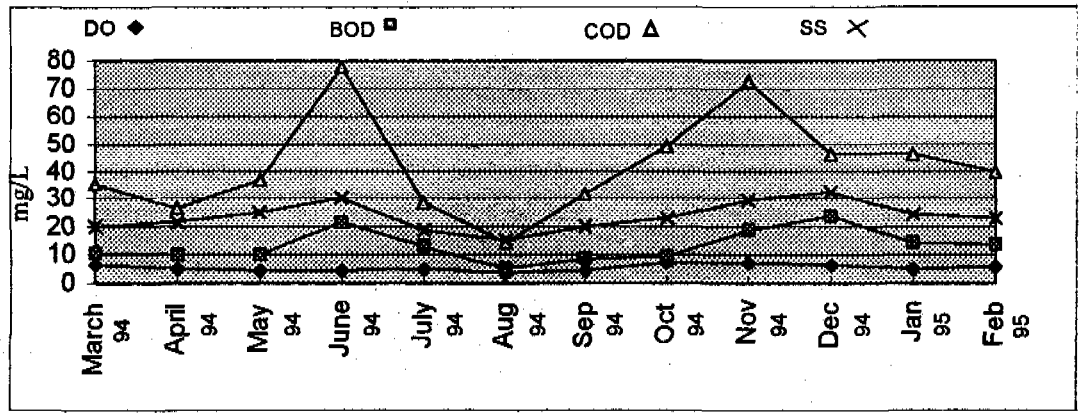

Figure1. Change in the pollution status of Lower lake between March 94 & Feb.95

The lake is, however, polluted for humanbeing but on the contrary it offers the hygienic room for myriads of pathogens to flourish. The most common water borne diseases, observed in the inhabitants of its catchment area, during the course of study (March 1994-Feb. 1995) were Typhoid, Diarrhoea, Amoebic Dysentery, Cholera, Malaria and

acute as well as chronic urticaria especially in routine bathers. Transmission of the diseases presumed to be occurred either through vectors such as Flies and Mosquitoes or through bathing and washing of soiled linen in contaminated water; (which is not however, used for drinking purposes) or through fountains.

In order to make the work more realistic, the target population was divided into three manageable groups of 50 people each (Both sexes with average age of 22 yrs). These groups were designated as (a) Routine Bathers (RB) (generally lower middle class people), (b) Non-Bathers (NB) of catchment area and (c) Control Group (CG), living 5 Kms. away from study site. Out of these groups, it was the RB which was reckoned to be more vulnerable to various waterborne diseases, obviously so, the very group was given extra emphasis. Results from the study of this susceptible group are shown in Fig.2

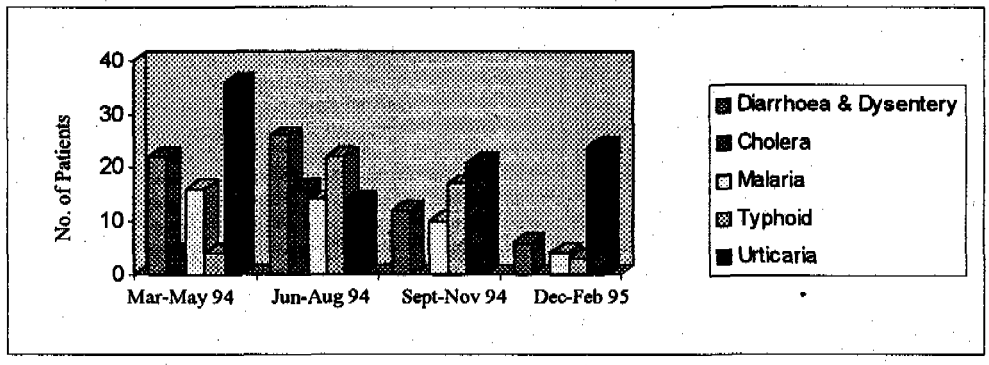

Figure 2. Seasonal variation of various diseases among Routine Bathers (RB) during March 94 to Feb.95 (Includes cases of single victimization)

The results of the study on the remaining groups (NB & CG) left an impression that the lake has lesser impact on the health of NB and almost none on the CG group.

The extensive study of the metabolic status of lower lake has concluded with the notion that the lake has not yet crossed the point of no return and the truly determined endeavours (as suggested in the paper) may rejuvenate the pristine glory of this lake which it once enjoyed.

Recommendations :

1. To check and divert the effluent discharge by the construction of a concrete sewar line all around the lake.
2. To bull doze all the residential places, erected on the bank of Lower lake.
3. To strive for alternative means of potable water (to make available the Narmada River to the citizens).
4. To check, atonce, the outflow of aerated water through weir.

WASTEWATER IRRIGATION AND GROUNDWATER QUALITY

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This paper reports the results of the research project „Wastewater Irrigation on Agricultural Fields" sponsered by *Umweltbundesamt, Bismarckplatz 1, D-14193 Berlin, Germany.*

The main aspect of the research project was to evaluate the practice of wastewater irrigation under the aspect of soil and groundwater protection in Germany.
About 70 locations were characterized, where wastewater is irrigated. It was shown that mostly nitrogen in ammonium and nitrate affects the groundwater quality. Beyond this COD has to be taken into consideration in subsurface water and heavy metals in the soil. Finally some recommendations were given for the treatment of wastewater irrigated on fields to avoid negative effects on soil and water.

First of all an inquiry was started to get informations about the following facts:

- the number of locations, where wastewater is irrigated
- the quality of irrigated wastewater
- the structure of soil and the quality of groundwater in irrigated areas
- the pollution of soil and groundwater caused by wastewater irrigation

The result were 41 locations, where municipal wastewater is irrigated and 32 locations, where irrigation of industrial wastewater (distilleries and sugar, milk, starch and candy factories) takes place. The treatment of wastewater as well as the remaining load with chemicals varies widely. For example untreated wastewater is irrigated next to completely biological treated wastewater. The range of load in municipal and industrial wastewater is shown in Table 1.

Chemical compounds	Kind of wastewater	
	municipal	industrial
COD [mg/l]	29-500	3.500-37.000
BOD [mg/l]	10-284	2.000-20.000
Total nitrogen [mg/l]	< 100	30-1700
Total phosphorus [mg/l]	< 25	0-900
Heavy metals [µg/l]	Cu: 2-117, Ni: 2-37, Cr: 2-71, Pb: 5-12,5, Cd: 0,3-46, Hg: 0,09-1, Zn: 11-1.170	Cu: 30-156, Ni: 20-40, Cr: 0-30, Pb: 9-60, Cd: 0-20, Hg: 0-0,5, Zn: 30-3.370

Table 1 Load of municipal and industrial wastewater

Data concerning the concentration of chemicals in soil and groundwater were available at only three respectively two locations (irrigation with municipal wastewater).Therefore a field test was carried out at a place where industrial wastewater was irrigated with the following objectives:

- determination of the input of heavy metals and nutritive substances
- investigation of nitrification and denitrification capacity in the unsaturated zone
- measurement of groundwater quality

Table 2 shows the results determined in the groundwater.

Chemical compounds in	Location		
	municipal I	municipal II	industrial I
COD [mg/l] *drainagewater*	41	20	-
COD [mg/l] *groundwater*	16	13	10
nitrate [mg/l] *drainagewater*	122	90	-
nitrate [mg/l] *groundwater*	66	94	83

Table 2 Parameters characterizing groundwater quality at three irrigated locations

Based on the investigations about nitrification and denitrification capacity in the unsaturated zone it is possible to give the following results:

- the rate of mineralization and nitrification is nearly independent of wastewater irrigation
- there is no significant influence of wastewater irrigation on COD-concentration in soil and groundwater
- the potential denitrification capacity increases in the unsaturated zone significantly by faktor 3.5 in comparison to unirrigated fields

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CHARACTERISTICS OF GROUND WATERS IN ANAMBRA STATE, NIGERIA, POLICIES AND REMEDIES.

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SUMMARY

The Physical, Chemical and biological properties determine the pollution level, type of treatment required and potability as regards domestic and industrial use. These also generate remedies and governmental policies Based on these, the Physicochemical and biological quality of ground waters in five local government areas of Anambra State, Nigeria were analysed using World Health Organization standards and standard methods for the examination of water and waste water. The Chemical analyses showed that most samples are acidic, have high Iron, Manganese, ammonia and nitrate concentrations. Some are moderately hard while others are soft. Biological examination revealed that most of the waters contain lethal dose of Escherichia coli Staphylococus aureus, Coliforms and Streptococus faecalis.

These results calledfor cleanliness of ground water environment, elevation of wells and boreholes, aeration of borehole waters and addition of Chlorinating agent. Local people are advised to boil their well waters. From these recommendations, Anambra State Ministry of Health, Awka, environmental Health division has come out with a 3-month periodical analyses and other rules for wells and boreholes in the State. As further remedies, Short term storage of water in containers, incorporation of activated charcoal in between sand filteration systems and use of "weeping pots" for rural water filteration are recommended.

ANALYSIS OF LONG-TERM CONCENTRATION CHANGES OF MAJOR IONS IN LATVIAN RIVERS

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An analysis is reported of long-term historical records of the concentrations of major ions and TDS (total dissolved solid) for 7 river sites in Latvia. The results of long-term changes of river water major ions concentrations from Latvian territory are examined.

Mineralization or the sum of major ions is the key property of natural water. The magnitude of mineralization greatly determines the utilization of water for drinking and non-drinking purposes. Despite world-wide increasing mineralization in the river and lake water, little attention has been paid to this ecologically hazardous problem. Contamination with highly soluble mineral salts stands out for its resistance: self-purification is not operating; neither chemical nor biochemical and physicochemical processes decompose mineral salts and cause to vacate water. Changes in water mineralization are a result of human activities in the catchments and mirror the process.

These paper presents the results of an analysis of long-term river water quality changes in Latvia. The periods of water quality observations ranged from 41 to 47 years. A study of the quarterly adjusted time-series showed an abnormal data distribution, seasonality, serial correlation and mostly positive significant trends. The application of state of the art software based on non-parametric statistics such as the seasonal Kendall's slope estimator and the seasonal Hodges-Lehmann's estimator, made it possible to investigate these water quality records more accurately than other methods allow.

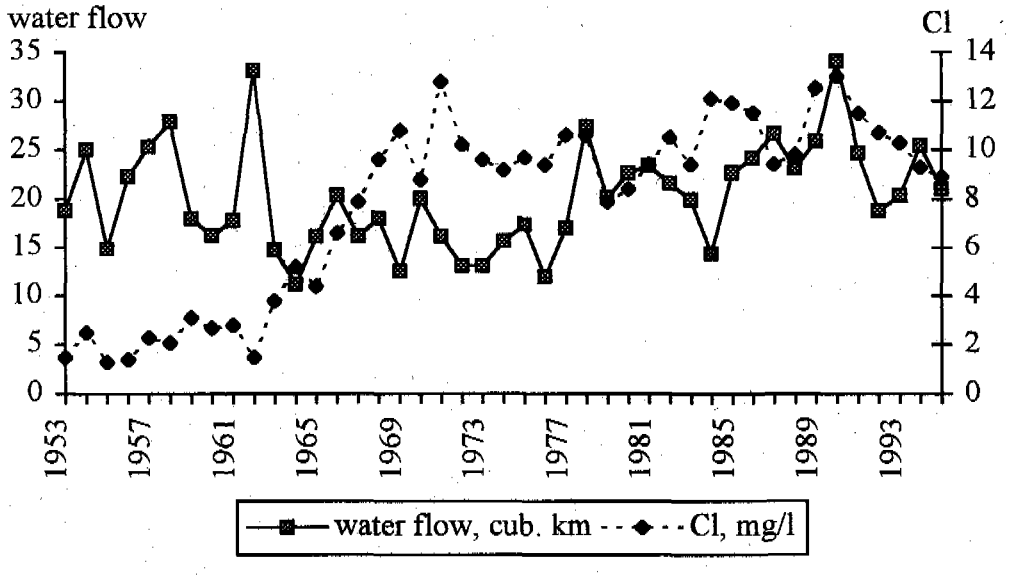

Figure 1 **Flowweighted concentration of chlorides and water flow in Daugava Daugavpils**

It was shown that fertilizer applications and marsh land reclamation could cause widespread and intensive major ions changes in the river water. The concentrations 5-10-fold higher than background values were detected for Cl^-, Na^++K^+ and SO_4^{2-}. Fig 1 and 2 show the increase of Cl and TDS concentrations in Latvian rivers between 1953 and 1995. The water quality changes mostly took place in the 1960's and the early 1970's due to fertilizer excessive applications and intensive reclamation works. After that concentration increases for constituents others than sulphates were statistically insignificant. For sulphates these upward trend was probably due to additional impact of increasing atmospheric deposition.

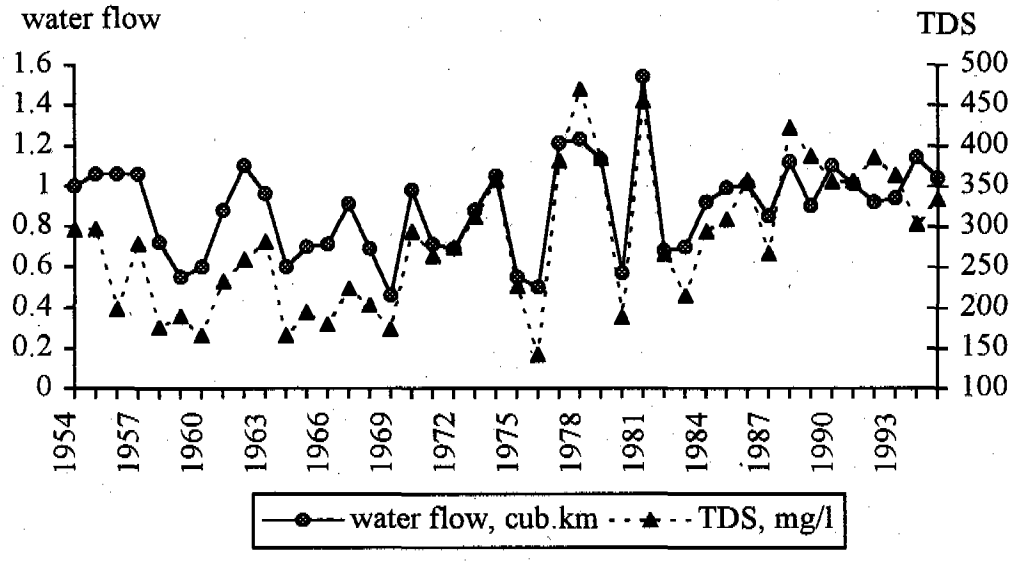

Figure 2 **Flowweighted concentration of total dissolved solids and water flow in Barta Dukupee**

In view of political and economic developments in the early 1990-ies, fertilizer applications and reclamations has curtailed and water management methods changed. These changes are likely to be bound to cause changes in the concentrations of major ions in the river water. These supposition, however, contrasts with the observation results for Latvian Rivers. There is a certain retarded lag water reaction to gradual changes in the catchments.

TOXICITY OF CYANOBACTERIAL BLOOMS IN LALLA TAKERKOUST RESERVOIR (MOROCCO): ECOLOGICAL IMPLICATIONS.

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The occurrence of toxic cyanobacteria waterblooms has been reported worldwide (Codd, 1994 ; Carmichael, 1995) and their presence in waterbodies used for public water supply, watering of livestock and recreational purposes has focused attention on the dangers of cyanobacterial toxins to human and animal health.

This work constitute a first report of Toxic cyanobacteria freshwater blooms in a Moroccan reservoir. During the study of phytoplankton dynamics in Lalla Takerkoust reservoir (35 Km South Ouest of Marrakesh city), we have noted that the cyanobacteria waterblooms occured each year, essentially in summer and early autumn. *Microcystis aeruginosa* is the main forming bloom species (up to 95%), associated with *Phormidium* sp.. The growth starts in June and reachs its maximum in October (7,7 x 10^9 cell/L).

Toxicity of bloom material and M. *aeruginosa* laboratory culture was measured by intraperitoneal mouse bioassay, using 18-22 g Swiss male mice. Lyophilized cyanobacteria cells were suspended in 0,9% NaCl solution and two mice were injected per dose level for each of five dose levels. Injected animals were observed continuously for two hours and then each 30 minutes during the following 6 hours. The results showed that bloom material is more toxic (LD_{50}=3,85 mg/Kg body weight of mice) than M. *aeruginosa* strain (LD_{50}=33,33 mg/Kg body weight of mice). This difference in toxicity is due to culture conditions which controlled efficiently the toxicogenesis (Sivonen,1990). At a lethal dose, the animal survival time recorded is less than two hours. Histological examination of the liver reveals extensive centrilobular hemorrhagic necrosis with loss of characteristic architecture of the hepatic cords, both hepatocytes and hepatic endothelial cells are destroyed. So, the use of these waters without previous treatment for domestic needs and cattle watering may provoke intoxication accidents which could be sometimes fatal.

Ecological effects of this waterbloom toxicity will be repercussed on lake food chain. For this reason, we have investigated in a series of short-term tests the mortality of the zooplankter *Daphnia pulex* when it was exposed to M. *aeruginosa* . In addition, the interaction between the amount of adequate food (*Scenedesmus* sp.), Daphnid life-stage (adult or juvenile) and cyanobacteria (toxic food) exposure was reported. Fig 1 and 2 show that exposure to cyanobacteria caused mortality in both adult and juvenile *Daphnia pulex*, so the strain tested is lethally toxic to the daphnids. It is evident that the toxic effects were attenuated when the daphnids were in presence of high amount of adequate food (*Scenedesmus* sp.). In this case, we noted that the Cladoceran can avoïd feeding on cyanobacteria cells because of their toxicity. We reported that no significant difference between the life stages could be shown. Consequently, the toxic bloom might have also a crucial ecological effect on the other lake biotic compartments.

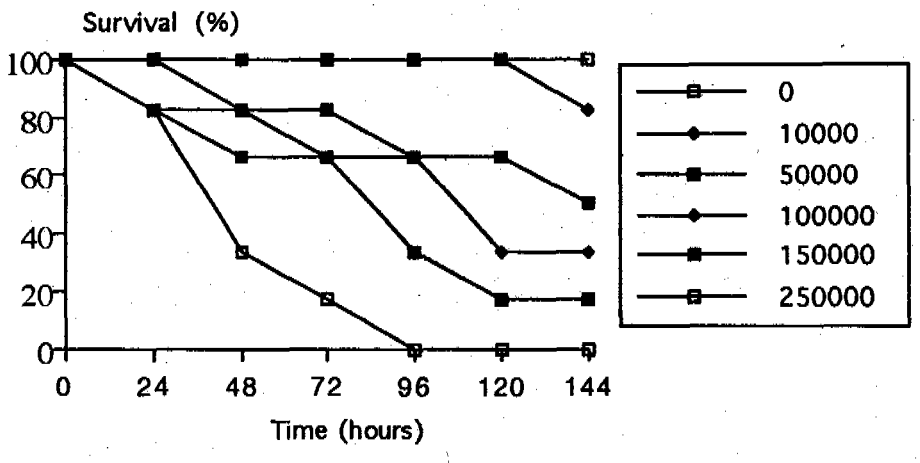

Figure 1 Survival of juvenile *Daphnia pulex* exposed to different concentrations of M. *aeruginosa* (cell/ml).

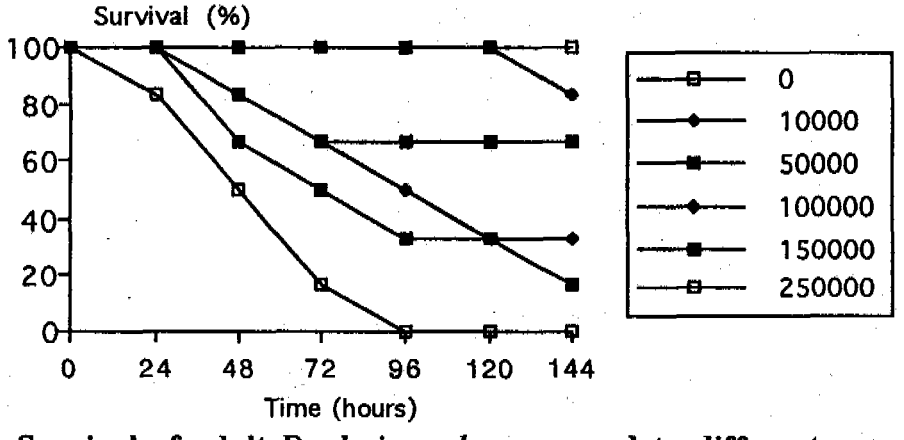

Figure 2 Survival of adult *Daphnia pulex* exposed to different concentrations of M. *aeruginosa* (cell/ml).

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HYDROTECT® - WATER EVAPORATION RETARDANT

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Dr. C. Schröder, Chemist, Market Development,
CONDEA Chemie GmbH, Überseering 40, 22297 Hamburg, Germany, Fax. (40)6375-3595

The number of humans living in areas without sufficient fresh water supply is constantly growing. As it is difficult to increase ground water and rain fall, limitation of water loss is becoming essential.
Besides modernisation of pipe systems etc., the use of a water evaporation retardant is an efficient means of increasing the amount of available fresh water.

HYDROTECT® is an emulsion of **fatty alcohols** in water, similar to cosmetic formulations. It has a cream-like consistency and can be easily diluted with water.
When this diluted emulsion is applied onto the surface of water reservoirs, it forms an invisible layer. This layer reduces the water evaporation by an average of 50%.
As the product is:

- non-toxic to humans
- non-toxic to fish or algae
- readily biodegradable
- practically insoluble in water

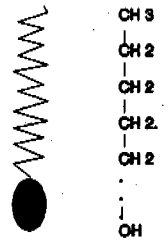
it poses no health risk when applied to drinking water reservoirs.

The **fatty alcohol** molecule consists of two parts:

a hydrophobic alkyl chain

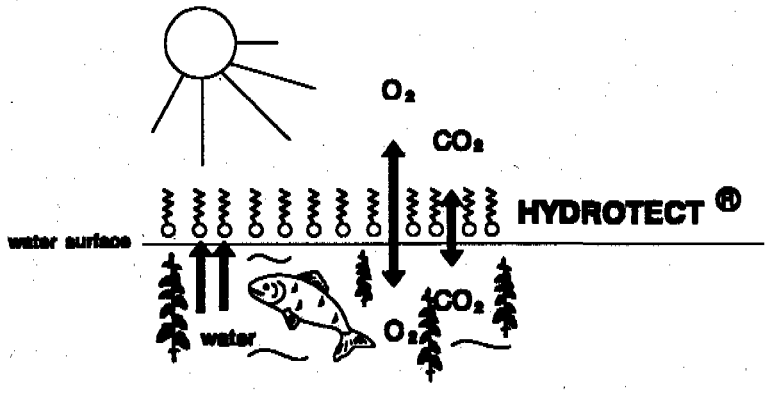
and

a hydrophilic hydroxyl group



Due to their structure these molecules do not dissolve in water. Instead, they remain on the water surface where they orientate with the hydroxyl group towards the water phase and build a closed film.

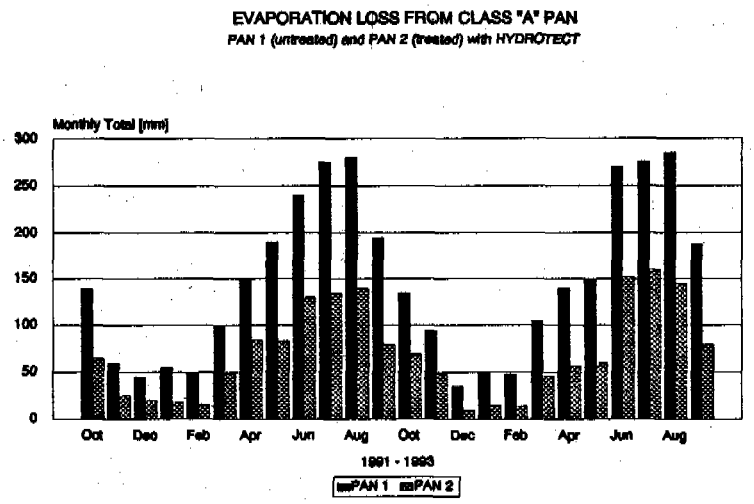
Tests performed with **HYDROTECT®** prove that no adverse effects on the quality of drinking water and the aquatic life in the treated reservoirs need be expected.



HYDROTECT® is readily biodegradable, thus even prolonged use of this water evaporation retardant will not cause adverse effects.

The graph on the right shows test results achieved by the **Water Development Department of Cyprus** from 1991 to 1993.

An important fact to note is that **for the whole period,** the water loss following treatment by **HYDROTECT®** is reduced by **50%**.



It is necessary to achieve an even distribution of the applied material on the treated water surface to optimize the water retarding effect. This even distribution can be attained by several means, making **HYDROTECT®** well suited to varying local conditions:

	Pouring	Spraying	Dropping	Reservoir (i.e. net)
Lakeside	☒	☒	☒	☒
Boat	☒	☒	☒	
Airplanes	☒	☒		

The quantity required is approx. 100-300 g of the suspension per 1000 m^2 water surface and day, depending on the local climate conditions.

The economic benefit of **HYDROTECT®** depends on the application method. The cost for **HYDROTECT®** is in the range of 0.05 to 0.10 US$ per m^3 of saved water.

HYDROTECT® offers:

- **increased water evaporation retardation**
- **simple application technology**
- **ideal cost/performance ratio**
- **safety for humans and the environment**

For further information, formulation proposals and samples, please contact our Marketing/Sales department. We will be pleased to help you find custom-made solutions to your application problems.

EXPERIMENTAL STUDIES ON THE PURIFICATION OF WASTEWATER BY THREE AQUATIC MACROPHYTES UNDER ARID CLIMATE OF MARRAKECH

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Due to urban agglomeration growth, there is a great increase in water requierement for both consumption and irrigation. Reclaimed wastewater is an interesting non conventional resource that can reduce this water shortage. In arid and semi arid areas, there is a growing need to reuse wastewater not only to reduce waste discharges to surface waters but also to improve potential water resources. In Marrakech spreading zone, raw wastewaters are reused in agriculture without any treatment and cause many human and animal sanitary risks (Bouhoum et al, 1995). Wastewater production in Marrakech city (arid climate) is recently estimated to around 15 millions m^3 per year and is expected to reach 44 millions m^3 by the year 2020. So treatment of this potential water resource becomes imperative prior any reuse. In this respect, macrophytes-based system is one of the used treatment systems experimented in Marrakech area. Therefore, it appears interesting to test several macrophytic wastewater treatment plants in order to propose the most adapted of them to arid climate conditions that could provide an effluent without sanitary risks (Mandi et al, 1992 ; Mandi, 1994 ; Mandi et al , 1996).

The results of the present work are from the first Moroccan experiences in wastewater treatment by macrophytes. Two species of floating macrophytes : *Eichhornia crassipes*, *Lemna gibba*, and one species of emergent macrophyte : *Phragmites australis*, are experimentaly tested to purify wastewater and to produce a biomass under arid climate of Marrakech. Results show that domestic wastewater purification by *Eichhornia crassipes* permit a good depletion of organic load (COD : 78%, TSS : 90%) and parasitical load (helminth eggs : 100%) for a short retention time of 7 days. The mean rate assimilation of Nitrogen and Phosphorus by *E.crassipes* reaches 850 $mg.m^{-2}.d^{-1}$ and 385 $mg.m^{-2}.d^{-1}$, respectively. During the warm period, water hyacinth biomass attains 38.6 $gDW.m^{-2}.d^{-1}$ and contains a high content of Nitrogen, Phosphorus and Potassium. Duckweed *Lemna gibba* cultured on wastewater with slight organic load, permit a removal of organic load (COD : 68.5%, TSS : 87%) and parasitical load (helminth eggs : 100%) for a 7 days retention time. Nitrogen and Phosphorus assimilation mean rate by *L. gibba* reaches 160 $mg.m^{-2}.d^{-1}$ and 55 $mg.m^{2}.d^{-1}$, respectively. *L. gibba* productivity varies between 3.72 to 5.3 $gDW.m^{-2}.d^{-1}$ during the cold period.

Beside macrophytic ponds, reed beds represent another type of extensive system experimented under arid climate of Marrakech. With a hydraulic application rate of 0.86 to 1.44 $m^3.m^{-2}.d^{-1}$ reed beds (planted with *Phragmites australis*) allow an organic load removal of 48% to 62% , and a parasitical load depletion of 87% to 97%. The elimination is better during the active growth period of *P. australis*. The annual harvest of reed beds permit to remove a low content of Nitrogen (5 to 6%) and Phosphorus (10 to 12%) of the system. Therefore, cutting the reed beds seems to be useless.

Both systems have furnished a B category effluent (WHO, 1989) which can be reused to irrigate cereal, industrial and fodder crops, pasture and trees.Water hyacinth and duckweed biomass with a high content of nitrogen, phosphorus and potassium could be exploited in several fields (green fertilizer, biogaz, etc...).

However under the arid climate of Marrakech, the process based on water hyacinth and duckweed for wastewater purification is faced with a major problem : the evapotranspiration water loss reaches 60% during the summer period. The

proliferation of mosquitoes particularly in summer, constitutes another problem in the water hyacinth system (Mandi et al, 1992).
In order to improve the purifying efficiency of the reed beds experimented under arid climate of Marrakech, it should be necessary to : - reduce the hydraulic application rate, - increase the irrigation frequency as well as the used surface area to more than $9m^2$ per equivalent person expressed by hydraulic load (Mandi et al, 1996).

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WATER EDUCATION PROGRAMS IN CALIFORNIA SCHOOLS

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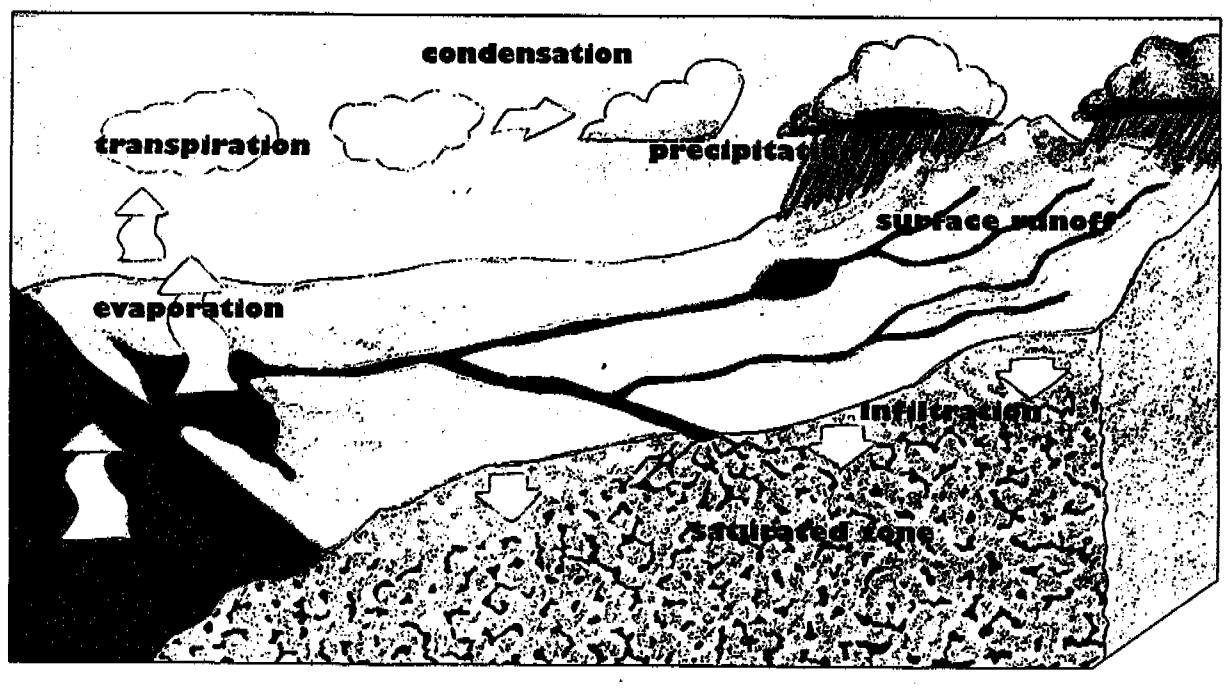
The Water Education Foundation is dedicated to developing and implementing education programs on water issues and to resolution of water problems in California and the West. The Foundation uses a variety of methods to educate its three main focus groups: journalists, decision-makers and schoolchildren.

Today's students are tomorrow's voters and leaders. It is part of the Foundation's mission to provide educational programs for students and train teachers in the use of these materials to prepare these future decision-makers. On a more immediate level, many successful public information campaigns have their genesis in the schools, for example the anti-smoking campaign over the last 30 years. Children took what they learned home to their families. Our research indicates that students do the same with wise water management and conservation methods that they learn from their teachers.

The Foundation's school programs are designed for children in grades four through 12 (ages 9 to 18). These programs are interdisciplinary, teaching students to develop critical thinking skills and to correlate information from a variety of disciplines: biology, chemistry, social studies, geography, government.



The importance of ground water to California's water supply is gaining prominence. This hidden resource provides 40 percent to 60 percent of the annual water needs of Californians, and it is an integral part of the surface water supply.

Despite its importance, many people have no conception of what ground water is, imagining it is in underground rivers and lakes. The Foundation has developed a comprehensive secondary school program on ground water education. The program is used in conjunction with a ground water model, a Plexiglas reconstruction of typical ground water aquifers found in California. The model can be used to demonstrate ground water issues and problems of primary importance to California, such as overdraft and contamination.

Students can experiment with the model, using hand pumps and colored water to see the effects of various actions on the ground water aquifers of California.

We know that most people learn best from a variety of media. Therefore, in addition to the ground water model, the education program uses laboratory exercises, video, research projects and a board game to maximize the learning experience of students.

Our goal for developing future leaders and scientists is to assist them to develop a global approach to solving water problems in California and the western United States by providing them the opportunity to develop and practice critical reasoning skills. Each generation is confronted with increasingly complex decisions on how to use water -- our most valuable resource.

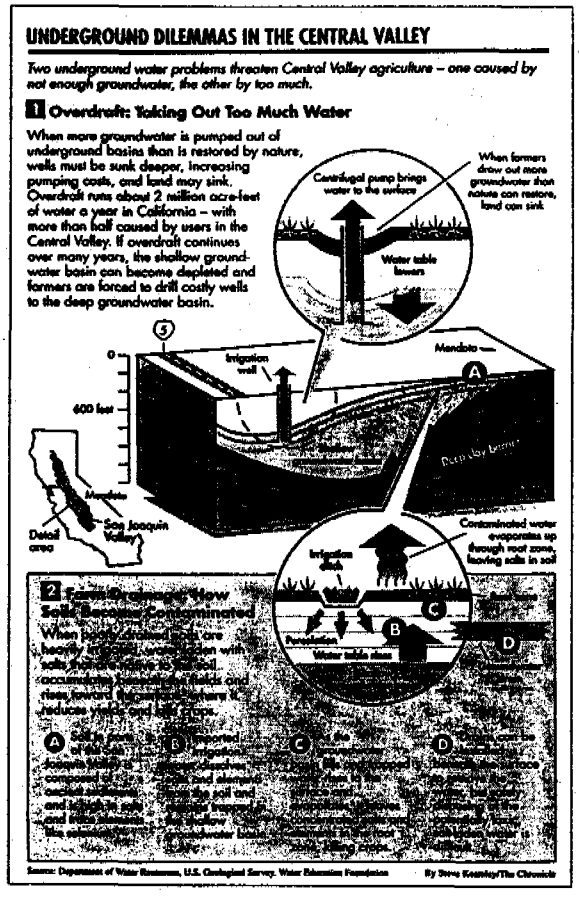


Fig. 2 Underground dilemmas in the Central Valley, Ground Water Education Program

IDENTIFICATION OF THE POTENTIALLY TOXIC NANO-FLAGELLATE *CHRYSOCHROMULINA POLYLEPIS* USING A SPECIES-SPECIFIC PROBE TARGETED TO 18S rRNA

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A major problem in environmental monitoring of toxic phytoplankton blooms in the sea is the identification and quantification of small nanoflagellates. This problem was clearly demonstrated during the harmful bloom of *Chrysochromulina polylepis* in Scandinavian waters in the spring of 1988 (Carlsson, 1990; Lindahl, 1990). Identification of this species is often not possible without using transmission electron microscopy. A considerably easier and quicker (answer within 24 hours) way to identify these flagellates is to use species-specific fluorescent probes targeted to highly variable regions in ribosomal RNA in *in situ* hybridisation experiments.

In order to be able to design rRNA targeted probes, one has to identify the sequence of the gene that codes for the rRNA. We have partially sequenced a 18S rDNA PCR fragment from *C. polylepis* and compared this to sequences from other *prymnesiophyceae*. In doing so we were able to identify a highly variable region suitable as target for a hybridisation probe. The specificity of the probe was tested on fixed *C. polylepis* cells and visualised by epifuorescence microscopy.

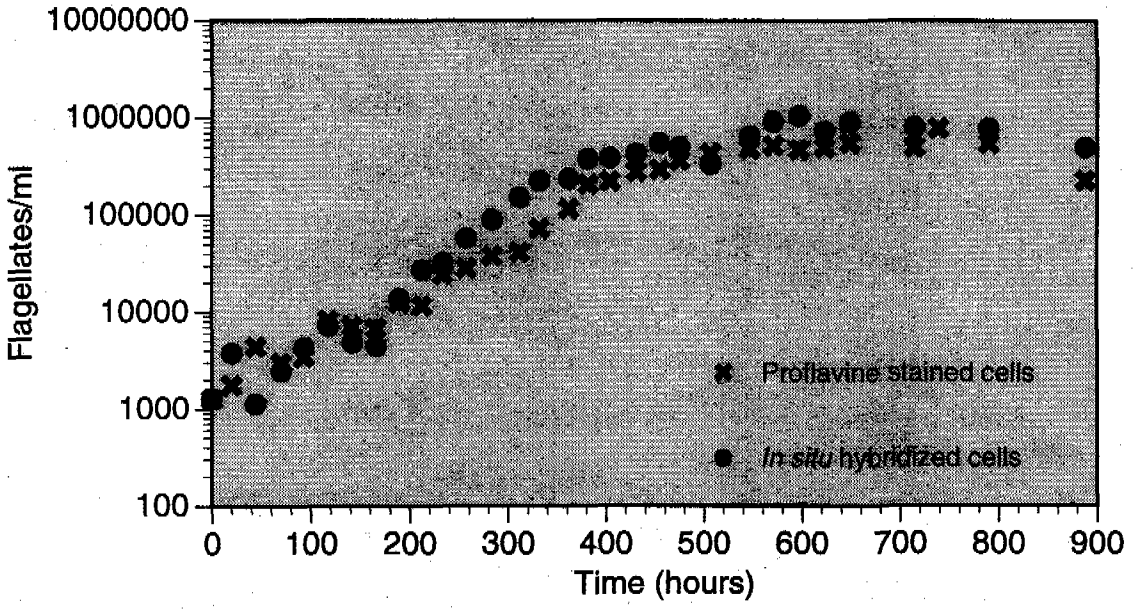

Figure 1 **Comparison of proflavine stained cell counts and *in situ* hybridized cell counts.**

A major obstacle in the application of rRNA targeting hybridisation probes to natural sea water samples, is the alteration in the rRNA content of the algae due to difference in physiological stage. To master this problem we used biotin-labelled probes, whose binding was detected by subsequent treatment with fluorescin-labelled streptavidin.
We can here present data from batch culture experiments, where samples were taken once a day until the culture was well into the stationary phase of growth. Counts of *in situ* hybridised cells and cells counted with traditional methods were compared and high similarity was observed between the different detection methods (r^2= 0.94, Fig. 1). This established agreement convinced us that our designed identification probe can be used for the specific detection of *C. polylepis* in *in situ* hybridisation experiments of natural sea water samples.

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GROUNDWATER MANAGEMENT IN PARTS OF Bushehr STATE, SOUTH IRAN

N. Kalantari, Chairman, Department of Geology, Shahid Cahmran University, Ahwaz, Iran.

The Bushehr state alluvial plain falls in semi-arid climate and is facing acute shortage of water for both agriculture and human utilizations. Dalaky, Shahpour and Shur (Saline) rivers cross the state. Apart from saline water of Shur river, improper usage of Dalaky and Shahpour rivers for irrigation accelerate soil and groundwater degradation. This study aims to identify keys for reclamation of soils and usable groundwater.

Water management policy have certain attributes which depends on local environmental conditions. The utilization of saline groundwater and water management practices have been discussed by many workers (Gupta, 1983; Handa, 1983; Kalantari, 1989; Kalantari and Thigale, 1991). In this regard the Bushehr state alluvial plain on the northern coast of Persian Gulf was selected. It experiences semi-arid climate with high evaporation and less precipitation of 300 mm annual rainfall. Dalaky, Shahpour and Shur (Saline) rivers originated in the northern upland of Zagros Structural Belt after crossing the state finally enter into the Persian Gulf. Improper usage of both ground and surface water in the study area has created the problems of water management which is the main theme of this study.

The present communication indicates that the study area constitutes multi-tier aquifer system of both influent and effluent natures. The Dalaky and Shebankareh district in the northeast are such aquifer systems. The shallow depth groundwater of poor quality causes extensive water logging in the area whereas, the deeper ones are suitable for domestic uses. In the central part of the study area the situation is reverse. In the southeastern part, good quality water is promising. The measured electrical conductivity in the southwest and northwest of the study area varies from 4000 to over 10000 Microseimens/cm.

The rivers system of the area have variable quality of water. The Shur river is very salty as the name indicating and adversely affect the groundwater. The two other rivers provide good water quality to the study area but poor management leads to wastage.

However, this study reveals that proper planing for water management is needed and it presents remedial measures for suitable utilization of water and water effected soils. The following points are proposed;

1. Conjunctive use of both surface and subsurface saline water in proportional quantities helps in prevention of further water quality deterioration.

2. Systematical recharge methods such as construction of underground water reservoir.

3. Introduction of proper drainage system to water logged and effected soils areas.

4. Cultivation of salt tolerant crops in such areas of high salinity soils and water.

5. Protection of land from saline water flooding by construction of small bands on tributaries originated in areas of gypseous rocks.

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CONJUNCTIVE USE FOR SUSTAINABILITY OF TANKS IN SEMIARID TROPICS - A CASE IN TAMILNADU, INDIA.

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Groundwater, a natural resource of high economical and ecological value, is of vital importance for sustaining life, health, agriculture and the entire integrity of the ecosystem. This priceless resource acts as a buffer in periods of water scarcity and delay or failure in monsoon rains. With the advent of modern bore hole technology, energisation, rural electrification and institutionalisation of credit gave a boom to groundwater development.

Groundwater exploitation has a limited future as, in several places ill effects due to over exploitation had been experienced. Eventhough significant advances had been made in almost all phases of groundwater technology in recent years, understanding the groundwater flow behavior and its interaction with the surface water is very much needed before addressing any problem related to it. For preparing plans for assessment of water resources of a basin and their utilization, accurate assessment of both surface and groundwater together has to be made and its interrelationship has to be studied.

Irrigation projects were prepared either on surface water resource or groundwater resource separately which sometime results in either water logging or depletion of groundwater. In either case it was detrimental to the ecology of the region. Further, the two water resources were not being utilised optimally, economically and sustainabily.

For intensive irrigation and promotion of good crops, adequate and timely irrigation is essential, which in many a case may not be ensured by a single resource. Sometimes the chemical qualities of groundwater may also pose limitations and its dilution with surface water may serve the water quality needs of the crops.

In Tamilnadu state and more so in southern India, Tanks were the oldest and most common surface water reservoirs used for irrigation. This tank irrigation is intricately woven with the tradition and lifestyles of the entire community. In Tamilnadu there are about 39,200 tanks which accounts for 17 per cent of all tanks in the country, irrigating an area of 928,000 ha. Most of these tanks are rainfed tanks. Well irrigation too, was in vogue and the earliest record dates back to Vedic times (5000 BC). Until the recent years the drawl of groundwater was restricted to the length of rope used to draw water. Bullocks were generally employed to draw water and the length of travel was also restricted by the size of the farm holding and thus encouraging sustainable use. Under the present changed conditions, revival of the traditional methods poses a problem of different dimension. Therefore the computer model for conjunctive use was developed and applied to

Nanmangalam tank irrigation system in Chengai MGR district of Tamilnadu state as a case study. The tank is to its brim during the start of the crop and dry before crop maturity-(34 months). Also there are 41 shallow dug wells whose water table is directly correlating with the tank water level. These wells are irrigating about 26 per cent of the tank command of 100.81 ha. Rice is the major crop grown twice in a year. Conjunctive management was almost absent and poor crop yields were noticed. Thus, there exists a great scope for conjunctive management to increase crop yields and cropped area.

A two dimensional unsteady groundwater flow model was developed using Galerkin approach of the Finite element method. The Finite element method is a flexible tool by which the response of water table to the varying levels of abstraction at various well locations in a study area can be computed. The effects of conjunctive use of tank water and well water for the study area was simulated with a historical data for 11 years.

Table 1. Results of Conjunctive water use model for Nanmangalam tank

Performance indices	Before Conjunctive Use (Average over 11 years)	After CU (1994-95) [Normal rainfall year]
Crop Yield (kg/ha)	4540	5560
Area irrigated (ha)	87	101
Irrigation intensity (%)	136	164
Profits (Rs./ha) at constant prices	2179	2669
Ground water use (%)	8	21

The results of simulation as release schedule for both surface water and groundwater helped in bringing more area under irrigation, reducing the level of risks in water availability and thus resulting in overall sustainability of the surface water system (tank), groundwater system, agricultural system and largely the welfare of the farming community.

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GROUND WATER RESOURCE EVALUATION FOR NEXT GENERATION - A REMOTE SENSING BASED CASE STUDY

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India is a vast country having diversified geological setting. Variations exhibited by the rock formations, ranging in age from the Archean crystallines to the recent alluvia are as great as the hydro-meteorological conditions. Variations in the nature and composition of rock types, the geological structures [Lillesand & Kiefer, 1987], hydrogeomorphological setup and hydro-meteorological conditions have correspondingly given rise to widely varying ground water situation in different parts of the country. Rainfall is the source of annual ground water replenishment and the movement of ground water reservoir takes place by several ways. In tropical countries like India, the recharge through rainfall takes place only during a short period of monsoon but due to slow sub surface movement of ground water, it is available for use throughout the year in all most all the areas except the highly permeable cavernous terrains. The general tendency of the farmers is to take up well sinking at highest point in the plot to gain advantage of commandability. The ambitious farmers resort in making wells of more than required dimensions and depth. Deepening in hard, massive and unproductive granitic formations would further shatter the economic conditions of the poor farmers. Artificial recharge is an important aspect of ground water management in the areas of highly permeable cavernous terrains like limestones as it provides storage space free of cost during dry period.

In this paper, a detailed study was carried out for identification of artificial recharge areas using satellite imageries. The area used for this study is an overdeveloped limestone area viz., Samudrala Watershed, Andhra Pradesh, India. Selection of sites and designs for artificial recharge structures depends on the configuration of confined aquifers, hydraulic gradient and location of source of excess surface water. The satellite imageries are interpreted visually and prepared various thematic maps viz., gradient map, geological structural map, landuse / landcover map, hydrogeomorphological map and drainage map along with the secondary data. The secondary data consisting of the information obtained from detailed hydrogeological and geophysical surveys. These information are integrated and used as a guide to identify the favourable sites for artificial recharge areas.

By using the information obtained from the analysis of geophysical and geomorpho-logical data, the annual utilisable groundwater, net ground water draft and groundwater balance were computed. The status of ground water development in percentage was foundout with the help of the norms CGWB, 1982] given by Central Ground Water Board, India. These norms were used for computation of ground water resources on villagewise all over the study area. The villagewise status of groundwater development is shown in Table. 1. The stage of development as indicated in the table is for the year for which the discharge and

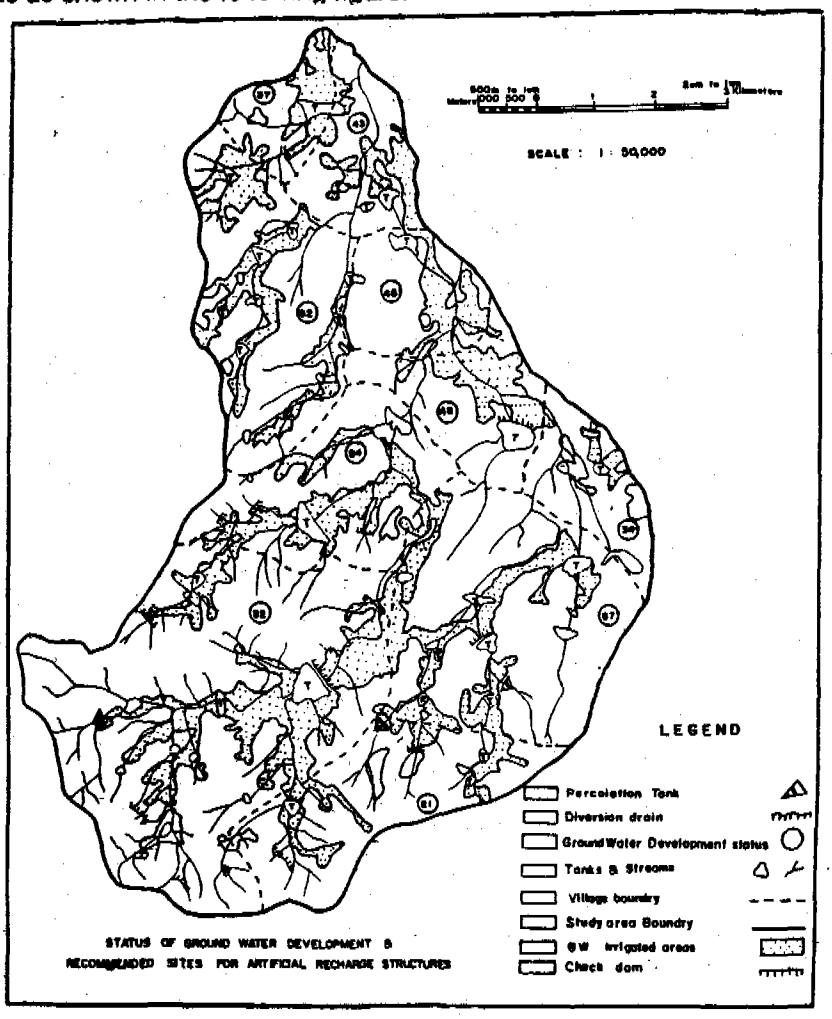
TABLE 1: VILLAGEWISE STATUS OF GROUND WATER DEVELOPMENT

Sl.No.	Name of the Village	Annual utilisable Ground Water Resources (MCM)	Net Ground Water draft (MCM)	GW Balance (MCM)	Status of GWD
1.	Narayanapur	1.2848	0.4438	0.8409	34.54
2.	Gottamitta	1.0634	0.3124	0.7509	29.38
3.	Nakkerakommula	0.7958	0.3049	0.4908	38.32
4.	Pariveda	0.9262	0.3593	0.5668	38.80
5.	Kachapur	1.2560	0.8423	0.4137	67.06
6.	Samudrala	3.7498	0.9498	2.7999	25.33
7.	Sriramulapalli	1.0248	0.5070	0.5177	49.47
8.	Potlapalli	1.8280	0.5004	1.3275	27.38
9.	Pandilla	2.9205	1.5725	1.3479	53.84
10.	Regonda	3.4759	0.5795	2.8966	16.66

recharge components have been estimated. Such a stage of Ground Water Development [GWD] is taken as the ratio of the net draft to the net recoverable discharge. Based on the level of Ground Water Development, the area can be devided into three categories. If the level of

GWD is more than 85%, it is termed as dark areas, if it is from 65% to 85%, the area is called as grey area and the GWD is less than 65%, the area is said to be white areas.

The interpretation of thematic maps was carried out at micro level. This interpretative data was integrated with the secondary data and prepared a map showing the favourable sites for artificial recharge. The entire study area was categorised based on percentage development and a map is prepared showing the status of GWD. These two maps are superimposed and a common map is prepared illustrating status of GWD and recommended sites for artificial recharge areas as shown in the following figure.



This study has revealed that a] Major lineament zones are promising horizons for potential ground water at depths and proper identification of these lineament zones through remote sensing techniques followed by field checks would be fruitful means of selecting the areas for assured ground water development. b] A detailed hydrogeomorphological surveys supported by geophysical surveys and remote sensing techniques ensure pinpointing of successful well sites for construction of dug wells, bore wells and tube wells. Thus wasteful expenditure can be avoided and well failures can be minimised. c] It is suggested that, In semi-arid area like Samudrala Watershed where ground water is being under used, construction of artificial storage reservoirs like, check dams and percolation tanks are most appropriate to utilise this resource and of its potential for next coming generation.

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STOCKHOLM WATER COMPANY

Stockholm Water is an environmental and engineering company owned by the City of Stockholm.

We produce and deliver drinking water to about 1 million people in Stockholm and ten neighboring municipalities.We also manage and treat wastewater from Stockholm and seven neighboring municiplities.

We own and manage two waterworks and three wastewater works, pipe networks for drinking water and wastewater, pumping stations, water reservoirs and so forth in Stockholm.
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Through cooperation with other municipalities in Stockholm region and through international activities, we contribute to creating the conditions for better water and an improved water environment, not least in the Baltic Sea area.

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The Global Water Partnership – First Consultative Group Meeting

Stockholm, 9 August 1996

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Note 1

The GWP Mission Statement

The mission of the Global Water Partnership is to support countries in the sustainable management of their water resources.

This can be stated more in detail as follows:

Water is a finite natural resource essential for human survival. Competition and conflict over its use are increasing. There is now a critical opportunity for nations and people to work together to manage the world's water resources sustainably for purposes of development.

The Global Water Partnership (GWP) has been created for that purpose. It is a working partnership between organizations concerned with water resources around the world. These organizations recognize the importance of coordinated action to improve the use of the human and financial resources available for water development.

The GWP aims to help people, especially the poor and other vulnerable groups, to benefit from improved water resources management, while safeguarding the environment.

The GWP promotes integrated approaches to sustainable water resources management consistent with the Dublin and Rio principles. It encourages people and organizations to work together in more effective and collaborative ways. It seeks to create trust and understanding, both among its partners and between them and other parties interested in the development of water resources.

In particular, the GWP will

(a) clearly establish the principles of sustainable water resources management,
(b) identify gaps and stimulate its partners to meet critical needs within their available human and financial resources,
(c) support programmes of work at the local, national, regional or river-basin level that follow principles of sustainable water resources management,
(d) help match needs to available resources, and
(e) strengthen mechanisms for sharing information and experiences.

The success of the GWP will be measured by its tangible impact at local, national and regional levels.

Note 2
Why Join the Global Water Partnership? A Note on the Value Added

The GWP will
- *provide the first global forum for action-oriented decision-making regarding water,*
- *improve collaboration of all parties interested in the sustainable development of water resources,*
- *help find improved and innovative solutions to the problems in the water sector,*
- *help mobilize external and internal resources, and*
- *enhance capacity building in developing countries.*

Certainly attention has been given to water by the international community. There was the international drinking water supply and sanitation decade (1981-1990). Then there was the Delhi Statement of 1990, the Dublin principles on sustainable water use of 1992, the 1992 UN conference in Rio and its Agenda 21 with its lengthy chapter on water, the 1994 Ministerial Conference on Drinking Water and Environmental Sanitation in Noordwijk, Netherlands and, most recently, the Beijing Declaration on managing water resources of large cities and towns of March 1996. But there has still been no effective mechanism to translate all these noble statements, declarations and principles into action. And there has been no action-oriented forum where the various parties interested in water use could get together to reconcile their conflicting demands on what is an increasingly limited resource.

The GWP was conceived to fill this gap. It will provide the **first global forum for action-oriented decision-making**, with a focus on putting the international agreements into practice and supporting developing countries in the sustainable management of their water resources.

There are a multitude of agencies active in water resources management at the international as well as national levels. In many instances, communication between them has been nonexistent and responsibilities unclear although they often compete for the same water resource. There is no institution or internationally binding framework to guide activities in the water sector. With the GWP, the **collaboration of all parties interested in the sustainable development of water resources will improve**.

This cuts two ways. First, it relates to aid donor coordination which today is, at best, piecemeal and isolated. At present, the water sector is characterized by overlapping

place in Latin America clearly are of interest to Africa and Asia and vice versa. Due to information and language barriers they are not well-known.

Since publications are primarily disseminated in the industrialized world, often in English and accessible only in international databases, an important function of the Partnership will be to **help make information available where it is demanded and needed**. This may take place through workshops, seminars, conferences, research, publication and library support. Once information is available to the members, they are in a position to determine the value of the experience of others for their own reality.

In summary, the value added by the Partnership consists in creating and improving services that are increasingly needed to cope with the challenges in the water sector, but that are nonexistent or ineffective today.

Note 3
The Global Water Partnership – Devolution to "The Appropriate Level"

The Global Water Partnership is an international forum to agree on the principles and prerequisites for integrated water resources planning and management. It will be active by supporting negotiating processes at global, regional, country and local levels, as appropriate in each case.

A Valid Concern

The present co-sponsors of the Global Water Partnership (GWP) are the World Bank, UNDP and Sida, three donor agencies. The chairman is a Vice President of the World Bank, the Executive Secretary is a Swede and the chairman of the Technical Advisory Committee (TAC) comes from Denmark. Is the GWP another donor-driven initiative launching a debate over the heads of the developing countries that should be the prime beneficiaries of its services? This is a very valid concern that all members of the Partnership should consider with care. This note addresses that issue.

The Integrated Approach to Water Resources Development

During this century the withdrawal of water from surface and ground sources has been about two and a half times more rapid than population growth. The need and demand for water will continue to expand without any corresponding increase in supply. Current trends suggest that we are approaching a water crisis in many parts of the world, including both rich and poor countries. In the near future, availability of water rather than land will be the main constraint to agricultural production in many areas. Perceived water problems often stem not so much from an absolute shortage of water as from inefficient use, degradation of available water from pollution and unsustainable use of groundwater. In the developing countries water shortages are increasingly becoming an impediment to development and causing hardships to people.

An underlying reason for water shortages is often a piecemeal and disintegrated approach to the development of water resources. Water is used in a variety of different sectors and for many different purposes. There is growing competition for finite water resources, and the costs of developing them are soaring. Water management has been organized in a sectoral manner with negligible cross-sectoral coordination. Decision-making, accountability and loyalty have been directed upwards in central ministries. There is little overall coordination of the development of this crucial but finite resource. There are choices decisive for development to be made in

The major task of the Partnership is to promote the integrated approach to water resources planning and management by and within developing countries, including countries in eastern Europe, that are facing acute water scarcity and deteriorating water quality. Such countries should be encouraged and assisted to create the negotiating process involving all stakeholders that has been described above. The services of the TAC will be used, as appropriate, to assess the priorities for action and determine what is required and feasible, including the provision of technical assistance through consultancies, training or other means.

With time there should therefore be a multitude of water partnerships at regional, sub-regional, national or watershed levels. For example, we may soon be talking about a Southern Africa Water Partnership and a Zambezi River Basin Partnership. We already have a Mekong River Basin Committee, there is a Nile River Basin Action Plan and there are many others. The approach applies equally to international water development programmes, such as the environment programmes for the Baltic Sea and the Black Sea. It is not claimed that the approach itself is new or revolutionary. **What is new is the creation of a global mechanism to promote the approach in a systematic manner in the developing countries.**

It is central to the concept of the Partnership that it be low cost and minimal in terms of organizational superstructure. The negotiating process to be initiated within or between developing countries will need to be supported by some staff resources on a permanent basis. But just as in the case of the Global Water Partnership they should be small and as much as possible linked integrally to existing organizations, avoiding the creation of new institutions for this purpose.

They will also need to be supported by well qualified technical expertise that the parties to the negotiating processes regard as neutral and unbiased, an important requirement for the efficiency of the process. It is within the mandate of the TAC to make proposals for the mobilization of such expertise on water resources management at regional level. To the extent possible the expertise needed for water partnerships should come from the region concerned. The Partnership may assist in locating the expertise required within the region, if necessary supplementing it from other regions and providing financial support. Eventually the countries involved should themselves assume responsibility for locating and managing the technical expertise required to support the negotiating processes.

Developing Country Participation in GWP Governance

Negotiating processes on water resources management at regional, country or watershed (or equivalent) levels will be conducted by the countries involved, if necessary with professional and financial support provided by the Partnership. The stakeholders involved in these processes should be members of the Partnership to benefit from its support. These members will meet once a year at the meeting of the global assembly of the Partnership. At the outset these gatherings will take place in Stockholm. Whether this will also be the case in future years remains to be seen.

On this occasion the members will approve proposals for activities to be supported and elect representatives to the committees of the GWP according to the statutes in force. Care has been taken in drafting these statutes to provide for equal

Note 4

TAC Assignments in the Short Term

The Interim Committee has assigned five tasks to the interim TAC in the short term: (1) Agenda 21 and the Dublin Principles, (2) southern Africa, (3) water resources legislation, (4) large cities and towns, and (5) identification of gaps in international water management activities.

At the meetings of the Interim Committee in February and May it was agreed that the TAC would start with a few specific activities which are of importance to potential partners of the GWP and which can illustrate where the GWP can make a (quick) impact. Five possible activities were mentioned in the Progress Report from April. They are outlined in more detail in the following.

Agenda 21 and the Dublin Principles

The Dublin principles, which are also integrated in Agenda 21, namely

- to manage water at the lowest appropriate levels,
- to treat water as a social and an economic good,
- to involve women in water resources management, and
- to promote a holistic approach to water resources management

are basic to the work of the GWP. At the same time, guidelines are lacking for the application of these principles. When, for example, would a programme suggested by a Partner fit under the GWP umbrella? Should at least one of the principles be followed, two or all of them? And what exactly does management of water as a social and economic good mean? To what extent ought political and social circumstances be taken into account? One of the interim TAC's first endeavours ought to be a review of the Dublin principles with a view to making them as practical and operational as possible.

Such a review could take place by analysing water resources management policies and experience in recent years by different countries and agencies and by the development of a best-practice guide. One result of the review should be guidelines for the Partners on what type of water resources management interventions should constitute programmes that would fit under the umbrella of the Partnership. These guidelines would be presented to the Consultative Group meeting in 1997 for consideration.

Water Resources Legislation

It is now generally recognized that for water users to manage their resource effectively and sustainably, user rights are a primary condition. A functioning user right system implies functioning mechanisms for monitoring, enforcement and sanctions. In addition, appropriate fora are needed for the various stakeholders to express their needs and demands.

In view of increasing water scarcity, both due to pollution and increasing demand, a number of countries have in recent years abandoned the administrative top-down approach to water resources management and are attempting to build up stakeholder-based systems. They also recognize that, in addition to user rights, economic incentives play an important role in encouraging users to use water more efficiently. In most countries this re-thinking implies that water resources legislation has to be introduced or reformed, in accordance with the requirements imposed by local circumstances.

Examples of countries that have implemented new approaches to water resources management, are for example Chile (water markets), Brazil and Indonesia (variations of the French approach to water resources management), and several African countries (water resources management strategies).

TAC should assess if there is a need to look at such new approaches to water resources legislation that would be of potential benefit to other countries which are in the process of reviewing their approaches to water resources management.

TAC should also look at the experience of those countries that have introduced new approaches to water resources management with a view to assessing if there is a need to analyse and disseminate this experience to assist interested Partners. Gaps should be identified, for example in the areas of access to information, capacity build-up, and current technical expertise.

A number of countries are now in a stage where conclusions can be drawn as to the impact, success and failures of their new approaches. While hitherto much of the information disseminated on water resources development and management has come from developed countries, notably the United States and France, the recent experience in developing countries can be used to illustrate their approaches to the emerging problems regarding water resources. For example, Latin America has a wide range of countries at different stages of development and with different problems related to hydro-climatological and socio-economic conditions. The experiences of this continent may, with appropriate modifications, be applicable for both African and Asian countries.

Through a TAC assessment of the on-going initiatives the Partnership could promote dissemination of valuable information on practical experience. After an initial assessment by the TAC, analysing and summarizing such experience, it could be disseminated in the form of reports (in several languages) and by workshops.

At present, the *Water and Sanitation Window* is represented in the Partnership by the World Bank/UNDP Water Supply and Sanitation Programme which with its field offices has a certain capacity to assist Partners with technical expertise. Concerning research and dissemination, institutions such as the IRC in The Hague, Amref in Nairobi and the London School of Hygiene and Tropical Medicine have expertise in water and sanitation issues. Regarding management of urban water and sewerage utilities, a number of private companies, notably in France and in Britain, have expertise to provide. In countries such as Denmark, Germany and Sweden also public-sector utilities have recently started initiatives to become active internationally.

In the *Irrigation and Drainage Window* IPTRID and IIMI can be identified in the area of research and dissemination of research findings.

Clearly, the above are only examples. The institutions mentioned cannot support an entire window of the GWP. TAC should identify which gaps there are with regard to both the programmes and the core concern, namely integrated water resources management. TAC should also consider the windows themselves and make recommendations regarding their number and configuration.

Gaps can certainly be found at the global level but also at regional and national levels. For instance, concerning the activities of the Zambezi River Authority, the needs perceived by the stakeholders are different from those concerning research on drainage issues at global level.

TAC should present its findings concerning

- gaps in the GWP windows and
- gaps in national and regional contexts (with emphasis on 'hot spots')

at the Consultative Group meeting in 1997 together with recommendations for action by the different stakeholders.

Note 5
The Global Water Partnership – Membership Criteria, Responsibilities and Benefits

The Global Water Partnership offers an innovative approach to development aid. It attempts to instil, from the outset, a culture of interdependency and mutual responsibility. All partners benefit from the services and, while taking into account their differing abilities, all contribute towards the costs of providing the services.

A Culture of Mutual Responsibilities

In recent years development aid has been declining, and it is hard to see any change in that trend. It is becoming necessary to accelerate the search for more cost-effective ways to deploy available aid resources as efficiently as possible. The Global Water Partnership (GWP) may serve as a model for future development cooperation.

In today's technology-driven world knowledge is paramount. The industrialized countries will have a large part of the scientific knowledge needed by developing countries for many years to come. They will also have the means to disseminate it, even if aid resources continue to decline, since the associated costs are modest. But sustainable water resources management is very much an issue in industrialized countries also. They can learn from experience gained in developing countries and vice versa. There is much to be gained from flows of knowledge between countries at different stages of development. In future years development cooperation may focus increasingly on capacity building and exchange of technical knowledge between stakeholders on different levels.

The nature of development aid will then change. There will be a gradual erosion of the traditional donor-recipient relationship and increasing emphasis on partnerships of stakeholders where all have something to contribute toward the solution of a common problem. The reinforced network approach of the GWP provides a framework for this to happen. But it is inherent in a partnership that just as there are mutual benefits there are also mutual responsibilities. In a partnership benefits and responsibilities flow in both directions.

The GWP attempts to instil, at the outset, a culture of interdependency and mutual responsibility. All partners benefit from the services and all contribute towards the costs of providing them. If the word partnership is to have any real meaning, the commitment of members should be manifested not only in attendance at GWP-financed meetings but also in contributions to the costs of operating the venture. The partners will contribute according to their abilities and these will differ, often

Partnership may be able to devote attention to water resources management anywhere in the world, assuming it is given the resources to do so.

The Costs of the GWP

The GWP will incur costs of two kinds. **First, there will be the core costs for the basic governance structure.** In the initial phase these are carried by the three current co-sponsors: Sida, the World Bank and UNDP. In 1996 Sida has set aside the equivalent of about USD400,000 to host the GWP Secretariat. The World Bank has approved USD250,000 for the TAC and the UNDP USD50,000 for the same purpose. A total of USD700,000 has thus been made available this year for the core costs of the Partnership. For 1997 Sida has approved about USD450,000 for the Secretariat, while the World Bank and UNDP have each budgeted USD250,000 in support of the TAC.

The core costs are likely to increase in 1997, since the TAC will require a secretariat of its own (it will be serviced by the GWP Secretariat in 1996). The initial annual costs of a TAC secretariat are likely to be about USD250,000, i.e. about as much as for the TAC itself. It may be possible to offset part or all of these costs against the contributions of the World Bank and UNDP to the TAC, provided that they materialise at the levels indicated.

Second, there will be the costs of GWP "field activities", i.e. activities arising from the work of the TAC and from GWP members' requests. Most of these activities would be modest in size but catalytic in nature and assumed to have a significant impact on sustainable water resources management. Providing illustrative examples before the TAC has had time to consider them in depth is hazardous and of necessity hypothetical. Nevertheless, second-guessing from the list of first TAC assignments (cf Note #4), the following activities might be suggested:

- provision of technical assistance (consultancy services) for the creation of integrated water management processes in southern Africa;
- support to modest secretariat services for such processes;
- exchange visits for experts from southern Africa to visit other regions where similar processes have been successfully launched;
- a series of workshops in southern Africa on the experience of countries that have introduced effective water rights legislation.

It is not feasible at this stage to estimate the associated costs of GWP "field activities", but they are likely to be small relative to overall investments in water resources development. Overall, they may not amount to more than USD2-3 million annually in the first years of the Partnership.

Sources of Financial Support

The "field activities" will need to be financed by special contributions to the GWP. They may be of essentially three kinds.

Membership Contributions. These will be annual contributions by GWP members in return for being able to benefit from GWP services and having a voice at membership

Benefits to Members

Overall, the benefits of the GWP can be summarized on two levels. **In the long term** the major benefits would accrue from of a more coherent and systematic approach to water resources management, matching demand for water to its availability more effectively than in the past and coordinating the use of scarce financial resources for investment better than in the past. These benefits would result from the work of the TAC on the standardized, operational interpretation of the internationally agreed principles for water resources management and its application in the design of investments by the World Bank and other donors. It would inevitably take time for these benefits to materialize. In many instances non-members would also gain from them.

Another intangible and long term benefit would result from the increased attention that could be devoted to water resources management in the donor community as well as within countries. By focusing the development discourse in a concerted manner on the need for improved management of water resources, additional financial and human resources may be devoted to this area.

In the short term more tangible benefits would result from the kind of activities mentioned above, initiated at members' request and often as a consequence of direct support from other members. These activities would often entail capacity-building in various forms and would include

- technical assistance through consultancies,
- provision of support in kind to facilitate local processes,
- training through workshops, exchange visits, short courses etc., and
- dissemination of experience and scientific findings by a variety of means, including workshops and newsletters.

The GWP Secretariat should begin to build up a capability for information dissemination later this year. This could include a newsletter on Partnership activities, preparation of information packages on relevant experience, the facilitation of training, and so on. Since this is not now foreseen in the budget of the Secretariat it might be developed as a discrete activity of its own and submitted to donors for funding. This function need not necessarily be located at the GWP Secretariat, but it should be closely coordinated with the work of the Secretariat.

The value added to be derived from membership in the GWP has been discussed more in detail in another context (cf Note #2) and the benefits arising from the devolution of the Partnership to "the appropriate level" are raised in yet another (cf Note #3).

Annex 1 (Note 5)

Membership Declaration
(Draft)

[name of the organisation] hereby applies to become member of the Global Water Partnership. We, the signatories to this document for [name of the organisation], agree the following points on its behalf:

Principles

We recognise that water is a finite global resource essential for human survival.

We agree to follow integrated approaches to sustainable water resources management.

We wish to coordinate our activities in water resources management with those of other organisations.

We aim to help people, especially the poor and other vulnerable groups, to benefit from improved water resources management, while safeguarding the environment.

We recognise that women play a central part in the provision, management and safeguarding of water.

Our commitment to the GWP

We wish to put these principles into practice by joining the GWP.

We understand that our commitment to the GWP will be both financial and professional and valid until revoked by either of the parties.

We will pay an annual membership subscription, currently at the level of [value in US Dollars, as per sliding scale provided by the Secretariat]. We will pay this in cash and/or in the value of our staff members' time and travel devoted to the GWP.

We will give advice and professional inputs to the GWP and to its other members: these will be free of charge up to a reasonable level according to our organisation's resources, and at a mutually agreed charge above that level.

We will share our information and experience concerning water resources management freely with other GWP members.

The GWP's commitment to us

We expect the GWP to provide us with the full range of its benefits to its members, in particular:

- guidance on identifying critical needs
- technical advice

Note 6
The Global Water Partnership Governance Structure

The present governance structure of the Global Water Partnership consists of the Patron, the GWP Chair, the Consultative Group, the Steering Committee, the Executive Secretary, the Secretariat, the interim Technical Advisory Committee and field programmes.

Preamble

This note provides a status report on the present governance structure of the Global Water Partnership (GWP) together with some brief comments about likely future developments.

The Patron

Professor Kader Asmal, Minister of Water Affairs and Forestry of the Republic of South Africa, has kindly agreed to be the first Patron of the GWP. In this capacity he will promote the purposes of the Partnership in circumstances where it is useful and appropriate for him to do so. In the future the GWP may have additional Patrons.

The GWP Chair

Mr. Ismail Serageldin, Vice President of the World Bank, will chair the GWP in a personal capacity for a period of two years.

The Consultative Group

The Consultative Group of the GWP is the annual membership meeting of the Partnership where members meet to exchange experience ("consult"), discuss the business at hand and reach key decisions. It takes place in August in conjunction with the Stockholm Water Symposium.

The Consultative Group can amend as appropriate any of the documents that guide the business of the Partnership.

The Steering Committee

Between meetings of the Consultative Group the Steering Committee (SC) will follow up key decisions and assist the Executive Secretary in the operations of the GWP. The SC has ten members who are broadly representative of the GWP membership.

have decided to become members of the GWP. However, there are no plans to create a hierarchy of GWP membership meetings.

Note 7
Statutes for the Steering Committee

The principal decision-making organ of the Global Partnership is the Consultative Group, which meets annually. In between the annual meetings a representative body, the Steering Committee, assists the Executive Secretary in the operations of the Partnership.

Overall Purpose

The principal decision-making organ of the Global Water Partnership (GWP) is the Consultative Group where members meet to exchange experiences ("consult"), discuss the business at hand and reach key decisions.

The Consultative Group meets annually. In between these annual meetings there is a need for a representative body to assist the Executive Secretary in the operations of the Partnership. This is the Steering Committee (SC).

Reporting

The SC reports on its activities on an annual basis to the Consultative Group. The Executive Secretary is responsible for compiling the report which should be approved by all members of the SC.

Duties of the Steering Committee

The SC assists the Executive Secretary in making key operational decisions on the business of the Partnership.

In particular, the SC will decide on

- the submission to the TAC of new work assignments,
- the initiation of project activities resulting from the work of the TAC,
- the allocation of financial resources pledged to the GWP,
- follow-up of decisions by the GWP Consultative Group,
- the agenda for future meetings of the GWP Consultative Group.

In addition, the SC will advise the Executive Secretary on

- the work and resources of the GWP Secretariat.

Organisation of the Steering Committee

The SC will have ten regular members and seven substitute members.

Note 8
Statutes for the interim Technical Advisory Committee of the Global Water Partnership

The Technical Advisory Committee (TAC) is a body of independent scientists and professionals working in a personal capacity to provide technical advice on water resources management issues to the members of the GWP at their request, including recommendations to be taken. These statutes deal with the work of the interim TAC, which will prepare the creation of a regular TAC by 1998.

Overall Purpose

The Global Water Partnership (GWP) aims at bringing direct benefits from improved water resources management to people, especially the poor and other vulnerable groups, while safeguarding the environment and its ecosystems.

The Technical Advisory Committee (TAC) is a body of independent scientists and professionals working in a personal capacity to provide technical advice on water resources management issues to the members of the GWP at their request, including recommendations on action to be taken.

The interim TAC was constituted in 1996 as a step in the build-up of the GWP.

Reporting

The interim TAC reports through its Chair to the Consultative Group of the GWP.

In addition, the interim TAC will report regularly to the members of the GWP on its activities.

Duties of the interim Technical Advisory Committee

The interim TAC will

analyse existing gaps in development assistance programmes, identify priority areas for action by the GWP, and identify appropriate mechanisms for action by the GWP in these priority areas.

It will do so by

- developing a conceptual framework for the GWP,
- developing a set of criteria for programmes adhering to widely accepted principles of sustainable water resources management,

available to the interim TAC will be decided annually by the Consultative Group as proposed by the Executive Secretary in consultation with the interim TAC Chair.

There will be a budget for the interim TAC prepared by the Executive Secretary in consultation with the interim TAC Chair and approved by the Consultative Group. The interim TAC Chair manages this budget.

Sub-committees

The interim TAC may form sub-committees of its own for specific work assignments.

Non-members may be attached to sub-committees on terms and conditions approved by the interim TAC Chair.

The Regionalisation of the interim TAC

As far as possible the interim TAC shall collaborate with experts from the region or, as appropriate, the country in which the activities are located which are subject to its review.

The interim TAC shall build up a roster of suitably qualified experts on a regional basis to whom a gradually increasing share of its responsibilities may be delegated according to procedures to be developed.

Remuneration of interim TAC members

Interim TAC members will be paid according to UN consultancy rates for work performed. The members will be remunerated at the same rate.

Such work includes attendance at scheduled meetings, participation in reviews and agreed work at home.

All individual work assignments shall be approved by the interim TAC Chair who shall also approve requests for payment of fees by members, according to procedures to be elaborated in cooperation with the GWP Secretariat and the UN.

Interim TAC members shall be compensated for travel costs according to UN rules.

Note 9
The Global Water Partnership – Progress Report June 1996

In Stockholm in December 1995 a meeting of 56 institutions (national governments, multilateral banks, NGOs, UN agencies, bilateral agencies, professional associations and the private sector) and about 75 participants decided to found the Global Water Partnership, which now stands before its launching conference to be held on 9 August. This Progress Report briefly summarizes developments since the December meeting and the current situation as regards creation of the Partnership[1].

Interim Committee

At the December meeting Johan Holmberg was asked to form an interim committee to move things forward. In January an Interim Committee of nine members was constituted. It consists of E. Aguilar (Mexico), J. Briscoe (World Bank), L. Currat (Swiss Dev. Cooperation), G. Gosh (UNICEF), J. Holmberg (Sida, Chair), J. Lane (WaterAid, United Kingdom), B. Leleka (SADC-ELMS, Lesotho), R. Lenton (UNDP), and P. Najlis (UN/DPCSD).

The committee met in Stockholm on 23 February to discuss how to proceed and to start up activities. A second meeting was held in Washington, D.C. on 9 and 10 May for a progress review and for preparing the launching conference on 9 August.

GWP Chairman

Ismail Serageldin, Vice President of the World Bank, has "with considerable enthusiasm" agreed to chair the Partnership in a personal capacity for a period of two years.

Creation of the Interim TAC

In February the Interim Committee agreed on a short-list of candidates for the interim TAC on the basis of nominations received at that time from participants in the December meeting. Invitations were sent out to fourteen candidates and the response was extremely positive. It resulted in twelve acceptances and only two regrets.

The interim TAC met for the first time in Copenhagen on 10 and 11 June. A report by the chairman, Torkil Jonch-Clausen from Denmark, will be provided to the August meeting as Note #10. The interim TAC will work until the end of 1997. One of its tasks will be to facilitate the process of forming a regular TAC which will be selected

[1] A report from the December meeting can be obtained from the GWP Secretariat.

contribution of USD300,000 towards the costs of the interim TAC. Other donors have suggested the possibility of additional support.

GWP Launching Conference in August

With the formal GWP structure in place and key issues for action defined, the conference on 9 August is the first meeting of the Consultative Group during which the GWP will be formally created. This will be immediately after the Stockholm Water Symposium which takes place during 5-8 August. Participants of the December meeting have received invitations. The meeting is open also for all other participants from interested institutions and organizations active in water resources management.

A GLOBAL FRESHWATER CONVENTION - THE BEST MEANS TOWARDS SUSTAINABLE FRESHWATER MANAGEMENT?

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ABSTRACT

This paper highlights the vital need for a *"blue revolution"* in the way mankind manages its freshwaters, to secure the huge increase in productivity of freshwater usage needed for next century and to establish sustainable exploitation of water resources. AGENDA 21, Chapter 18 on Freshwaters has recommended what is needed - integrated water resources management, based on catchment basins or sub-basins as the management unit. Thus a series of measures is proposed to begin to implement AGENDA 21's recommendations and get the *blue revolution* under way. The catalyst for the needed changes would be a new global Freshwater Convention, with initially three principal objectives:- a) arousing public attention, b) focusing political will for executive action at international, regional and national levels, c) setting up a programme for the widespread establishment of Basin Management Agencies or Committees for (for rivers and lakes) to carry out the necessary integrated basin management. In addition an international public relations exercise is recommended, led by a team of "champions", to promote the cause of the *"blue revolution"*.

KEYWORDS

Global freshwater convention/treaty; global freshwater commission; AGENDA 21 - Chapter 18 Freshwater; *"blue revolution"*; integrated water resources management; catchment basin management.

INTRODUCTION

The water resources challenges facing mankind in the next century are vast and are poorly appreciated by the world's population. Hence there is little perceived urgency to begin to take the much needed steps to provide freshwater security to a rapidly increasing and urbanising world population.

The present situation has parallels with the potential food shortage situation which faced the world in the second half of the present century. That challenge was met by the "Green Revolution". By dint of improved farming practices, plant breeding, irrigation, fertilisers and pesticides, etc the required huge increase in food production was achieved.

What is needed now is a *"blue revolution"*, to bring about a parallel massive increase in productivity of usage of the world's freshwaters. Attitudes and behaviours towards freshwater usage must be changed and systems for the sustainable exploitation of an increasingly scarce resource put in place. An important element in this will be the concepts set out in Chapter 18 of AGENDA 21 on a) the integrated management of water resources, and b) that such management should be carried out at the level of the catchment basin or sub-basin. Thus the early establishment of Basin Management Agencies (or Committees) for both river and lake basins will be one of the priorities. The reasons for this will become apparent later in this paper when it is pointed out how many of the world's freshwater basins are shared by more than one country.

It is recognised that the world presently does not favour large bureaucratic organisations and that there is a move also towards growing privatisation of government activities and introduction of market concepts. The suggestions in this paper recognise these facts and would endeavour both to keep bureaucracy to a minimum and permit widespread use of market mechanisms. Also acknowledged is that the proposed Convention and establishment of Basin Management Agencies would only be the start of many other much needed changes. But a start has to be made somewhere and soon, if crises and conflict are to be avoided.

CHALLENGES OF FRESHWATER MANAGEMENT

The overall theme is one of growing competition for a finite resource, combined with inefficient, harmful and frequently wasteful usage. Fundamental to the competition for freshwater are:- a fast growing population with rising expectations of quality of life and food consumption; expanding industrial activity; increased energy needs (hydropower included), widespread urbanisation with a concomitant increased demand for water, and a variety of others. Furthermore in many parts of the world responsibility for freshwater management is fragmented and inefficient.

Looking at some of these issues in more detail:-

- little attention is paid to combined land/water use policy. Irrigation usage is often inefficient and at times positively harmful in terms of salinated soils and poor quality drainage water. Urban areas waste vast amounts of water through badly functioning utilities; and industrial and municipal effluents and agricultural runoff are causing widespread and serious deterioration of water quality;

- the world population continues to increase apace. During the past century the world's population tripled and water usage grew tenfold. On present estimates the world population is expected to grow a further 45%, from its current level of 5.7 billion, causing a further huge increase in water demand. All of this emphasises the immediate urgency for a new global water strategy;[1]

- a high proportion of the world's water resources are in river or lake basins shared by more than one country. Such shared basins make up nearly 50% of the Earth's land area and some 60% of the area of both Africa and Latin America.[2] Currently almost 50% of the world's population lives in shared river or lake basins and it is estimated that there are some 240 river basins shared by more than one country. Water shortage problems are growing. By definition, water shortage occurs when freshwater availability falls below 1700 m^3/capita/year. By 2050 some forecasts have estimated that 65 countries will face water shortages and that 65% of the then projected world population will be affected, most of them in developing countries;[3]

- the worldwide incidence of waterborne disease remains high. Faecal contamination of water supplies, poor sanitation, inadequate domestic hygiene practices, malnutrition and lack of vaccination all contribute to this, but contaminated water supplies are a major source of the problem;

- within many countries responsibility for freshwater management is divided between several ministries, often with little coordination or cooperation. Division of responsibility for freshwater affairs is also apparent in agencies. As AGENDA 21 Chapter 18.6 has pointed out:

  "The fragmentation of responsibilities for water resources development among sectoral agencies is proving to be an even greater impediment to promoting integrated water management than had been anticipated".

- frequently there is a serious lack of a national water resources management policy and, in the

case of shared water resources, limited cooperation, if any, between riparian states to secure effective use of resources. The World Bank's Economic Development Institute has recommended National Water Strategy Formulation as one of four key criteria in water resources management.[4] However in the large number of shared basins around the world this can only be effective in collaboration with other riparian states and few mechanisms exist for the needed consultation and coordination;

- water is low on the political agenda of very many countries;

- it is widely accepted that, in water scarce areas, especially where tensions are high for other reasons, the risk of armed conflict over shared water resources is looking evermore likely.

The above emphasises how interdependent much of the world is set to become, in freshwater as in so many other areas of life. It points to the need for cooperative action and a big increase in efficiency.

THE BLUE REVOLUTION — OBJECTIVES

The principal objectives of the *blue revolution* would be to bring about the needed changes in attitude and behaviours in order to ensure that adequate freshwater of the right quality is available both for mankind and the rest of the planetary ecosystem. If successful, there would be a huge increase in the productivity of freshwater usage.

Looking at the objectives in more detail, the *blue revolution* would seek the following:-

Attitude Changes:-

- to raise awareness worldwide about the principal issues in freshwaters - pollution, wasteful use, the finite extent of available freshwater

- to create in each citizen a sense of personal responsibility towards freshwater conservation and preservation

- to provide a climate for water resources sharing among nations in ways which have not been widespread before

- by mobilising citizen concern, put pressure on local, national, regional and international political processes to move freshwater issues high up the agenda

Behaviour Changes:-

- to introduce integrated water resources management at catchment basin level, taking account of integrated land use/water management

- to prevent wasteful water use practices in agriculture and industry

- to introduce efficient utility usage of freshwaters

- to minimise or prevent water pollution by industry, municipalities and poor agricultural practices

- to encourage technological innovation for more efficient usage of freshwater in agriculture, industry and domestic/municipal settings.

A VISION FOR FRESHWATER USAGE

Modern approaches to corporate strategic planning emphasise the need for a vision statement, which is then augmented by a more comprehensive mission statement. For the vision it is difficult to find a more eloquent and inclusive one than that of AGENDA 21 Chapter 18.2:-

"Water is needed in all aspects of life. The general objective is to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combatting vectors of water related diseases".

THE FRESHWATER MISSION STATEMENT

A comprehensive mission statement, taken again from Chapter 18, would comprise:-

a) Need for Integrated Management:

"The widespread scarcity, gradual destruction and aggravated pollution of freshwater resources in many world regions, along with the progressive encroachment of incompatible activities, demand integrated water resources planning and management. Such integration must cover all types of interrelated freshwater bodies, including both surface water and groundwater and duly consider water quantity and quality aspects. The multi-sectoral nature of water resources development in the context of socio-economic development must be recognised as well as the multi interest utilisation of water resources for:- water supply and sanitation; agriculture; industry; urban development; hydropower generation; inland fisheries; transportation; recreation, low and flat lands management and other activities" — Agenda 21, Chapter 18.3.

b) Need for Management at Basin Level:

"Integrated water resources management, including the integration of land and water related aspects, should be carried out at the level of the catchment basin or sub-basin" — Agenda 21, Chapter 18.9.

c) Need for Harmonisation by Riparian States:-

"In the case of transboundary waters there is a need for riparian states to formulate water resource strategies, prepare water resource action programmes and consider where appropriate the harmonisation of those strategies and action programmes — Agenda 21, Chapter 18.10

d) Need for Demand Management and Economic Tools:-

"The role of water as a social, economic and life sustaining good should be reflected in demand management mechanisms and implemented through water conservation and reuse, resources assessment and financial instruments" — Agenda 21, Chapter 18.17.

e) Need for River Basin Management Systems:-

World Bank Vice President, Ismael Serageldin[5] has added his thoughts to the above and focused on the concepts of river basin management agencies or committees as a model for planning freshwater use, with other entities or utilities carrying out the actual work of freshwater delivery:-

"Water must be managed comprehensively. We must stop managing water sectorally - by its separate uses - and begin to treat water systemically; that is intersectorally. We have learned about the benefits of developing a comprehensive framework for water resources management that recognises the interactions between various elements of a river basin's ecosystem and allows for the incorporation of cross sectoral and environmental considerations in the design of investments and policies. Here the French and German systems of river basin management could serve as models. Under these systems, river basin committees decide long terms plans for developing water resources. Regulation and enforcement are conducted by various national ministries, while operation and maintenance of the different components are left primarily to regulated private entities and public utilities".

f) Need for Peaceful Cooperation Among Riparian States:-

In his address to the 1994 Cairo World Water Resources Conference, Mahmoud Abu Zeid[2] made the following recommendations:

"While there are numerous treaties regulating the use of shared water resources, international agreements are often either inadequate or lacking entirely in some parts of the world where a water basin (river or lake) is in greatest demand. No region in the world with shared international waters is exempt from water related controversies though the most serious problems occur in water scarce regions. The key to peaceful solutions of disputes over shared water resources is continued communications between the states concerned, over everything from hydrologic and meteorological data to basin wide development plans".

A PLAN FOR ACTION — THE MAIN COMPONENTS

From the foregoing, the challenges are clear, and formidable. AGENDA 21 has projected the vision. And AGENDA 21 and key international experts have articulated the main components of the mission which needs to be carried out. What is needed is a plan to carry through the *blue revolution* with the needed practical steps.

Central to this plan and acting as a catalyst for change, would be a new Global Freshwater Convention, consisting of both a Freshwater Treaty and a Global Freshwater Commission. Augmenting the Convention and motivated by it would be a programme for the widespread, early establishment of Basin Management Agencies or Committees. The final element, although it may need to be the first to be carried out, would be a global public relations campaign to urge the whole process forward.

Why a Convention? Experience in other sectors (and, interestingly most other sectors of the environment except freshwater have now or will have shortly Conventions, treaties or protocols) have shown that Conventions:-

- attract widespread media attention and publicity, sensitise the public to the issues involved, mobilise public opinion in favour of the needed changes and begin to bring about major changes in thinking and behaviour

- bring public opinion and concern into the political process and exert the necessary pressure for executive action at international, regional and national levels

Conventions have been shown to be effective in changing attitudes and behaviours on an international scale. They act as a symbol via which public opinion is mobilised, a focus for subsequent executive action by governments and a banner under which needed change is carried out. Today, few other devices, if any, are known to be as effective in making changes at global scale in a reasonably short time.

Given the challenges facing the freshwater sector it is difficult to see what other means could activate the *blue revolution* and achieve the needed changes within the required timeframe. And, thereafter, provide an appropriate framework for the care and sustainable and equitable use of the world's freshwaters, well into the future.

A GLOBAL FRESHWATER CONVENTION

This would consist of a new Global Freshwater Treaty, of the framework type, and a new Global Freshwater Commission. The purpose would be to focus on means of managing the world's freshwaters in an equitable, integrated sustainable way, recognising the catchment basin or sub-basin as the appropriate level for such integrated management and the high level of interdependence of the world's population living in shared basins. A key would be to minimise bureaucracy and to seek to create an appropriate enabling environment for integrated water resources management to flourish in the many different forms which will emerge. The Convention should be crafted so that, not only can it embrace a framework for getting the *blue revolution* under way, but it can also provide a structure within which mankind can protect and exploit freshwaters both equitably and sustainably, far into the future.

Funding will be required to support the work needed for the Convention. Whereas initially this will need to come from the UN and supporting governments, the arrangements of the Law of the Sea Convention merit examination. That Convention has a Treaty, a Commission and a ***commercial arm.*** The latter is interesting. It raises money through the issue of licences for mineral exploitation of the sea bed. Clearly the Freshwater Convention could not imitate this directly. However freshwater activities worldwide involve multi-billion dollar expenditures and it seems feasible to consider a levy on major water users to raise the needed funds. Certainly this should be examined carefully so as to eventually move the Convention away from dependence on agency or government funding.

A GLOBAL FRESHWATER TREATY

This must be a **framework** treaty, setting down the main principles, but flexible enough for regional interpretation because of the very diverse nature of water resources systems worldwide. It is not proposed here to go into the detail of what it should contain but rather to point at certain general principles and also indicate some relevant initiatives in progress at present. In general the Treaty would include provisions for sustainable qualitative and quantitative exploitation of water resources. It would recognise the huge interdependence of nations on shared resources and would emphasise the need for equitable and reasonable utilisation and the need to avoid harm to a resource. It would highlight the need for formal arrangements to promote fair use of shared resources and make provision for resolution of disputes.

As far as international watercourses are concerned the UN International Law Commission (ILC) has recently submitted to the UN General Assembly a new set of "Rules on the Non-Navigational Uses of International Watercourses". These contain 33 articles covering such principles as:- watercourse agreements; equitable and reasonable utilisation and participation; obligation not to cause harm to other watercourse states; general obligation to cooperate; obligations to notify other watercourse states about planned measures; protection and preservation of ecosystems; prevention and control of pollution; protection/preservation of the marine environment; management; regulation; settlement of disputes etc. These Rules have been reviewed by member states, and a working group from the General Assembly will revise them late 1996. The ILC has requested then that the General Assembly should convene a conference to discuss the production of a convention based on the Rules. The ILC has specifically cast the Rules in framework form, so that they are flexible enough for interpretation in the light of different regional circumstances.

Elsewhere the Global Programme of Action for Protection of the Marine Environment from Land Based Activities (GPA) agreed an Action Programme at a meeting in Washington DC in

November 1995. Adopted by more than 100 governments, the Programme aims to protect seas from pollution generated on coasts and far inland. It is currently addressing 2 priority areas: i. the proper treatment of urban waste water and sewage; ii. development of a global legally binding instrument on persistent organic pollutants. Both of these are of great importance not only to coastal seas but also the freshwater systems which drain into them.

Both the Rules and the GPA could be included, as appropriate, in a Global Freshwater Convention.

In Europe two initiatives offer guidance on how a region may actually go about implementing agreements on freshwater usage. Firstly, the UN Economic Commission for Europe (ECE) has adopted a Convention on the Protection and Use of Transboundary Watercourses and International Lakes. It is orientated to water quality issues and will come into force during 1996. Implementation is based on intended cooperative agreements between countries bordering the same waters.

Secondly, within the European Union (EU), the European Commission has recommended the development of a comprehensive strategy on freshwaters and seas. This will set out an integrated planning and management approach to groundwater and surface water resources, which will focus on both quantitative and qualitative aspects of Europe's freshwaters and will ensure also a sustainable management of regional European seas. The intention is to issue, in draft form, a Framework Directive for a European water resources policy in late 1996, with possible implementation by the year 2000.

The European examples are important, for two reasons. Firstly they show that a major politically and economically interdependent region has chosen already the route of Convention and Directive for its freshwater management. Secondly they suggest that other economically dependent regions (existing or becoming so) could have the necessary foundations for effective implementation of the Freshwater Convention, eg ASEAN in SE Asia, MERCOSUR in Latin America, etc.

GLOBAL FRESHWATER COMMISSION

Its **function** would be to administer the implementation of the Treaty and promote and assist in the setting up of Basin Management Agencies or Committees (BMAs), including identifying and channelling needed financial assistance. The initial priority for setting up such Agencies or Committees would be in regions of water shortage, particularly those nearing crisis point and where armed conflict is possible. In addition the Commission would ensure the provision of machinery for settling disputes, using existing institutions where feasible, such as the International Court of Justice, but also making provision for arbitration and maybe establishing an International Tribunal on Freshwater Issues. The Commission would seek to identify and promote Best Management Practices (BMPs) for the sustainable exploitation and management of freshwaters. It would also identify research and training needs, then promote action to meet these needs.

The **composition** of the Commission would be crucial. A big challenge to the Commissioners would be to broker agreements among riparian states to set up Basin Management Agencies or Committees. Commissioners would need to work at the highest levels of government, including heads of state. They could also be called upon to assist in dispute resolution and influence the allocation of funds from donor agencies. Thus it is vital that Commissioners be persons of influence and very high personal standing. They would provide the much needed leadership which, it is claimed, is seriously missing at present.[6]

Among the Commission's **resources** would be a small permanent staff, chosen from a wide range of organisations, including the private sector. However, the intention is not to establish a significant bureaucracy but rather to provide the necessary minimum staff to service the

Convention. Thereafter the Commission would tap into the resources of the wide range of existing organisations, individuals and institutions in the many parts of the freshwater sector. These would include the Global Water Partnership, World Water Council, UN agencies, banks, international and national water professional associations, universities, the expertise within existing river basin agencies, bilateral aid agencies etc. A major challenge to the Commission would be to encourage these different organisations to view freshwater management more holistically, rather than the fragmented approach adopted to date. Almost certainly a new "water think tank" institution would be needed, but it is understood that such an initiative is presently under discussion.

A further challenge facing the Commission would be dealing with the concept of water sovereignty or "**our** water". In a very interesting recent project in the Middle East[7] a team of economists, water specialists and negotiators were able to move thinking away from the traditional conservatism about water sovereignty towards ideas of water values and water markets. A model was produced which will enable the countries concerned to trade available freshwaters to their mutual benefit and to attain further benefits from regional management of freshwaters which would not have been possible with a national management approach. Some important concepts are involved in this with potential for further and wider application, but more work is needed to evolve them further. Certainly water sovereignty issues, economic concepts such as those above and other aspects of water markets and economic activity will all play key roles in future freshwater management concepts.

RIVER BASIN MANAGEMENT AGENCIES OR COMMITTEES

The main principles which should guide basin management systems have been laid down in AGENDA 21 Chapter 18.9. The stress is on integrated water resources management, including the integration of land and water related aspects. The advice is to carry out water resources management at catchment basin or sub-basin level and that four principal objectives should be pursued, as follows:-

(a) *To promote a dynamic, interactive, iterative and multi-sectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socio-economic, environmental and human health considerations.*

(b) *To plan for the sustainable and rational utilisation, protection, conservation and management of water resources based on community needs and priorities within the framework of national economic development policy.*

(c) *To design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within clearly defined strategies based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy making and decision making.*

(d) *To identify and strengthen or develop as required in particular in developing countries, the appropriate institutional legal and financial mechanisms to ensure water policy and its implementation as a catalyst for sustainable social progress and economic growth.*

(e) *In addition, in the case of shared basins, there is the need for harmonisation of water resources strategies among riparian states — Chapter 18.10.*

The above are the principles. In terms of actually setting up and evolving the Basin Management Agencies or Committees, Stockholm Water Prize laureate Madhav Chitale has offered some thoughtful guidance.[8]

"Rather than aiming at a standardised set up for all international river basins, basin organisations can best be allowed to grow in phases according to the needs of the respective basins. The nature of the basin organisation and its stage of evolution will dictate the type of personnel required. These organisations will have a federal set up to represent the interests of all stakeholders. Even though the governance of these organisations will be by a body of political representatives of the participating countries, the technical and professional wings should have the necessary freedom of action in their normal work. For healthy working of river basin management committees, negotiations between the participating countries will be the principal thrust. Still a provision for arbitration for resolution of disputes will be desirable.

These words emphasise the likely wide variation in character of basin management entities, depending not only on the particular circumstances of a basin but also the status of development of the riparian states and the activities carried out within the basin. Thus some basin management entities may be advisory committees whereas others would function as executive agencies including carrying out programmes.

Generally however as Serageldin[5] pointed out in the examples of French and German Basin Management Agencies, the priority would be to set policy and produce an enabling environment, including regulatory framework, for other agencies and utilities to carry out the actual freshwater exploitation programmes.

Privatisation of such programmes will continue to be of growing importance in many basins. Privatisation of the executive capacity of a particular Basin Management Agency should also be an option, where appropriate. In addition, as with the suggestion for the Global Freshwater Commission, it may be possible eventually for Basin Management Agencies to recover their costs from a levy on major freshwater users.

CAMPAIGN/PUBLIC RELATIONS INITIATIVE

At the beginning of this paper the lack of public perception and absence of serious concern about the magnitude of the looming freshwater challenges was highlighted. A major initiative is needed to educate the public about the issues involved and mobilise public opinion in support of the *blue revolution*. Experience in other sectors and with other important global issues, eg famine, poverty, etc suggests that a campaign led by some highly prominent, respected international figure, or better still, group of figures, could achieve the desired effect. He/she or they would "champion the cause". If effective this could bring about the necessary pressure on the political systems at national and international level and bring about reasonably speedy implementation of the Treaty, the setting up of the Commission and the BMAs and the crucial initial objective of achieving systems for the sustainable management of the world's freshwaters. One of the challenges then is to identify the person(s) to lead such a campaign and secure his/their commitment to action.

CONCLUSIONS

The ideas outlined above are not new in themselves. All have been tried and tested somewhere in the world, usually to very good effect. What is new is the synthesis of those ideas into a meaningful framework of action for the freshwater sector, based on Chapter 18 on Freshwater from AGENDA 21. When viewed in comparison with other sectors of the environment, it is strange to many that a Convention or Treaty approach has not been seriously pursued for freshwater before. Virtually all other sectors of the environment are now covered, or probably soon will be, by a convention, protocol, or similar. Yet freshwater, the lifeblood of planetary systems, has seemingly lagged behind. It is now time to begin to catch up.

Let us be absolutely clear about the central issue — the *blue revolution* is not an option; it is a necessity.

The problems of the freshwater sector are well known and have been discussed widely and comprehensively. What is needed now is action to begin to overcome them.

The proposals outlined above would accelerate substantially the needed revolutionary process. However, it takes time to mount a successful public relations campaign, time to put a Convention in place and it will need more time still to set up functioning Basin Management Agencies or Committees. Yet, given the burgeoning demand for water and continuous deterioration of freshwater quality, time is not on mankind's side. Thus the need is for action soon to begin to implement the proposals. Should we fail to do so, then the consequences for mankind would be dire indeed.

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KEYNOTE ADDRESS

FIRST MEETING : GLOBAL WATER PARTNERSHIP

Prof. Kader Asmal, MP

Minister of Water Affairs and Forestry, South Africa

Stockholm, August 9 1996

Chairperson, ladies and gentlemen, distinguished colleagues, friends. It is a great pleasure to be in Stockholm for this important first meeting of the Global Water Partnership. I am honoured by your invitation both to be a patron of this organisation, and to give this keynote address. It is an honour which, I believe, reflects not on myself, but on the astonishing position that South Africa has gained in the international community in the last two years, under the leadership of that remarkable statesman, President Nelson Mandela.

Your agenda is one that has been challenging me since President Mandela asked me, a little over two years ago, to take responsibility for a Ministry which had historically been somewhat marginal to the main thrust of the apartheid state machinery, except to meet the needs of the white majority.

Because I had the fortune not to have worked in the sector before, but to come from a background of human rights and administrative and constitutional law, I have been able to bring the benefit of naiveté to the subject - and naiveté, correctly applied, is a powerful tool of analysis.

In my naiveté I asked, or rather demanded, of my new officials that they explain to me how to achieve equity in access to water in our country.

They explained that there was already equitable access to water in South Africa; there were no racial laws defining who could and could not have water; their work was to develop and manage water resources for the good of all.

How then, I asked, was it possible that in many parts of the country, tens and hundreds of thousands of people, living right in the shadow of large dams, still had to fetch water,

untreated water, from crocodile infested rivers and dam surfaces and carry it kilometres to their homes. How was it, I asked, that women and young girls balancing overfull buckets precariously on their heads remained one of the primary images of water in South Africa.

That I was told, was another matter. The job of the Department was not to provide water supply services to individuals; that was the task of local government; we were just the water resource managers, making sure that water was available to those large users who were organised enough to come and get it.

Our Tourist Board used to run a sanctions-busting campaign, inviting international visitors to come to South Africa under the slogan, "a world in one country". This is a theme to which I keep returning and once again it is apt. In the tension between the needs of today and the demands of tomorrow, in the poverty stricken communities huddled in the shadow of our great engineering achievements we, in South Africa, reflect the broader challenges faced by the water sector internationally.

The dilemma facing us is that freshwater is a limited resource for which demands are growing daily as a consequence of population growth and development. Competing demands on the resource have to be met within the confines of what is available and this can only be effectively achieved if there is an integrated approach to water resource planning and development.

The reality however is that the approach to water resource development is fragmented and piecemeal, globally, regionally, and nationally. Each of us brings examples from our own countries but internationally too, there are over a dozen multilateral agencies involved in water resource matters at the global level with little or no contact between them, each of whom thinks their answer, their approach, is the correct one, and the others' , lacking.

The temptation is to place water resource development on a pedestal, somehow removed from the challenge of meeting our peoples' immediate needs. It would be wrong to do so from two perspectives. Firstly, if we forget the children of today, how can we claim to be caring for the children of tomorrow ?

Secondly, and more pragmatically, where many people do not have access to basic services, the political pressure to respond to these needs is huge and any attempt to ignore it will marginalise the rest of your agenda, no matter how sound your logic.

In South Africa, it is precisely because we have put peoples' immediate needs first that we have gained the ethical basis to demand a long term view of sustainability. We have even enshrined this approach in our Constitution, which contains internationally pathbreaking clauses on equality and socio-economic rights, included in which is the right of all citizens to have access to sufficient water.

Against the advice of a number of experts both domestically and internationally, my Department initiated a programme to assist newly established local government to provide basic services; already we have (in just two years) brought water to nearly a million people with implementation underway to meet the basic needs of a further four and a half million. We have built an inter-Departmental coalition to promote basic sanitation and initiated a sanitation programme which is now moving into its implementation phase.

It is these basic needs programmes which have helped to mobilise the political support which has already allowed us to

- begin the implementation of a massive programme of providing community water supply and sanitation;

- gain cabinet approval for water to be priced at its resource value rather than its historic cost;

- gain broad support for a revision of our water law with the objective of managing water resources to achieve the long-term social and economic benefit of the nation rather than to protect any entrenched property rights;

- fund a massive water conservation programme that links land use with water resources while creating jobs by clearing alien vegetation;

- ratify the Southern African treaty on shared water courses.

In summary, my staff have adopted as their mission one which I commend to you as it encapsulates our desire to achieve long term sustainability while meeting our peoples' immediate needs. We are engaged in ensuring "some water, for all, for ever".

We are attempting to undo the awesome legacy of the apartheid past, both in South African and in our relations with our neighbours. We invoke not some tired cliche of a discredited past, but the simple virtue associated with a simple word: equity.

But there is no point building political consensus if we cannot give leadership. And this is a reason that I welcome the Partnership. It is an approach as needed in North America as in Africa and we should remember that although we may focus on development in the Third World, there are many lessons that we can learn from each other across the economic and geographic spectrum.

South Africa is often described, sometimes by well-meaning people, as having "first world" and "third world" components. But in fact there is only one world, within South Africa – and globally. One world in which wealth and privelege exist because of and not in spite of poverty. We must beware that our use of language does not set up brick walls between poverty and privilege, enabling each to transport itself inexorably into the future.

Instead, we need a mechanism that can promote a systematic, co-operative, approach to water resource development, that gives a voice to all stakeholders. We need a mechanism that can take us beyond the resounding declarations of New Delhi, of Dublin, of Rio de Janeiro and Delft, that can lead us from polemic to practical action. We need active, democratic, multilateralism.

This highlights what I understand to be the real agenda of the GWP. And I am pleased to learn that one of the first initiatives will be in Southern Africa where nations at vastly different

levels of development, with different resource endowments, potential and constraints, are coming together to address our common future on an equitable basis.

We should not pretend that there will not be tensions and difficulties. In Southern Africa, South Africa is perceived as a powerful and potentially dominant neighbour; our neighbours rightly fear that we may abuse our position to gain an unfair share of our region's limited water. Once again, this microcosm reflects the tensions and power dynamics on a global scale.

The Partnership offers us a vehicle through which to resolve this type of tension. But we must remember that true co-operation is only successful if the partners can work together as equals. Regrettably, the partners in the GWP are not yet equals, and it will require the stronger side to be particularly attentive to the voice of their other, and poorer, partners. There are two areas in which this is relevant.

Firstly, in the development of water resources, we must be careful to avoid simply imposing the standards of the rich world on the poor without giving due consideration to their appropriateness. Our Indian colleague M A Chitale of ICID (International Council for Irrigation and Drainage) focused with some delicacy on the problem at the recent International Conference on the Management of Urban Water Supply in Bombay when he said that:

> "because of the enormous delays in the construction schedules of the projects in hand caused by the newly raised social and environmental issues, and on account of the long winding procedures for environmental clearances involved for the new projects under planning, the storage planning of India has been completely upset in the last few years. This is bound to affect the supply side seriously in the coming decades and may cause a sudden widespread distress in a year of drought. Environmental concerns, real or imaginary, have completely overshadowed the urgent socio-economic requirements of the society."

Clearly the demands of sustainability and, as important, the legitimate expectations of people affected by water resource development projects must be met. We cannot risk our future for our present, nor vice versa. But, as I know from my experience with our augmentation projects

which we are implementing together with Lesotho, there is a small but vocal lobby which would impose near impossible conditions on such development.

There are times when it appears that vested interests in the North are using environmental issues as part of a broader protectionist agenda to hinder competition from and development in the poorer countries of the South.

The true path to success is not the Luddite rejectionism that eshews economic growth as intrinsicaly a bad thing. This is a view that can only be held by return-ticket activists, those who arrive for short periods to pontificate about policies in places where others, the wretched of the earth, must live their whole lives. Poverty is inglorious. There is no dignity - and certainly no romance - in it. We often hear that power corrupts; we must recognise that powerlessness can corrupt more, corrupt and destroy the spirit and consciousness, thus preparing the world for warlords, chauvinists and bigots.

We must abandon patronising attempts to teach the impoverished to embrace their situation rather than changing it through socio-economic development. Instead, we must place the idea of equity at the heart of governance. The idea of equity echoes the familiar ideals of redistribution, except that it does not abandon the fundamental goal of wealth creation. It seeks a better life for all by dismantling economic privelege which so often masquerades under the banner of alleged economic efficiency. Privelege and efficiency are not the same, despite the predictable attempts of the priveleged everywhere to dress their privelege in the rhetoric of efficiency. If we view, as we must, the dismantling of economic privelege as the central requirement of enhancing economic efficiency, then the false first world/ third world division everywhere collapses. The poverty of what is conveniently called the third world is structurally related to the privelege of what is self-servingly called the 'first world'.

Only when we genuinely adopt the model of equitable development within One World will we arrive at a clear view of the privelege that requires dismantling.

The developing nations now have a chance to learn from the mistakes of the developed (dare I call it the over-developed) world, and even the Asian tigers, and not create a situation where

uncontrolled development requires a massive clean-up further down the line. We have a chance to start implementing ideas of sustainable development before we destroy vast and unique areas of biodiversity that can never be recreated, never be 'rehabilitated'. Lost species are lost to us forever.

But we must also make sure that the environmental standards that are applied are appropriate to the needs of a developing nation. We have to recognise the overwhelming needs of our people for water, for food, for jobs and for houses, and we have to fulfil these needs.

The development of the so-called "first world" during a period of lax environmental standards came at the expense of the whole world - environmental degradation is no respecter of political boundaries. Swedish attempts to clean up pollution from the erstwhile Soviet Union bear testimony to this. Within countries, the principle that "polluter pays" is a familiar feature of environmental policies in dealing with enterprises. But this principle should not be confined to domestic politics; it should have also global application. The whole world, not merely the developing world, must pay for the maintenance of environmental standards in the so-called emerging markets, must pay for the protection of an environment severely degraded by the high-consumption patterns of the rich nations.

There are a variety of ways in which this can be achieved, through multilateral funding mechanisms, for instance, or by paying countries for leaving their forests intact – a suggestion that has been much discussed in relation to the problems of Amazonian and Indonesian deforestation. It can hardly be equitable that the emerging economies, having voluntarily subsidised the self-described first world during the colonial period, should again be called upon to subsidise the whole world through shouldering the major costs of environmental protection.

The Global Water Partnership, functioning as a truly democratic international organisation, could set an example to the world in the equitable sharing not only of the benefits of development, but also the costs.

But there are many forces at play in the global arena which act to limit the possibility of equity, the possibility of nations acting as equals in decision making. We must recognise that the broad arena of international relations is a contested one. Such power-plays give the lie to Fukiyama's self-congratulatory nostrum about the end of history. It will be the role of the Global Water Partnership, in this uneven terrain, to make the option for Orwell's great unwashed, to ensure that globalisation is a bottom up process, dictated by the ordinary people, by the disadvantaged and not a top down process responsive only to the dictates of corporate power.

Such contesting forces will have to be addressed on many fronts. My Department recently participated in a regional food policy conference where it became clear that one of the biggest obstacles to rational water resource management was not the unwillingness of the region's governments to adapt their approaches, but the constraints imposed on us by the developed world.

Thus we would like to remove market distortions and barriers to trade. Specifically, we would like to put more of South Africa's limited irrigated land under high value fruit crops rather than under subsidised grains; this would allow our neighbours to use their comparative resource advantage to grow food for us - a win-win strategy for the region.

Unfortunately, under the highly unequal terms of trade entrenched in the recent round of GATT and the WTO, this avenue is blocked - by European agricultural interests. They are blocking our access to their markets; so our farmers stick to grain, the barriers to our neighbours stay up and our region is the poorer. Yet at the same time, in the water sector, we are supposed to welcome the idea of partnership by opening up our services sector (one of the few growth areas in Europe but one in which we have some ambitions too, at least in our own backyard) to (mainly) European utility companies.

If we ignore issues like this, our protestations of co-operation will be a sham. I do not raise them with exaggerated expectations. My underlying theme is that water can be a leading sector; it can lead us into conflict or it can lead us into new modes of co-operation which will necessarily go beyond just the water sector. I believe that the GWP offers us an opportunity

to lead our stakeholders in a direction that is not just environmentally sustainable but also equitable.

There can be no development without water. The Global Water Partnership must provide leadership in the dangerous tensions and conflicts that will arise around access to water in the future. It must take the lead in updating international water law according to the principle of equity, not prior appropriation of resources.

Given our diverse backgrounds and interests, I must say that if we are not able to address equity as well as sustainability, the partnership will be dead before it even begins. That places heavy responsibilities on us all; It places responsibility on the members from developing nations not to whine or deny that there are many cases in which fingers are justifiably pointed. But it equally means that "First world" agencies must be flexible - as indeed they would be if called on to address a crisis in their own country and remember, the need for development is a crisis, one which, if not properly dealt with, threatens the very future of our world community. They must also recognise that the policies of their countries and institutions are at times inimical to the kind of co-operation we seek and that they must be willing to make common cause in demanding policy reform.

And finally, the very notion of a partnership, a true partnership, around such an important resource, requires an open and inclusive approach to other international organisations working in the same field. We must all pull together.

Chairperson, delegates, these are heavy demands which we place upon ourselves but I am confident that our common concern as custodians of what is truly the lifeblood of our world will drive us. I am confident that we agree that we cannot forget the children of today yet claim to be caring for the children of tomorrow.

In short, we can ensure that there will be some, for all, for ever. I look forward to working together to achieve that goal.

[ends]

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There is a Tide

Opening remarks
by
Ismail Serageldin
at
the founding meeting of the
Global Water Partnership
Stockholm
August 9, 1996

Friends,

We are gathered here to take a step, an important step, in addressing the most critical issue facing us and our children today: the use, misuse and abuse of water resources.

I know that you fully understand the nature and complexity of the water issues.
I know that you believe that we must do better.
I know that you are committed to do so, otherwise you would not be here.

But what I want to share with you now, is the sense of urgency that we must have in bringing about what is truly a paradigm shift in the way water resources are managed and investments in that all important sector are conceived. We must overcome the fragmentation that pervades this field, internationally, nationally and regionally. We must translate the accepted consensus into reality. That is why we need this Global Water Partnership... This inclusive, reinforced network of the concerned, this coalition of the caring, to bring a holistic approach to the reality of water resource management.

As we advance in today's discussions it will be essential to make one's contributions positively, in shaping the Global Water Partnership, its mission, priorities and governance structure in a way that will enable it to reach its lofty promise, and to make each of us feel comfortable with what we will leave with at the end of this day.

I know, perhaps better than most, that these are exceptionally difficult times for launching international collaborative efforts. I know that it is difficult for many to make the necessary commitment to stay the course together. It is always easier to block agreement or to go it alone. It is never easy to reach a consensus between so many differing views on priorities and preferences for different modes of action. But these are really differences at the margin. On the heart of the matter there is profound agreement, and during our discussions today, I urge you all to make that marginal concession in order to bring out more forcefully the common ground. The common human enterprise is best served by all of us coalescing around a common purpose, finding and building on that common ground. We need this today more than ever, for we have an enormous environmental and developmental agenda ahead of us...

For there is a tide out there ...

There is a tide ...
There is a tide of humanity,
a population growing and multiplying
in the remotest corners of this vast world,

Millions of young people demanding a right to a decent life,
a life without fear or despair,
a chance to break free of the misery of poverty...
That tide, that unstoppable tide of human ambition will not be denied...

And if it is, then it will be a tide of anger, of hate, of violence, that will engulf all before it and consume us all in its fiery embrace of rejected present and a foregone tomorrow.

There is a tide ..
A Tide of suffering,
Of Children malnourished, stunted, deprived,
haunt our television screens and our dreams..
fellow human beings ..
Left to their fate...
While a new class of rich consumers discuss the prices of everything and the value of nothing...

There is a tide of pollution
from our cities and our factories
that destroys our rivers,
from the industrial waste in the Nile
to the human waste in the slums...

...A tide of destructive chemicals that leaches into the groundwater and in the food we eat...

There is a tide of ignorance and greed
that ravages the trees and destroys our groundwater..

But also...
There is a tide of new awareness...

A tide of awareness that water is the key to life, and that we must make sure that all have the same basic rights to access this precious and scarce resource...

A tide of awareness that the rights of women, minorities, the weak and the poor are indivisible from our own...

There is a tide of awareness that the past practices of wasteful, unsustainable development cannot be accepted, for they will surely bring misery and wretchedness on our selves and our children..

There is a vista of possibilities
where the scope of our achievements is bounded only by our imagination and constrained only by our determination to succeed.

Yes...there is a tide in the affairs of Men
which taken at the flood leads on to fortune ...

Fortune, not just in terms of more economic growth,
although that, too, can be accommodated...
Fortune, not in terms of accumulation of dollars in national or foreign bank accounts..

but fortune in terms of true well-being.

Fortune in terms of quality of life.
Fortune in terms of the satisfaction of doing what is right.

Fortune in terms of leaving for our children,
and our children's children, a better world.

Yes ...
There is a tide that leads on to fortune.

Omitted, all the voyage of their lives
is bound in shallows and in miseries ...

If we fail in bringing about this change in the way people think about water...

If we fail to persuade our colleagues in governments, the media, the universities, the streets of our cities and the fields of our countryside...

If we fail to convince,

If we fail to go beyond the exhortation to do good...

Then the poor among us will indeed suffer, the world will indeed be poorer and future generations will pay the price of our failure to act...

Then our future will indeed be bound in shallows and in miseries ..

On such a full sea are we now afloat, and we must take the current when it serves or lose our ventures

The sea is indeed full, it is full of threats, and full of promise.

We have the opportunity not just to navigate this sea, but in fact to show the way towards a more responsible relationship with each other and with the world, to show how development can be indeed equitable and sustainable.

This is the vision of a new future, a new paradigm, where the centrality of water is fully reflected in our design for better tomorrows...

A vision that is people-centered and gender-conscious. That seeks equity for all and empowerment of the weak and the vulnerable everywhere - so that they may be the producers of their own welfare and bounty, not the recipients of charity or aid.

A vision that places short-term actions within the long-term framework.

A vision that is environmentally sustainable, that will leave future generations as much if not more than what we found ourselves, that will husband the resources of this fragile planet just as we learn to use its bounty.

And the time to forge this partnership is now. We cannot delay..

For there is a tide out there ...

a tide in the Affairs of Men...
Which taken at the flood leads on to fortune.

Omitted, all the voyage of their lives
is bound in shallows and in miseries.
On such a full sea are we now afloat
and we must take the current when it serves
or lose our ventures.

Let us not lose our ventures..

Let us create the Global Water Partnership with shared ideals and common purpose, as the platform, the reinforced network of those engaged with water projects everywhere..

Let us today move forward with determination to succeed.

Yes! We have the opportunity to change the way people relate to water, to each other and to the world around them.

We cannot afford to let this opportunity escape us - either by commission or omission.

We must convince ourselves and convince the world at large

It can be done, it must be done, it will be done.

Stockholm Water Symposium, 1996

Empowering Communities - Challenges for Technical Communicators

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1. Introduction

The Cooperative Research Centre for Freshwater Ecology is a research organisation of around 150 people working on rivers, storages, wetlands and floodplains in rural and urban Australia, largely in the South-East part of the continent. It is an unusual organisation in that it is a collaboration between the researchers who produce knowledge, and the management agencies who are users of knowledge. We have recently undertaken a strategic planning exercise, and come to the view that in the long haul our success would be judged by whether we had improved the condition of the waters of Australia. This is a surprising vision for a research organisation. The researchers initially saw success in terms of contributions to science and the numbers of papers published. It was the management partners who said the science did not add value to Australia unless we made a difference on the ground and improved the condition of our waters. The partnership between the providers and the users of knowledge has a powerful potential.

Australia has just released its first National State of the Environment Report. This report showed that excess clearing of vegetation for agriculture, and the over exploitation of that land had led to significant loss of biodiversity and to extensive and possibly irreversible land degradation. The catchment activities led to serious problems in the condition of waterways. These degraded waterways caused obvious impacts on coastal waters. These interconnections had not been this obvious in public documents in Australia before this report.

The symptoms of degradation we commonly observe in waterways are:

- rising salinity,
- inadequate flow,
- increased turbidity,
- loss of native fish and other aquatic organisms,
- infestations with exotic fish, other animals and plants,
- algal blooms - especially toxic cyanobacterial blooms,
- loss of significant wetlands.

These symptoms reflect issues that are causing major economic dislocation. Farmers are going out of business and rural towns are shrinking, partly as a result of land and water degradation. In large areas of Western Australia all surface waters are salt affected. Some 15% of the Western Australian wheat belt has been lost to salinity in the last 20 years and a further 15% is expected to be lost over the next 30 years. Similar consequent economic impacts of land degradation can be seen in most Australian States. There are also regions where farmers have learned to modify their practices and farm these impacted areas. These lessons need to be transferred to the wider rural community.

The factors causing these various symptoms are many and varied, but many are quite well understood, even though they are difficult to remedy eg.

- Blockage of rivers with dams and weirs preventing the upstream migration of native fish, and causing impoundments which are ideal for algal growth. The release from dams of cold, poor quality water that impacts rivers for up to 300km.

- Excessive clearing of catchments leading to both soil erosion and rising groundwater, which is often saline. Clearing of riparian vegetation leading to direct impacts on waterways, as well as loss of buffer strips.

- Excessive extraction of water for irrigation, and subsequent mis-use of that water leading to rising water tables and saline and nutrient rich return flows.

Despite these failures of Australian land management, there are encouraging signs. One of them is the control being taken by local groups through the Landcare movement. Another is the recognition that where we have been successful in dealing with these issues it has been where we have looked at the whole catchment and the whole system rather than attempting to treat symptoms in isolation.

2. Some Understanding of Learning

Many of these problems have been caused by greed and ignorance. We cannot do much about greed except expose it to public and government scrutiny. We need to appreciate that many ill-considered Government decisions in the past have put landholders in a difficult economic environment. We can do something about ignorance, and that is the theme of much of this paper.

There are three essential elements in changing the behaviour of landholders, which is the fundamental requirement in addressing the degradation problems of Australian catchments. The first is knowledge of how to manage land better in the Australian context; the second is to communicate that knowledge and the third is to modify values to ensure that people move to more sustainable agricultural practices.

We have a growing knowledge about adult learning. We now understand that people can learn things by rote - where they can repeat things with little understanding or ability to apply the concepts (called "shallow learning"). In contrast, "deep learning" occurs when people process the concept and put it into their own language and apply it to problems they are familiar with. So teaching is much more than just presenting material. If deep learning is to take place there needs to be a dialogue where the learners process and attempt to apply the material, identify and correct errors and test their understanding. This can be done with a teacher, but it is often more successful, and less threatening with peers.

Social psychologists have suggested that the same sort of dialogue may be important in reordering values for an individual. We all hold various value sets, some of which may be in internal conflict. The wish to maximise short term income and the wish to sustain the land base are good examples. Many people hold both values strongly. In some situations the values are in conflict which can lead to considerable personal stress. Dialogue gives people time to process the values and establish a value priority in the context of a particular situation. It is widely used in rural communities for making decisions about farming practices amongst family members. When the dialogue is done with neighbours and peers, considerable group pressure can arise. The group itself can provide significant status rewards in terms of recognition that reinforces the values and the learning.

Someone needs to lead and facilitate this learning process. The landcare system provides for funding of landcare coordinators who are external to the local social structure. The most successful ones appear to be young, female and urban, and clearly learning on the job. They are not expected to be a repository of all knowledge; they are expected to be able to find things out and communicate with the locals. There is no authority structure in this learning environment. If expert advice is needed it is best achieved by inviting the expert onto a particular farm and discussing the issue in the local context.

3. The Landcare Movement in Australia

Landcare involves local communities banding together to solve problems, often with the support and assistance of the various government agencies. A community landcare group is a voluntary organisation of local community members dedicated to combating land degradation, protecting wildlife and managing the land in a responsible way. It involves neighbours working together to tackle common problems of concern. It recognises that water, rabbits and other degrading factors do not recognise farm boundaries. Landcare groups are significant in that they draw upon common and pre-existing social values and networks, and yet empower the individual to action (Cock, 1992). They allow the development and articulation of a new land management ethic, but also provide a framework through which government support and expertise can be made available in a cost-effective manner compared to previous extension models.

Landcare has demonstrated the power of community groups to provide an integrated approach to a problem and get solutions adopted. This has involved genuine public ownership of a problem and real public based decision making - not just an opportunity to participate or even be involved with someone else's decision making,

This has been a quite remarkable development. The pressures on farmers might well have inhibited an open sharing of community problems. The possible impact on land prices, and the risk to the farmers' reputations as a "good farmer" have not however stopped the development of Landcare (Stone, 1992).

3.1 Community land management plans

An example of effective Landcare operations will be given from the Granite Creeks: A Strathbogie Ranges Landcare project published in 1994. This is in the State of Victoria in South-eastern Australia. It is given as an indicative example. The landcare management committee comprised 12 local people, and was supported by government agencies and other groups. This exercise involved six separate landcare groups and covers 664 individual farm properties. It covers an area of 95,500 ha, mainly used for grazing and has a rainfall ranging from 600 mm to 1200 mm. Extensive clearing for agriculture early this century led to gully and stream erosion from the increased runoff. The invasion by rabbits and other vermin, weed invasion, tree decline and increasing acidity of soils are some of the challenges threatening the viability of this rural community. Not only are these processes degrading the land, but they have led to serious deterioration in water quality in the streams.

The landcare groups have been active for some time, and in the period 1991-3 they treated 12.9 km of eroding gullies, fenced 23 km of riparian areas, planted 25,000 trees and undertook various rabbit control programs. The area was subject to a major bushfire in 1990 and major floods in 1992. The planning identified five interlinked programs:

- rabbit eradication

- tree and understorey establishment
- pasture establishment and maintenance
- weed and vermin control
- creek and gully stabilisation

The total costs of implementing the various programs comes to $15 million, with landholders contributing slightly over half of this amount. The remainder will come from sponsorship and government grants.

This example shows the power of community based decision making. It involves the following elements:

- Understanding of the resource base
- Agreeing on the critical issues
- Identifying and comparing options for dealing with the issues, using information from a variety of sources.
- Choosing a course of action
- Doing all of the above in an inclusive way so participants own the process and the findings
- Implementing the plan in a cooperative way using private and public resources

3.2 Community nutrient management plans

Toxic cyanobacterial blooms have been a major problem in Australia in recent years. An algal management strategy across the Murray-Darling Basin was developed that required, amongst other actions, the reduction of nutrient inflows to rivers. This is to be achieved by community based catchment plans that identify how each catchment can reduce its nutrient inflows (point and non-point) to the basin. This is generally done by considering loads (mass transport/unit time) rather than simply concentrations. An assessment was made of actual phosphorus loads at various nodes within the basin, and a modified OECD-Vollenweider model used to estimate sustainable loads that would keep chlorophyll levels below 10 ug/l over the summer period. This approach was used to set target loads for each catchment on an equitable and transparent manner.

The local community groups then developed nutrient management plans to achieve these targets. Different approaches were used, but basically the load arising from different land uses and from different land management strategies was estimated, and point source options modelled directly to identify loads that would come from the catchment following various interventions. Obviously the link between a management change and the change in load is somewhat speculative, but the community groups were quite happy to accept best judgment linkages. It is also not easy to determine a "magic" number that must be achieved, and economic and equity issues were important to community groups in selecting appropriate load targets for sub catchments. There is considerable effort going in to trying to determine best management practice for agricultural lands.

These approaches may not allocate funds in the most economically efficient way. They are based on the assumption that everyone contributes to the problem, and all must own the problem and change behaviour if they are to make a difference. The economist might argue it is more appropriate to focus resources to high problem areas. In an economic sense this is correct. But it leads to communities blaming other communities for the problem rather than accepting they must

change their practices. This community education and inclusiveness is a critical part of the Australian experiment in "bottom up" land management.

4. The Role of Science

The CRC for Freshwater Ecology is one of the major providers of knowledge in this system. We seek effective mechanisms to get scientific input into these participatory processes to ensure that communities make the best decisions possible that lead to better land and water management. We are dealing with complex ecosystems, even though we simplify them as they degrade. Our predictive models are poor and time is a variable we have not properly understood in an ecosystem context. The existing data base is often poor, and at times inconsistent and misleading.

4.1 Barriers to effective scientific input

The knowledge providers from research have to re-examine how new findings can be got out to the rural community. No longer can agricultural experimental stations be relied upon to test and demonstrate new approaches, since Governments have withdrawn resources from such establishments over the last decade. These demonstrations will be done with lead farmers. There remains a challenge of getting highly technical information presented in a form that it can used effectively by community groups.

There are a number of difficulties in providing helpful scientific input to these community processes.

- we deal with complex ecosystems which might take up to 50 years to show a response to some human intervention,
- we deal with highly variable ecosystems driven by highly variable rainfall patterns,
- demonstrating causality between an intervention and an outcome is often difficult,
- science advances by disagreement - yet when this disagreement spills into the public arena it can be damaging to the communications process,
- organisational arrangements often do not provide appropriate bargaining arenas for resolving views with agencies becoming advocates of particular fashionable views of the day,
- farmers may not have the resources to do what should be done.

These are of course not new problems. Australia once had an extensive top-down agricultural extension model which has now been dismantled by Governments as it was seen as ineffective. It was effective in getting information through to the innovative farmers, but less effective in communicating with others. Other farmers tend to take leadership from economically successful farmers. These are often not the innovators, but more commonly the early adopters of new practices.

4.2 The usefulness of science

There has been little scientific study into the usefulness of science in natural resource management. Some early work looked at the scientific inputs to coastal planning in California where the scientific input was seen as useful, but not crucial (Cullen, 1990). The reasons for this are as follows:

- Scientists often do not recognise the clients needs

- Scientific experts are often seen to be wrong,
- Scientific experts are often contradictory,
- Scientists often take on the philosophy of the agency that employs them,
- Most scientists err on side of caution,
- Many issues are not related to science but to values,
- Most ecosystems are so dynamic that prediction is very questionable,
- Non-scientific information is often more persuasively argued.
- Scientists often have poor communication skills.

4.3 Delivering effective scientific advice

Experiences on a range of Advisory Committees where I have attempted to provide scientific input to community groups has led to the following understandings of this process.

- It takes time to build trust with the community representatives who are wary of outside experts.

- One's greatest influence is in setting the agenda by asking for reports or data on particular aspects. Asking questions is often a powerful contribution.

- Community representatives can handle uncertainty and probability and will demand that the scientist treat them in a mature way and help them make value judgments.

- Field visits are especially important in allowing the scientists to demonstrate the critical need and value of local information. This overcomes the power problem when the "powerful" expert becomes dependent on locals for information. This is helpful in building a relationship between the outside expert and the local group.

There is an interesting tension developing here in the form of technical advice. Agencies are now heavily into performance assessment, and see as crucial that every project ends up with some products that can be neatly packaged and distributed to potential users. On the other hand involving the community in the research as it is carried out can involve progressive learning as understanding as results come in and are discussed.

4.4 Building community capacity to understand technical information

These empowered community groups no longer wait for experts from various government agencies to come and tell them what should be done. They now have a healthy distrust for technical expertise, and will seek to test it against other technical advisers and against the realities of what they see in the landscape. These groups are taking responsibility for gathering the information they need, and they do this by talking with a variety of technical experts, reading more widely and visiting other community groups to share experiences and see what has worked in other settings.

Many community groups have well informed and educated members. It is often useful to help build the capacity of these people to understand the specialist technical advice. They have peer credibility, and can see the application of the knowledge in a local setting. If such people do not accept the information being provided, it is difficult to make progress. Consequently it is valuable to spend time with these influential members and help them to understand the basic scientific processes and issues.

4.5 Using scientists to transmit information

Research funding bodies in Australia are caught up in a fashion that researchers should be responsible for the extension of the information to users. Some scientists are outstanding communicators to lay groups and can perform this work very effectively. Whether it is the best use of their time is another issue. Other scientists are most uncomfortable with the simplifications and generalisations involved in this technology transfer, and do not do it well. They may well set back or sabotage the adoption process because of their lack of communication skill and failure to understand the context of the recipient of the information.

The best situations exist where the community groups or landholders assist with the research and feel an ownership of the results. In these situations it is important to explain progressively during the research exercise the results that come in, and their implications, rather than trying to present an overview after the project has finished.

4.6 The role of professional communicators

A number of groups in land and water research employ professional communicators to help them get scientific insights to the agencies and the community groups who might use the information. These people are important for the following reasons:

- they see communication as the core business rather than something to be tagged on at the end if the time and energy is sufficient.
- they argue for budgets for the communication elements.
- they are able to allocate resources in a strategic way to important communication opportunities, rather than be simply opportunistic.
- they are able to bring a professionalism to media liaison that makes media exposure easier and better.
- they sensitise research staff to opportunities and the need to communicate their work to wider audiences.

5. Summary and Conclusions

The landcare movement in Australia has been a total revolution, with community groups now beginning to own the problems of land and water management and taking responsibility for rectifying them. New ways of providing technical information in this emerging "bottom up" model are being developed. These models are grounded in our improved understanding of adult learning. These require information to be provided in a form that provokes dialogue to enable the recipients to process the information and to test it in the context of their own district and particular situations. It requires a facilitator who helps landholders find out rather than an expert who is seen to know all the answers.

Research organisations need to develop ways to make new knowledge accessible to these facilitators and community groups. Some of this can be done through mass media, but much is done through articles in semi-technical press and speaking to landholder groups. Who should do this "extension" activity is an unresolved question.

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MOVING TOWARDS A NEW WATER RESOURCES AGENDA:

A CALL FOR A LAND-WATER STRATEGY ENABLING CLEAN AND MOIST DEVELOPMENT

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Your Majesty
Excellencies and
Dear young,
and less young, colleagues....

During this week an avalanche of quantitative data has, as previous years, once again convinced us of the frightening challenge that stands before our feet:

how to reverse the rapid deterioration of our limited and finite land and water resourc in a situation of unavoidably increasing pressure ~~*on water and land*~~, due to growing demand from us humans. We are aware today of the fact that if water withdrawals continue at present rate we will hit the estimated ceiling for realistic water withdrawal in the early or mid 21st century.

But at the same time there exists some hopeful contrasts to this gloomy picture. First, there is a growing awareness of the problems, and a manifested will to act

Examples can be seen in Agenda 21 ~~and the efforts of developing national and local action plans~~; and initiatives like the Global Water Partnership and the Global Freshwater Assessment.

Moreover we often have access both to appropriate ~~and sustainable~~ technology and knowledge, and the diagnostic information to answer the Where's, Why's, and What's.

Secondly, it seems as if we are in a phase of conceptual development, perhaps even a paradigm shift, going from a sectorised research, development and management structure, towards an hydro-societal arena characterised by integrated approaches, where water through its linkages to basically all human activities in the landscape, is given the role it deserves.

The question is then, why does it still go wrong ? Why are we, despite all the scientific data and technological knowledge, not able to implement ~~sustainable~~ solutions to assure a qualitatively-*clean* and a quantitatively-*moist* development?

The position taken in this speech is that a major part of the answer is found in our incapacity of going from knowing to doing, which in turn is caused by a number of structural and perceptional barriers and mismatches. How to overcome these barriers is a great challenge for researchers (both young and senior...), policy-makers, managers and society in large.

My objective here is to present some thoughts, evolved from the very creative work with the Young Scientist Workshops during two Stockholm Water Symposia, on possible ways of overcoming some of the, from my point of view, most important barriers.

Ecorealism

"We need to get realistic"...as Sandra Postel stated in her plenary speech at the 1995 Stockholm Water Symposium (Postel, 1995),

Water scarcity poses limits to societal development and we cannot escape from the integrity of the water cycle. We can only manipulate with its flows, leading unavoidably to rule effects and competition. PRIORITY SETTING

What we have to avoid is that ecohydrological considerations keep on getting side-stepped by strong political will, too often driven by short-sighted egoism.

By adopting a diagnosis, that takes into account the different forms of ecologically, climatically and human induced water scarcity, and the division of water into its "blue" and "green" water flows, a more rigorous basis for decision-making would be possible;

"Green" water stored in the soil being a precondition for all biomass production, and "blue" water being the source for industrial and household withdrawal, and withdrawals for irrigation.

Ecorealism also means accepting a level of pragmatism. IFPRIs latest ~~world food security~~ assessment indicate that between 700-800 million

people are presently undernourished, almost 1 billion. A majority of these people are farmers living in rural regions, predominantly in dry tropical regions, where water scarcity is a constraint, present in everyday life

The aim should be to focus on how to find water use efficient, on-site developed solutions, as a first priority, and then consider spatially more large scale solutions, like dam and channel constructions, which might be unavoidable if no alternatives exist.

DEV. OLD SOLUTIONS TO NEW PROBLEMS

Rhetoric to real integration

Integration, between scientific disciplines (in multi- and/or interdisciplinary approaches) and between academia and other institutions in society, is often presented as a panacea ~~to sustainable~~ water resources management (Rockström and Forsberg, 1995). But seldom does rhetoric outlines turn into action, and seldom is integration really discussed in terms of how far integration should go, and what effects integration would have on for example academic structures.

It has been thoroughly explored, not least at these symposia, and broadly acknowledged; that there exists an extensive water blindness and deafness, originating from a deeply rooted land/water dichotomy.

The fragmented scene of action

What is interesting is that it is not so difficult to find some rhetoric evidence of a basis for sound land- and water integration; like for example in the water chapter (18) in Agenda 21 Stockholm Johan Holmberg

The problem is that the abstract and mostly inoffensive recommendations seldom attacks the real hot spots. The negotiators of conventions are diplomats and the ratification is done by politicians, who focus primarily

on finding "consensus" based recommendations on "visible" problems, which equals "politically correct" problems, or "vote attracting" issues which converge with the prevailing mentality of "OK, as long as it doesn't hit my back yard". Simplistic concepts dominate, which avoid invisible complex issues like multi-cause water scarcity including for example soil desiccation, upstream/downstream interactions, and human-induced overland flow of water.

Moreover conventions are useless if accumulating dust on shelves of high politicians ~~or diplomats~~. They have to be given a face on a regional and local level. If management structures at these levels are divided and isolated in vertical structures, then integration will stay rhetoric.

→ VERY ENCOURAGING PRES. (GWP)

Intellectual and cultural arrogance and indifference

Shift in social paradigm

Drastic change in household, industrial and agricultural water use is an absolute necessity. No convention in the world, however well written, can in itself do the job. There is a need of a social shift in lifestyles, through the development of norms, values and ethics that are founded on sound eco-centrism and not as today on ego-centrism.

This is a challenge also for our democratic system. How shall we be able to implement changes that will hurt, in economic term and in terms of life-comfort, in societies that are ruled by governments that can be overthrown in elections every 3-5 years? Well the answer is simple; through public pressure = to awareness...but the way to succeed is long and tough; through education....

The need of intellectual hydro-pipelines

We do not have time though, to wait for a new enlightened generation of hydrologically redeemed. Perhaps we should ask ourselves more often, who these famous policy-makers, decisions makers, and politicians, whom scientists so often overthrow with criticism and responsibilities, actually are, and should be in the future?

The scientific community perhaps has a moral responsibility to play a more active role in establishing bridges between science and governance. What we need is the construction of rigorous intellectual hydro-pipelines permitting high pressure flow from knowing to doing, and reciproque from the "real world" to the academic world. This in contrast to the often prevailing passive and reactive role, focusing on problem identification and monitoring.

YS's should participate in this pipeline construction, trying to (1) find ways to make politicians listen...by branching on to political arenas and (2) by trying to give our voice a weight (so often only attributed to well established seniors...), by making clear that we are not only often the ones having the "up to date" field experience but also represent the tap users of tomorrow...

- We would propose the establishement of Water extension services, perhaps branched to universities, which would have the role of converting scientific results to comprehensive information for water-users.

At these academic pumpstations, functioning as knowledge sprinklers irrigating society, perhaps scientists could be obliged to serve during bridging sabbaticles...

Arrogance

Cultural and intellectual arrogance is probably a major, in general underestimated, barrier. This includes not only the mutual contempt between scientists and politicians, but also an arrogance from the predominantly temperate North vis à vis the predominantly tropical South. "We, who call ourselves professionals, are much of the problem" as Robert Chambers has stated. So-called experts from the North have transferred scientific and technological knowledge, often as "Expert tourists".... behind ~~car-windows~~ in airconditioned 4-wheel drives...without even trying to discover the knowledge systems, indigenous traditions or the hydroclimatic constraints in recipient communities.

OH

Ohsss

Take for example the perhaps now familiar "Beauty on Water"....
OH 1 - Stadshuset
in a country on the top 10 list of UN's HDI.... with 514 mm of annual rainfall

in contrast to the region where 8 of the bottom 10 of UN's list comes from:
OH 2 - The Sahel,
with in this case, 560 mm of annual rainfall, in Niger...

Stockholm

The trick is of course that OH 3 ~~Sweden~~ has only around 500 mm of PET....

Crop yields of around 6-7 tons per hectare...

...compared to OH 4 the Sahel with more than 2000 mm of PET...and around 300-600 kg/ha

In temperate Sweden OH 5 we have developed a yield maximizing system compared to OH 6 the semi-arid tropics with a risk minimizing strategy.....

Both systems have through millennia developed hydroclimatically adapted and very sophisticated techniques to assure best possible performance.

there are few problems in these landscape, only radically differenct conditions possibilities and conditions; Roseores...

OASES.

→ ON-STATION ← well renomated Anglophone journal. Prob of course;

Things are changing, but far to slowly, as Dr Martin Holdgate, former director general of the IUCN, concluded at the Royal Colloquium on Coastal Zone Management 1994, initiated by Your Majesty. Most rural communities in the developing world have a evolutionary lead of some 3-5000 years over us, during which a lot of ecohydrologically adapted techniques and practices have developed.

These should be exploited, and after two decades dominated by development failures, especially in sub-Saharan Africa, we also start realising that there exists *no such thing as "Free lunches"*, rapid "leap frogging" solutions. We know this today but a lot of cultural awareness is

still needed before we attain a, as I see it, important goal, namely to never launch a new development project without learning from local experience, always questioning our own values and being self-critically aware.

Food and water - are we focusing on the wrong water?

A domain where simplistic diagnosis, and where a tendency of escaping fundamental land/water linkages, has dominated, is the extremely urgent issue of world food security.

Efforts have been demand oriented and focused on transfer of ~~mechanised agricultural packages~~ technol.

Rural development has had low priority in aid budgets, except for cash-crops and the construction of large-scale irrigation schemes.

Trade, with food produced in water-rich regions and transported to water-scarce regions, is often presented as a possible solution to some of the food-security problems;

But before drawing such conclusions it might be motivated to acknowledge that the question of why there is an agricultural crisis in many African countries is not well understood. This can be explained partially by the following:

- Little attention has been given to the analysis of driving forces behind decline in agricultural productivity,

- Only 2.5 % of the crop land in Sub-Saharan Africa is irrigated, which means that rainfed agriculture will for a foreseeable future supply the bulk of foods for expanding populations.
- The large majority of rural poor are subsistence farmers, with small or no alternative sources of income
- Soil/water linkages are poorly understood, ~~especially factors determ~~ining the partitioning between ~~productive and non-productive waterflows~~ in ~~biomass production.~~
- Water scarcity in agriculture, as seen from the slides, especially in the tropics, is often only seen as a question of poor annual rainfall,

Research carried out by our department (NRMI) and by colleagues at ICRISAT and the French research ~~institute~~ ORSTOM in the semi-arid Sahel region, points out clearly that (i) there is a large potential of increasing staple crop yields ~~like pearl millet and sorghum~~, through relatively simple measures of nutrient and water management, and that (ii) there are very large losses of non-productive water flows,

and nutrient management.

More efficient water use, ~~integrated~~ with an intelligent mix of organic and ~~inorganic soil fertility management, c~~ould probably increase yields during ~~non-drought years~~ with 50 %, ~~and still avoid total crop failures during~~ years with ~~periods of droughts~~. This would for Sub-Saharan Africa result in a increase in cereal production ~~for millet, sorghum and maiz~~e (the by far dominating cereals) with 21 million tons , which could be compared with IFPRIs total estimated import need year 2025 ~~for Sub-Saharan Africa~~ of 27 million tons.

What does "Blue" water data really tell us?

This rather optimistic view, focusing on rain use efficiency, points out the limited usefulness of present data on water withdrawals in agriculture,

which is based only on gross availability of "Blue" water which is equal to irrigation water

Based on this data agriculture withdraws, I suppose now familiar figure of 69 % of the water resource globally, a figure that exceeds 80 % for tropical developing countries, indicating the limited possibility of increasing agricultural water use (Gleick, 1993). Even worse, it is in general agreed that agriculture will have to diminish water use, in favour for unavoidable increases in water consumption by industry and households.

Is this actually a correct analysis? It is true that water demand by crops, results in a need of 1000 - 6000 m3 of water (ET) per ton grain yield (100-600 mm/ton/ha). But "blue" water withdrawals represents only a very small proportion of total water use in agriculture.

Does this mean that we are putting too much focus on the wrong water? Our present work indicates that this might be the case, which means that we should try to shift from the strong emphasis on downstream "blue", stable aquifer or river flow potentially accessible for irrigation development, to efficient use of upstream rainfall in order to maximise "green" water storage. This can of course include irrigation - through the capturing of "blue" surface flows for small-scale protective irrigation.

The role of scientists

On Papua New Guinea (PNG) there exists an extraordinary number of different ethnic tribes, with an estimated 270 languages, on a population of around 4 million people. A very steep, and thus well protected and for all work and transport very exhausting tropical landscape, has through millennia resulted in total isolation of small communities, which have

developed there own language, traditions and technical skills. The only time they were confronted, peacefully, with neighbouring tribes was to exchange goods, especially salt, an indispensable good for the inlanders. This trade, carried out thanks to a clear mutual benefit took place at the top of the hills, or on the hydrological dividing line, between different valleys/watersheds.

Even though these communities represent an agrarian system corresponding to medieval time in for example Europe, there exists some interesting similarities with our present modern scientific community.

Unesco statistical yearbook learns us that in 1995 there were some 3.3 million researchers and engineers engaged in research and experimental development, in Europe and North America (Unesco, 1995). This population, slightly lower than PNG, is divided into an impressive number of scientific disciplines. As an example from Sweden, there are some 300 scientific disciplines within the classical faculties, defined as research areas where you can carry out PhD-studies, which means that the research area is headed by at least one senior Professor (excluding the Technical faculty and the polytechnic schools with around 200 disciplines). A figure which corresponds quite well with the number as languages in PNG.

Academia has also, perhaps with the 10000-year old tribal structure serving as a model, created its small fragmented and isolated islands, with its own ethics, language, status symbols, legendary gods, and of course special arenas of excellence, like excellently ~~well~~ organised symposiums with special intricate rituals, attended only by honoured tribe members, both young and old though in certain enlightened tribes....

and a large number of distinguished international journals, read only by the members of the same tribe, peer reviewed by respected elders, and completely incomprehensible for other neighbouring tribes, not to speak of the low-respected, in general waterblind, "normal-peoples" tribe.

Oh yes there are some peaceful confrontations between tribes on the fringes of the tribal frontiers; when it comes to research-financing, or when it comes to attacking the only common enemy; the politicians. There was an extraordinary French TV emission some year ago, where a Papua-New-Guinean tribe met a white man for the first time ever. If there still exist scientific disciplines that never have been confronted with sister sciences I do not know, but one is allowed to speculate.

Evidently the PNG comparison might be a slight exaggeration, but still, the reality is such that the vertical and conservative scientific structures, hinder constructive dialogue and research that crosses discipline boarders. Efforts have to be undertaken to enable multi-disciplinary task force research that accepts individual deep digging research into one or a few slices of reality, but that also guarantees tight cohesion between research efforts on remaining slices, forming a complete diagnosis of different Man-Landscape related research topics.

Imagine the main branch of the intellectual hydro-pipeline mentioned earlier, being supplied by a multi-source including different scientific sub-basins, connected through secondary-pipe branches, in clusters of excellence.

The challenge here is to promote basic knowledge over discipline frontiers, in order to make possible a common language, and also to promote young scientists interested in inter-disciplinary research.

So the conclusion is that there is some plumbing work to be done.

Base promotion criteria and research funding more on:
- the practical applicability of the research (e.g. CSIRO Australia)
- bridging efforts between disciplines and between universities and society

The vision is to fill up the deep canyons between scientific disciplines, why not with water, that actually quite naturally flows in an intricate web between and within basically all both social and natural sciences. What we need to start off with is some common navigation knowledge, the use of one chart, and a compass course pointing in the same, hopefully moist and clean direction.