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CONFERENCES AND COMMUNICATIONS

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VOLUME 3

CONFERENCES AND COMMUNICATIONS

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1. REGIONAL WATER PLANNING IN AN ARID COUNTRY.

1.1. EXPOSE BY MR. HARIRI.

In his exposé, in the course of which he comments the document given to the participants, Mr. HARIRI makes a series of observations and recommendations, notably :

a) On dams.

It is easy to build dams in a relatively short time but the good use of water demands a lot of time and training. The lack of these elements has led to a lot of errors.
In arid countries, it is an error to give priority to hydroelectrical energy production for such projects can have dangerous long-term consequences.
In regions of feeble plant cover, the consequences of alluviation are catastrophic : the life span of big dams is limited to 15 or 20 years. If the alluvium is removed, which is the only solution, one does not know where to stock.
As for hydrological basin management, this is difficult and produces only long-term effects.

b) On geological and hydrometeorological restrictions.

In Iran, the existence of salt beds and salt domes raises the question of conceiving technical means for preserving the water from salinity.
The problem of paliating the unequal distribution of water also arises.

c) On iranian institutions.

Water problems are practically the responsibility of one Ministry, which is that of Water, now a part of the Energy Ministry.
However, water supplies, no longer managed by the municipalities, are now managed by the Ministry of Industry. This measure was justified by the precariousness of munucipal resources and management methods.
Regional Agencies have been created. Their division is in accordance with the natural water limits. The se Agencies function like commercial establishments, but in recent years, the lack of personnel has made them incapable of competing with the private sector. There is however hope of overcoming this difficulty by giving more power to the regional authorities.

In conclusion, Mr. HARIRI feels that :

...planners have a tendency to propose large-scale works : this is an error. It is better to prepare smaller projects, easily implemented and allowing a good utilisation of water, notably drainage of irrigated land and good ground exploitation.
Whatever the solutions adopted, water preservation must be the main objective, regardless of all economic considerations, and this, at the national level.

1.2. INTEGRAL TEXT OF MR. HARIRI'S COMMUNICATION : "WATER RESOURCES DEVELOPMENT IN IRAN, AND SOME RECOMMENDATIONS".

1.2.1. Introduction.

I have been assigned to describe a case of water resources development in an arid zone. It is easy for me if I provide a brief information about water resources development in Iran. Iran is a large country of 1.64 million square kilometers, but except for ten percent of its area enclosed between the Alborz mountains and the Caspian Sea, the climate is arid or semi-arid. The average annual precipitation is only 250 mm, with considerable fluctuation between excessively wet and dry years. About half of the country's area is covered by mountains and deserts, and of the remainder less than half is suitable for cultivation.

From these figures, the importance of water resources development in Iran becomes obvious. Since neither topography nor climate have changed significantly during the past twenty to thirty centuries, water always has played a key role in the long history of this area. The famous underground water systems, the "ghanat", are well-known in the world. Although this technique dates back at least 2500 years, it is still in use at many places and in several countries. The first written witness of the ghanat technique is found in the work of the famous Mediterranean historian Herodotos, and this technique was quite common in the Acheamedian Empire (550-330 B.C.). Archeologists have also excavated remains of river intakes, aqueducts, water reservoirs with well designed spillways and outlets, and even sewage systems dating back to the pre-Acheamenian and pre-Assyrian Elamite period (1500-600 B.C.).

Between the end of the Acheamenian era and the ascent of the Sassanid dynasty, the country was shattered by unrest and disturbance caused by Alexander the Great's march towards India, the interim region of the Seleucids, the struggles of their successors, the conflicts between the Parthians and the expanding Roman Empire, and countless local power struggles all over Persia. In this restless time no real progress could be made in water resources development.

In the Sassanian period (224-642 A.D.), water engineering returned to prominence, with higher attention and consideration than before. Regulation of water courses by means of diversion dams and weirs became quite common, and even large rivers like the Karun were tackled with courage and self-confidence. These structures were so well designed and solidly built that some remain in use today.

The two Mongol invasions in the 13th and 14th century caused a long decline in water resources development, through destruction of most of the existing irrigation systems. In the late Middle Ages a new dynasty, the Safavids (1491-1722 A.D.), came to power and commenced a new era of water control and engineering. It was in this period when the famous bridge-weirs in Esfahan were built, and large storage and diversion dams were constructed, some of which remain in use today.

Modern water resources development commenced in Iran in the middle of the 20th century in the Pahlavi Dynasty, when the first modern storage dams were constructed. The first dam provided water for irrigation, but the next schemes were multipurpose projects simultaneously focused on irrigation, domestic water supply and hydroelectric power generation.

Today the main requirements of water resources development in Iran are provision of more irrigation water for agriculture to attain self-sufficiency in food, delivery of adequate water supplies for domestic and municipal consumption and for industry, generation of more hydroelectric energy, and preservation of the natural environment. The hydroelectric power coupled with nuclear energy, will enable industry to expand without stressing irreplaceable fossile energy reserves.

Although water in Iran is relatively scarce, efficient coordination of water resources development coupled with careful conservation can assure adequate supply, quantitatively as well as qualitatively. The following country report shows how far Iran has proceeded, what remains for the future, and how the country intends to accomplish its lofty goals.

1.2.2. Area and climate.

Iran, situated in the south-western temperate region of the Asian Continent (approximately between 25° nad 40° latitude north and 44°-64° longitude east), is bounded by the Caspian Sea in the north and the Persian Gulf and Sea of Oman in the south. The country has common borders with Turky, USSR, Afghanistan, Pakistan and Iraq.

The total area of Iran is 1,650,000 square kilometers (628,000 square miles) of which 31,000,000 hectares are arable, 19,000,000 hectares under forests, 10,000,000 hectares under pastures, and the rest is built up areas of waste lands. The total area under cultivation is 19,000,000 hectares of which 8,000,000 hectares is at present cultivated annually. Out of 8,000,000 hectares 3,500,000 hectares is under irrigation and the rest is dry farm land.

The climate varies from hot and dry with maximum temperature of 34°C to 50°C (93° F to 122° F) during the summer months to sub-zero temperature in the winter period for the most part of the country, except along the Persian Gulf.

The major part of the country is arid or semi-arid where the rainfall is restricted to the winter months. There are other parts such as the northern flanks of the Alborz mountains, where there is sufficient rainfall for agriculture. On the plateau the average annual rainfall of over 200 mm in the north, decreases to less than 120 mm in the south and south-east. The climate and rainfall conditions make irrigation essential for raising crops in the greater part of the country. Table 1 shows the distribution of Precipitation in Iran.

"Table 1" - Distribution of precipitation in Iran -

annual precipitation mm	recipient area (millions of hectares)	ratio of recipient area to total area of the country (percent)
less than 100	22	13
100 to 250	100.5	61
250 to 500	28	17
500 to 1000	13	8
over 1000	1.5	1
total	165	100

1.2.3. Water management area.

Iran is divided into six water management areas, based on major river basins, including several sub-basins. These are the Caspian Sea, Persian Gulf and Sea of Oman, Lake Rezayed, Central Plateau, East boundary and the Kara Kum.

The existing soil-crops-water and natural conditions and water resources development of the country have been studied for each basin and sub-basin and are summarised as follows :

a) The Caspian Sea basin.

- *Location and Climate.*

This area of 179,000 square kilometers contains lands which are drained into the Caspian Sea, in the north. This is an enclosed sea, but salinity is considerably lower than that of ocean water. The area is bounded by the Alborz mountains on the south, starting from the eastern side drainage flows from the Atrak river's sub-basin on the U.S.S.R. border of the Caspian Sea, and from the Gorgan, Haraz, Tajan and Sefid rud rivers to the Aras river on the U.S.S.R. border on the west side of the Caspian Sea. The area is heavily populated and intensively farmed, adequately watered, humid, and wooded.
It has an annual precipitation of 600 to 1,800 mm, with summer rainfalls and moderate temperatures.

- *Crops.*

The basin produces both intensive, specialized crops such as tea, olives, rice, cotton, citrus and tobacco and also staples of wheat, barley, oilseed, legumes and vegetables. Water consumption for irrigated crops in this basin is estimated at 8602.2 m.c.m. per year.

- *Soils.*

Soils are characterized by areas of good use potential, mainly fine textured alluvials, browns and chestnuts by dromorphic soils of moderate potential, and large areas of poor potential basically lithosols, some of which are salinized.

- *Surface water.*

The total annual surface flow of the rivers within the basin amount to 20,950 m.c.m. of which 7,500 m.c.m. is the current usage. Large dams are the Aras, Shahbanoo Farah, Voshmgir and Lar having capacity of 4,900 m.c.m., and which control 3,800 m.c.m. of water. Surface water quality does not restrict agriculture in the basin.

- *Groundwater.*

The total amount of annual groundwater exploitation is calculated at 1,720 m.c.m. which is extracted from 1630 springs, 1450 ghanats, 2840 deep wells and 10750 shallow wells. On the basis of hydrogeological investigations, the groundwater resources could be developed in some of the sub-basins, and the reservoir safe yield is calculated at 2,500 m.c.m. The restriction for development of groundwater resources is due to the intrusion of the salt water into the fresh aquifers.

b) The Persian Gulf and Sea of Oman, with its adjacent islands.

- *Location and Climate.*

The basin is the southern sea coast littoral of Iran. All rivers within this area drain into these international waters. The area is bounded on the south by the Persian Gulf and the Sea of Oman, by the Zagros mountains on the north and west, and lower ranges on the east. The major sub-basins from east to west, are the Sea of Oman, the South East with additional subdivisions and Khuzistan. The area contains 418,000 square kilometers and is classified as arid, semi-arid, with a precipitation usually not exceeding 300 mm, and high to very high temperatures. In the more eastern arid portions of these basins rainfall averages are less than 100 mm per year.

- *Crops.*

The major crops in the area are wheat, barley, sugar beets and cane, cotton, oilseeds, legumes, citrus, dates and grapes. The large Khuzistan irrigation area produces sugar cane, oilseeds, wheat, barley, vegetables and dates. In some local areas additional crops such as pistachios and almonds are produced. Water consumption of irrigated crops in the area is estimated at 2725.8 mm per year.

- *Soils.*

The area has salt domes and salt diapers locally, indicative of an arid climate and salinized lands. Over this large area soil types and productivity are varied. The extreme east on the Sea of Oman is characterized by salinized lithosols and desert soils. Further west, the coastal area is characterized by salinized lithosols and desert soils of very poor potentials, but with some areas of salinized alluvials with good potentials. Further north, to the Zagros mountains the soil is even less adapted to agriculture, characterized by lithosols and salinized lithosols derived from marls. To the west, in the Khuzistan there are more areas of moderate to good potential and use, with alluvials and salinized alluvials.

The area also has poor salinized lithosols and salinized solonchalks and salt marshes. Finally, the extreme north and west of the basin, bordered on the east by the Zagros mountains is characterized by areas of good brown and chestnut soils, and by poor areas of salinized lithosols.

- *Surface water.*

The total annual flow of the rivers within the basin amounts to 43,550 m.c.m. of which 7,100 m.c.m. are now in use. Large dams in the basin are the Mohammad Reza Shah Pahlavi, the Minab the Reza Shah Kabir with a capacity of 6,590 m.c.m. The above mentioned dams control 16,439 m.c.m. of water. Since some of the rivers in the basin flow through salt domes and formations, their waters become polluted, and are not suitable for irrigation.

- *Groundwater.*

The total amount of annual groundwater exploitation is 3,900 m.c.m. which is extracted from 1300 springs, 1600 ghanats, 550 deep wells and 7100 shallow wells, groundwater level and quality is determined by me suring and sampling the 1748 observation wells. According to the investigations, the groundwater in some of the sub-basins originates from alluvial and fractured karstic formation and groundwater reservoir have a safe yield estimated at 5,500 m. c.m. per year. The quality of water drawn from either alluvial or karstic formations is good enough for irrigation purposes.

c) The Rezayeh Basin.

- *Location and Climate.*

The basin is a smaller one of 56,000 square kilometers where all streams drain internally into the extremely saline lake Rezayeh. It lies in the extreme north and west of Iran, bordering Turkey on the west and close to the U.S.S.R. on the north. The basin is mountainous and adjacent to the junction of the Alborz and Zagros mountain chains. It has low precipitations, generally not exceeding 250 mm. The basin has low winter temperatures, modified in the areas surrounding the lake.

- *Crops.*

Major crops are wheat, barley, oilseeds, legumes, sugar beets, potatoes, onions, tobacco, grapes deciduous fruits and nuts. Consumptive use by the irrigated crops in this area is calculated at 2725,8 m.c.m. per year.

- *Soils.*

The area has some alluvial, brown and chestnut soils of good potential and larger areas of salinized lithosols of poor potential.

- *Surface water.*

The total annual surface run-off of the river within the basin amounts to 7,740 m.c.m. of water, of which 3,200 m.c.m. is being used currently. Major dams in this basin are Shahpour Aval and Kourosh Kabir with a total capacity of 880 m.c.m. which control 730 m.c.m. of water per year. Some of the rivers within the basin have poor quality water when their flow is at the minimum. The two dams mentioned have considerably improved the quality of water.

- *Groundwater.*

The total amount of annual groundwater exploitation is estimated at 700 m.c.m. which is extracted from 450 springs, 1323 ghanats, 559 deep wells and 2071 shallow wells. Groundwater levels and quality are measured with 568 observation wells. Hydrogeological studies show that there is a possibility of groundwater development in the basin due to the alluvial tuff formations of the aquifers. The groundwater reservoir safeyield is calculated at 1200 m.c.m.

d) The Central Plateau Plain.

- *Location and Climate.*

This basin is the largest physiographic area in Iran with 845,000 square kilometers, encompassing six major sub-basins. These are the Central, Isfahan, Kerman, Dasht-Lut, Dash-i-Kavir and Fars. This great area is internally drained. It is bordered by the Alborz mountains on the north, the Zagros mountains in the west and south and the lower range on the east. The entire area is arid to semi-arid, with precipitation usually not exceeding 270 mm, down to zero, summer temperatures are high, and the area is distinguished as being a very large kavir, or salt desert, occupying the centre of the basin. It has scattered salt lakes, marshes and sinks. Along the north and south fringes, river surface run off and groundwater permit agriculture and development of several irrigation projects.

- *Crops.*

Major crops produced are, wheat, barley, sugar beets, potatoes, onions, vegetables, grapes, deciduous fruits and nuts. The consumptive use of irrigated crops for the basin is estimated at 9103.4 m.c.m. per year.

- *Soils.*

The area has some alluvial and sierozem soils of moderate to good potential and pockets of good soils within poor areas, but basically it is characterized by extensive areas of salt marshes, domes, lithosols and desert soils of poor potential. Only where good soil and water is found, or water is introduced or supplemented, does agriculture become significant.

- *Surface water.*

The total surface flow of the rivers within the basin amount to 8,875 m.c.m. of which 5,200 is in current use. Major dams are Farahnaz Pahlavi, Amir Kabir, Shahnaz Pahlavi, Shah Esmail, Dariush Kabir, Shas Abbas Kabir and Jiroft with a total capacity of 3025.5 m.c.m. of water which control 2610 m.c.m. of water. Some rivers in the basin have good quality water but when they flow through the salt domes and salt formations the amount of salt increases and causes some restrictions for irrigation purposes.

- *Groundwater.*

The total amount of annual groundwater exploitation is estimated at 10,400 m.c.m. which is extracted from 1300 springs, 9600 ghanats, 7600 deep wells and 13500 shallow wells. Groudwater level and quality is measured with 3262 observation wells in this basin. The development of groundwater resources in some of the sub-basins in fractured karstic formation is foreseen to have a good possibility, and according to the results obtained from alluvial plains studies, an additional amount of groundwater could be extracted. The groundwater reservoir safe yield is estimated at 11,400 m.c.m. of water per annum.

e) The East Boundary basin.

- *Location and Climate.*

The basin with 107,000 square kilometers, lies on the extreme east border of Iran bordering Afghanistan and Pakistan. It is subdivided into the Hirmands (Hermand) on the north, bordering Afghanistan, and the Moshkil on the south, bordering Pakistan. The area is internally drained, by streams flowing into the Hermand depression on the Afghanistan border, and minor sinks. Annual precipitation is low, not exceeding 200 mm. The temperatures are high.

- *Crops.*

Cultivation occurs only in local areas, where some wheat, barley and vegetables are produced. The consumptive use of irrigated crops is estimated at 753.5 m.c.m. per year.

- *Soils.*

Soils are generally poor in this area, there are a very few hectares of good soil scattered in the area.

- *Surface Water.*

The total annual surface flow of the rivers within the basin amount at 3210 m.c.m. The current usage is also 3210 m.c.m. One pajor water installation in the area, the Chahnimeh storage dam is under construction. The reservoir capacity of the dam is 224 m.c.m. with a controlling capacity of 105 m.c.m. of water.

- *Groundwater.*

The total annual amount of groundwater exploitation is estimated at 90 m.c.m. Groundwater safe yield is calculated at 110 m.c.m. There are no observation wells in the area. Due to poor recharge of groundwater and also the resources of brakish water the withdrawal of groundwater resources is limited. Groundwater safe yield amounts to 110 m.c.m. per year.

f) The Kara Kum Desert basin.

- *Location and Climate.*

The Kara Kum desert basin lies in the extreme north eastern corner of Iran, bordering the Soviet Union to the north and Afghanistan to the east. The basin has only 45,000 kilometers in Iran, called the Mashad basin, and it lies at the eastern extremity of the Alborz mountains in Iran. It is arid to semi-arid with annual precipitation not exceeding 270 m.c.m.

- *Crops.*

Major crops are wheat, barley, sugar beets, cotton, legumes and vegetables. Consumptive use of irrigated crops is calculated at 1388.4 m.c.m. per year.

- *Soils.*

Soils vary from small areas of good alluvials sierozem browns and chestnuts to salinized lithosols of poor quality.

- *Surface Water.*

The total annual surface flow of the rivers within the basin amounts to 500 m.c.m. The current usage is calculated at the same amount.

- *Groundwater.*

The total amount of groundwater exploitation is estimated at 1890 m.c.m. Groundwater safe is calculated at 2000 m.c.m. Groundwater level and quality is determined with 250 observation wells drilled in the area.

1.2.4. Water resources.

Through surveys and studies made, the annual precipitation is estimated to be on average about 368 billion cubic meters, fluctuation between 280 and 520 billion. Out of this quantity of water, only about 30 billion cubic meters are beneficially used for agricultural, industrial and municipal purposes, while the rest is lost by evaporation, penetration into the soil or flow into the seas, marshes and neighboring countries.

It is estimated that the loss includes about 85 billion cubic meters of surface water which flow into the rivers each year, so that the better utilisation of this water is the most important problem to be taken into account.

In parallel with the utilization of surface water, substantial measures have been taken regarding the exploitation of the underground water by drilling deep wells and shallow wells and ghanats.

On the basis of the hydrogeological surveys made throughout the basins and sub-basins, the annual groundwater exploitation from 37,000 shallow and deep wells, 14000 ghanats and 4000 springs amounts to 18690 m.c.m. and the amount of safe yield is estimated at 22,700 m.c.m. per annum.

"Table 2" - Total surface water and groundwater supply, m.c.m./year -

Basins	Water Supply incl Safe yield	Present Utilization	Available Future Supply
Caspian Sea	23 500	9 220	14 280
Persian Gulf Sea of Oman	49 000	11 000	38 000
Lake Rezayeh	8 900	3 900	5 000
Central Plateau	20 300	15 600	4 700
East Boundary and Kara Kum	5 900	5 770	130
IRAN	107 600	45 490	62 110

1.2.5. Water Management in Iran.

a) Nationalization of water resources.

Water resources in Iran are nationalized. The principles of nationalization may be formulated as follows :

- Right and freedom of usage.
- Limitation of use to actual reasonable requirements (allocation of water).
- Nationalization of resources (abolition of right of ownership in water).
- Prevention of wastage and pollution.
- Prevention of profit making.
- Comprehensive management in every form.
- Control of resources by proper exploitation through implementation of development plans.
- Consideration of economic feasibility, maximum use with least investment.

b) Basic objectives of the long-term planning.

The basic objectives may be formulated as follows :

- To provide reliable water supplies for the entire urban population and to improve the existing water supplies in rural areas.
- To supply the water requirements of agriculture so that the area under cultivation will increase substantially.

- To provide sufficient water for the industry.
- To increase installed hydroelectrical power-generating capacity to the utmost.
- To provide enough possibilities for recreation.
- To safeguard environment and conserve water quality.

c) Overall policies.

The overall policies are directed to the following aims :

- To prevent wastage of water into the seas, lakes, swamps and deserts by building suitable structures.
- To divert water from surplus areas to arid but fertile areas.
- To coordinate utilization of surface and ground waters in order to make optimum use of all water resources in every region.
- To prevent water salination caused by passage through salt domes or salty soils.
- To utilize the latest scientific, technological advances in such fields as sea water desalination, cloud seeding, water recycling for agricultural, industrial and domestic use.
- To construct modern irrigation and water supply networks where traditional methods fail to ensure efficient supply and thus cause water wastage.
- To construct drainage systems.
- To conduct research in the fields related to water resources development, utilization, conservation, recycling and other pertinent subjects.

d) Water development limitations.

Natural climatic and geological conditions such as low precipitations, high evaporation, salt domes, saline formations are main constraints to the availability of water. The deficiency in water resources is agravated to some extent by the low efficiency of some traditional irrigation practices, the natural adversities could be summarized as follows :

- Uneven distribution of precipitation during the year.
- Uneven distribution of precipitation throughout the country.
- Water become brakish and salty on passing through saline soils and salt domes.
- Great quantities of water penetrate into the karstic formations of Zagros mountains in western Iran and finally emerge into desert marshy areas.
- Very low rainfall in the southern and central part of Iran.
- Saline and alkaline soils in the lower part of the central basin.
- Very low vegetative cover in the watersheds of the country.

- High rate of avapo-transpiration.
- Long distances between the sources of waters and the places of utilization.

e) Institutional arrangements.

The principle water agency in Iran is the Ministry of Energy, with three main bodies for planning and development for water, power, and all other sources of energy in the nation. Attached to the Ministry are many special purpose semi-autonomous agencies or authorities, including regional water authorities in each province, electric companies. In addition, there are specialized agencies in water and power. These include the Water Resources Research Institute, Institute of Hydrosciences, Mahab Corporation, and Tavanir Corporation. These entities are charges with such specific development responsibilities as hydraulic model testing and cloud impregnation, training, consulting, contracting, and power generation and transmission.

The basic tasks of the Ministry of Energy are preparation and execution of plans and projects to provide and distribute water, supervision of utilization of surface water and groundwater sources, design, procurement, and operation of urban water supply systems, and supervision of construction of single and multi-purpose water development projects.

1.2.6. Conclusions and recommendations.

a) Avoiding mistakes.

It is not always realised that the development of water resources in the industrialised countries has been a fairly slow process. Many mistakes have been made and these have usually been corrected in the light of experience. Even so long term deleterious and sometimes irreversible effects have happened, such as a gradual build up of pollution in large rivers and lakes.

In the natural eagerness of developing countries to take advantage of the benefits of industrialisation there is great danger that exploitation of water resources may result in severe disturbances to the existing ecological system, and become counterproductive. Examples of such possible effects include :

- Excessive pumping of groundwater may result in the infiltration of deposits of saline water and the poisoning of agricultural land.
- Excessive irrigation without adequate drainage may cause the waterlogging of soil and crop damage.
- Expansion of domestic water supply systems without corresponding drainage and sewage systems may cause flooding and pollution.
- Increase in industrial use of water may cause industrial and chemical pollution of rivers and lakes.
- The extension of water supplies by recycling may result in an undesirable build up of chemical pollution.

- The construction of dams often results in long term problems of siltation in, and upstream, of the reservoirs, and sometimes severe downstream erosion of rivers. The reduction in flood sediments may have an adverse effect on agriculture.

It will be seen therefore that before any large developments are started, it is important that all the long term implications should be considered.

b) Main requirements.

The main requirements for water resources development in most countries are to provide more water for irrigation, domestic use, industry and hydro-electric energy. In some countries recreation and improvement of the environment are also being considered as essential requirements.
Although water is relatively scarce in arid countries like Iran but there is an adequate amount for all these purposes if it is efficiently utilized. Fortunately some of these requirements are not mutually antagonistic irrigation water can be recycled from domestic and industrial use which in turn can be obtained after extraction of hydroelectric power from high level mountain sources.

c) Recommendations.

The efficient coordination of these requirements, coupled with the need to avoid pollution and disturbance of the environment is a challenging problem. Attention of the administrators of the water resources development organizations is drawn to some aspects of water resources planning and management as follows :

- *Data collection and use.*

Long term reliable data is essential for water resources development. All data for surface water and groundwater should be collected and handled by a single organization. Real time hydrological data is required for forecasting and project management.

- *Planning.*

The planning should be multi-objective and should fit carefully to the overall economic development of the country. It is not practical to consider water resources development as an independent sector.
The planning process could be clearly identified as, *technical activity* and the *decision making process.*

- *Technical activity* is the work of measuring, computing, and comparing water availability and demand, and evaluating water projects which have been proposed or envisaged. It is the establishment of actual information required in order to make decisions such as the allocation of water or the implementation of projects. It is carried out by technicians especially trained and experienced for this purpose.
- *The decision making process* includes the process of allocating a limited water supply among various contending water users, and selection amoung various possible water augmentation projects. It is the determination of the economic and social solutions to the nation's water needs in the context of the total national resources and finances.

Water should be considered as a national asset and be treated accordingly.
Integrated use of surface water and groundwater is essential.
The national objectives should be set up for assigning the priority of the use for domestic, animal husbandry, industry, agriculture, hydropower and recreation. It is important to know these priorities before starting a plan.
Water resources projects regardless of the size, should be multipurpose.
Lack of funds is not a good excuse for overlooking part of the project.
Environmental aspects and pollution control should be considered seriously.
Re-use and conservation should be considered in the planning stage.

In arid countries the hydropower generation should not be the main objective of water resources development, in most cases it should be used only for peaking purposes.
Water saving and conservation aspect in arid countries should be the main concern for the planners.
No irrigation system in arid countries could be complete without sufficient drainage network.

The national water plan should be dynamic and consider all changes.
All phases of a project should be planned and designed at the same time.
Small scale projects should be given priority over larfe projects. In large scale projects establishment of the pilot projects are helpful for the success of the projects.
Many models for water resources planning are available but models should be prepared according to the national goals and criteria.
In this respect lessons should be learned from failures and successes experienced by other countries.
People should be involved in water resources planning.

- *Organization.*

Organizational aspect of water resources development is very important.
Planning of the water resources should be assigned to an office with qualified personnel and steered by a high level governmental council representing industry, agricultures and domestic users.
Regional development organization is necessary for the implementation of water and land resources development. .All phases of water and land resources development should be implemented in parallel in order not to waste time and investment.
Appropriate organization should be set up on the farm level to ensure proper water distribution and irrigation practices.

- *Operation and Maintenance.*

Maintenance of the water projects starts immediately the day after they are completed. Operation of the irrigation systems is the key factors for the success of the projects.
The operation and maintenance require skilled manpower, therefore training of the manpower should also be considered in the planning of the projects.

1.3. DISCUSSION OF MR. HARIRI'S EXPOSE.

Mr. ROWNTREE thanks the lecturer for his interesting exposé and opens the discussion.

Mr. ALBRECHT :
"You said that water problems depended on the Ministry of Energy, but you have created Basin Agencies. What will be the ultimate role of the Ministry in the future ?"

Mr. HARIRI :
"The Ministry of Energy's tasks include planning and budget, the regional Agencies take on the implementation of small tasks."

Mr. KOVACS congratulates Mr. HARIRI on the clarity of his exposé and the interesting recommendations formulated.
Mr. KOVACS, who entirely agrees with the fundamental water policy objectives expressed, makes some remarks :

- "Drainage of irrigated land is, in fact, of great importance. The Conference of Alexandria on arid zones came to the same conclusions".
- "Integrated management at the basin level raises the question of contact between organizations."
- 'On Table 2 of your report, I notice you have presented available water resources without making any distinction between surface and ground waters."
- "In Hungary, it has been proved that it is impossible to disassociate the two. Has any research been undertaken in Iran on the connections between these two types of resources ?"
- "Again concerning the same table : I read in the commentary just preceding it, that a great part of surface water is lost by evaporation and also by transfers to the hydrological basins of neighbouring countries."

  "This raises the problem of distribution between coastal countries and of international planning."

  "This is a problem which is extremely difficult to solve in Hungary."

Mr. NAJLIS :
"I would like to make three remarks :

- "You have spoken of *utilisation of rights and liberties*. Can you explain on what basis you can prevent water wastage and pollution ? What dues are envisaged ?"
- "Your conclusions on hydroelectrical energy should not, in my opinion, be generalised."
- "Your distinction between big and small projects does not appear to me to be essential ; what counts is the adequacy of projects to needs ?"

Mr. HARIRI :
(in reply to Mr. NAJLIS)

- "Water utilisation control is obtained through dues, but, till present, the latter have solved financing problems but not those of upkeep."

- "By small projects I meant those concerning less than 1000 hectares, but I was refering more to time lapse in implementation."

Mr. DA CUNHA :
"I would like to formulate some remarks :

- "Many lessons are drawn from failures ; what is important is to avoid repeating the same errors."
- "I recently attended a conference on drought defining the different levels of drought."
- "With regard to the place held by water energy, are there countries other than Iran where the same question is raised ?"

Mr. KINDLER remarks that Mr. HARIRI's interesting exposé constitutes an excellent introduction to the Workshop n° 4 debates.
Mr. KINDLER, who agrees with the orator that water recycling poses problems but is indispensible in arid zones, observes that in the expression "dynamic National Plan" formulated by Mr. HARIRI, the nature of the plan is of less importance than its mecanism, and that centralisation and decentralisation are not incompatible but complementary.
He finally points out the importance of water energy which has consequences which are interesting from the institutional point of view, but paradoxal, since water management is not the responsibility of the Ministry of Agriculture, a fact that is also of surprise to Mr. AGUILAR.

Mr. LAWSON explains the prime importance of water energy in certain developing countries :

- "Banks like the I.B.R.D. only accept to finance big projects in accordance with the financial returns criteria. How can we break free from this ?"
- "On the other hand, energy is a source of development. Negligence cannot be justified ! What must be imposed is serious inquiries and beforehand studies."

Mr. WIENER :
"...we must know what comes from within the system and what is exterior to it ; we must utilise all we possess in order to create ; we must be active and not interactive."
"Limitations in water use will certainly increase in the future ; which is one more reason to work towards integrated management in order to select priorities and optimalize."

Mr. OGUNROMBI :
"We do not have institutional problems in our country, but we meet with two kinds of difficulties to which Mr. HARIRI's exposé gives no answer :

- How to ensure financing ?
- How to ensure maintenance ? In Kenya, there exist wide gaps at this level. It is a problem of qualifications. ITCWRM must give more importance to training technicians."

Mr. HARIRI concludes the discussion by pointing out that in Iran, 70 % of its energy is hydroelectrical and expresses the wish that the World Bank be preoccupied with water preservation.

Mr. ROWNTREE requests Mr. BANERJEE to speak.

2. REGIONAL WATER PLANNING IN A COUNTRY HAVING IMPORTANT CLIMATIC AND HYDROLOGICAL CONTRASTS.

2.1. EXPOSE BY MR. BANERJEE.

a) The situation.

India is a predominantly agricultural country disposing of a lot of water. The difficulties encountered in providing for the needs are the following :

- seasonal imbalances. Between june and october (the monsoon), water must be stocked, but the reservoir volume is inferiour to the quantity of water flow.
- rocky surfaces cover two third of the country. Groundwater resources are therefore not widespread.

b) The Plan.

In 1950-1951, a development Plan was launched with the aim of :

- storing monsoon water,
- transfering water from overflowing basins to deficient basins.

The means at our disposal are the following :

- water is state property,
- the programmes are approved by the Planning Commissions of the Central Government,
- financing is ensured by state resources but grants are given by the Central Government,
- practically all resources are managed by the Ministry of Agriculture and Irrigation, which manages 90 % of the water, the remaining 10 % (domestic and industrial waters) being managed by other ministries.

c) Ground waters.

Ground waters, which have a special statute, justify specific remarks :

- 21 million hectares are irrigated by ground waters,
- irrigation projects are conceived by agriculturers themselves,
- financial institutions give loans to agriculturers, who own the installations, which are therefore entirely private.

This action was undertaken in deficient regions, but certain "pockets" have yet to be developed, particularly where ground water exploitation enables one or two additional crops outside the monsoon period.

One of the dangers of the private sector lies in an over-exploitation of nappes. The Central Government has created up-to-date laws which are not accepted by all the states.

d) Evolution of irrigation technics.

After having recalled that the World Bank had played an essential role in financing irrigation projects, Mr. BANERJEE resumes the irrigation situation in his country.

- India is approaching the integrated development stage.
- In addition to the efforts made at reducing the disparities in the country as a whole, the Administration is trying to put an end to situations where over-utilisation and under-utilisation are to be found side by side. For this reason, it refuses to irrigate each field independently, prefering to provide water to forty acre units.
- In the beginning, there was an enormous lack of management personnel. This has now changed thanks to a regrouping of agriculture and irrigation experts.

Regions concerned by this programme cover an area of 12 million hectares and concern zones qualified as medium (10 000 to 5 000 hectares) and small (5 000 to 2 000).

e) Big projects. Struggle against floods and interbasin transfers.

The central orgnization which relies on :

- the Central Water Commission
- the Central Water Office

natobly for centralisation of flood data and information, faces a certain number of obstacles and often has recourse to tribunals for interstate litigations.

Ambitious projects have been conceived :

- diversion of the Ganges to the south of the sub-continent, the investment and functioning (pumping power) costs being extremely high.
- diverting of the Indus through Rajasthan.

In order to implement these projects, political frontier problems, as well as technical ones, must be overcome : Thus "...we have not paid enough attention to consequences of dam implantation, and notably to alluviation often considerably more than expected."

"Nevertheless, a study of the concerned grounds has been undertaken and covers 1 million hectares. This study is necessary and must be accelerated."

By way of conclusion, Mr. BANERJEE points out that India is putting together all her resources to meet the water demands of her principle user : agriculture.

2.2. INTEGRAL TEXT OF MR. BANERJEE'S COMMUNICATION : "REGIONAL WATER PLANNING IN A COUNTRY WITH IMPORTANT CLIMATIC AND HYDROLOGICAL CONTRASTS" (example India).

2.2.1. Physiography.

The sub-continent of India has a great variety of natural surfaces from the highest mountain ranges in the world to vast river deltas lying only a few meters above the sea level. Physiographically, India may be divided into five separate and well defined regions : *Himalayas, the Indo-Gangetic plains, the Thar or Rajasthan Desert, the Southern plateau, and the Coastel Belts.*

The Himalayas, meaning the abode of the eternal snows, is the name given to the vast mountain ranges, which run along the northern frontiers of India for a distance of about 2 253 km from the Indus to the Brahmaputra. The Himalayas may be regarded as a double mountain wall running nearly east-west and descending into a series of valleys towards the north in which the Indus, the Sutlej and the Brahmaputra rivers gather their waters, while the southern Himalayan slopes drain into the mighty Ganga. On the north-eastern side, the offshoots of the Himalayas are know as the Naga Hills ; while the north-western offshoots, know as Hindukush and Suleiman Ranges, lie in Pakistan.
The slope of the hills in the Himalayas are used for agricultural purposes, and are also irrigated in certain areas. The Himalayas have not only had a profound influence on the climate of India, but have also been the dominating factor in shaping the history and destiny of the Indian people.

The Indo-Gangetic Plains, average elevation less than 150 m above the mean sea level, lie between the Himalayas on the north and the Plateau of the Peninsula in the south and are watered by the snowfed Himalayan rivers. This vast, almost level tract, 2 414 km long and some 250 to 300 km broad, and having an average slope of 1 in 8 000 between the Yamuna River at Delhi and the Bay of Bengal, consists of alluvial sediments brought down by innumerable streams and rivers from the great Himalayas.
The plains of northern India are watered by three distinct river systems : the Indus and its tributaries which drain into the Arabian Sea, the Ganga and its great feeders, and the Brahmaputra and its tributaries, the latter two having their outfall in the Bay of Bengal.
The network of numerous perennial rivers in the plains, coupled with climatic conditions and erratic rainfall, make irrigation necessary and feasible, and it is this region where some of the biggest irrigation systems of the world have been developed.

The Thar or Rajasthah Desert occupies a major part of the State of Rajasthan. The Thar Desert is an arid region in the north-western part of the country without any high hills. The desert contains large tracts of fertile soils which can produce good crops provided water is made available. A projet to bring water from the Beas River is in hand to irrigate a large part of this desert area. Irrigation is already being provided to part of this command area.

The Southern Plateau is almost triangular in shape and includes the whole of the country south of the Vindhya Hills as far as Kanya Kumari, except the flat coastal belts running along the eastern and western sides of the plateau.
At the western flank of the Vindhyas lie the Aravali Hills with Mount Abu nearly 1 707 m above mean sea level. The other two sides of the southern triangle are flanked by the eastern and western ghats, which run close to the sea coast. The western Ghats rise sharply to the elevation of 1 000 to 1 300 m and in places to over 2 400 m ; the less prominent Eastern Ghats are irregular broken chain of hills, being most prominent just north of the Godavari Delta where it rises to an elevation of 800 to 1 000 m.
The inner triangular plateau is also dotted with peaks and seamed with hill ranges ; the highest being the Nilgiries rising to over 2 134 m above mean sea level. The southern peninsula is one of the most ancient of land masses in the world, of which the present topographical features are due to weathering and denudation over billions of years. Almost the whole of the area is composed mostly of crystalline and metamorphic rocks which in some places are covered by later sediments of Lava flows. Although this region has no perennial rivers, it has very good potentials for irrigated agricultural production and hydro-power and consists of deltas formed by the rivers flowing east or west through the peninsula.

The deltas along the Eastern Ghats, formed by the Godavari, the Krishna and the Gauvory and other lesser rivers, are fairly extensive in area, and being flat and fertile are irrigated by some of the largest irrigation systems in the country ; the deltas of the west-flowing rivers are not so extensive and *the Western Coastal belt* is comparatively narrow.

2.2.2. Hydrometeorologie.

a) Climate and rainfall.

Abberant weather is a common phenomenon in this country. Although the monsoons that cause rains during specific seasons are quite regular, floods and droughts, cyclones and storms are experienced in some part of the country or other almost every year. All these aberrations of weather affect the agricultural production.
Since only about 32 % of the gross cropped area has been brought under irrigation, agriculture in the country is highly weather-sensitive. In some years bumper yields in some part of the country are offset by failure in another, and the production is normal or above-normal. In some other years, the opposite effect is produces and there are scarcities.
Drought is the biggest menace to agriculture, since it is extensive and prolonged when it occurs. Floods, have also their adverse effect and are regular features every year during the monsoon in some parts of the country.

b) Diversity of climate and weather in India.

The extend of diversity of weather and climate in India is perhaps greater than in other areas of similar size in the world. For example, Assam in the east and Rajasthan in the west present extremes of wetness and dryness.

Punjab has a continental climate with fierce summer heat and biting winter cold when temperatures go below the freezing point, whereas Kerala has a tropical maritime climate with almost unvarying warmth and uniform hymidity. In the Rajasthan desert, the average annual rainfall in certain parts is less than 15 cm, whereas at Cherrapunji in Assam it is more than 1 000 cm. In the rainy season, places like Simla in the Himalayas get clouded for days, and the air there remains saturated with moisture, but in the hot months the air gets desiccated to an uncomfortable extent. Dras in Kashmir has recorded a minimum temperature of -45°C, whereas Alwar in Rajasthan has recorded a maximum temperature of 50.6°C.

Apart from the above spatial diversity of weather and climate from one part of the country to another, there are variations from year to year in the weather conditions, region-wise and country-wise. This is particularly true of rainfall. Some parts of the country are subject to these variations to a greater extent and with a greater frequency than the others.

c) Extent of aberrant weather.

Past records show that in almost every year one part or other of the country has been subjected to drought, flood or cyclone. The drought-prone tract extends from Rajasthan to the peninsula including parts of Gujarat, Maharashtra, Rayalaseema, Mysore and Tamil Nadu. The neighbouring areas of Uttar Pradesh, Bihar, Madhya Pradesh and Andhra Pradesh are also subjected to droughts in some years. Assam and the adjoining regions of north-eastern India are not subjected to droughts.

The flood-prone areas in the country are confined mainly to the vicinity of north and central Indian rivers. Cyclones hit the east and west coasts and affect one or two districts at a time. Severe storms like nor'westers, thundersqualls of Bengal, hailstorms and duststorms of northern India are highly localized.

d) General distribution of rainfall.

The average annual rainfall in the Indian plains has been estimated to be 120 cm. Very few countries of the world get an average rainfall of this magnitude. However, its distribution varies widely from one part of the country to another. The striking features are the very heavy rainfall of over 400 cm over the southern slopes of the Khasi Hills, the Brahmaputra Valley and the Western Ghats, heavy rainfall amounting to over 200 cm over the whole of Assam and the western Rajasthan, with portions of it receiving less than 20 cm.

Nearly one-third of the country receives less than 75 cm of rain (Table 1). The normal annual rainfall is below 75 cm in the following regions :

Meteorological regions	Normal annual rainfall (cm)
Punjab (including Delhi & Haryana)	63
Rajasthan (eastern)	70
Rajasthan (western)	31
Saurashtra and Kutch	48
Rayalaseoma	68
Interior Mysore (northern)	68

- Table 1 - Broad area-wise distribution of rainfall in India -

Rainfall (cm)	Area (%)
0-75	30
75-125	42
125-200	20
Above 200	8

2.2.3. Water resources.

a) Potential resources.

The summer monsoon starting from the equatorial belt comes over the Indian subcontinent in two district currents known as the Bay of Bengal branch and the Arabian Sea branch. It has been estimated that during the four rainy months of June to September the Arabian Sea branch of the monsoon carries moisture amounting to about 770 Mham and the Bay of Bengal branch about 340 Mham of water. Of the monsoon moisture about 25 to 30 percent precipitates in the form of rainfall.
During the remaining eight months of the year also, there is a substantial amount of moisture over the country. This, however, has not as yet been scientifically assessed. It contributes a precipitation of the order of 100 Mham, a small part of it being in the form of snowfall.
Rainfall in the country varies from place to place but the annual average for its total area of 328 Mham is about 120 cm. The average annual precipitation is thus of the order of 400 Mham.

Estimates of the country's water resources have been made from time to time. At the beginning of the present century, the first Irrigation Commission had placed the surface water resource at 144 million hectare meters for India of that time but excluding Burma, Assam and East Bengal. In the absence of adequate data for this assessment, that Commission had described this estimate as "mere approximation". In the late forties, Dr. A.N. Khosla, then Chairman of the Central Waterways, Irrigation and Navigation Commission, figured out on the basis of an empirical formula which he had evolved, the total annual surface and groundwater resources to be 167 Mham.

According to a recent assessment the basic surface water resources derived from precipitation amount to 115 Mham. To these are added 20 Mham brought in from catchments lying outside the country. As regards ground water, the portion of the precipitation that goes into the soil is of the order of 215 Mham. A portion of it, roughly estimated at 165 Mham is held as soil moisture and the remaining 50 Mham percolates to watertable.
The soil moisture is exceedingly important for sustaining vegetation. But it cannot be extracted for purposes of irrigation or other uses. Thus, the water that percolates to the watertable may be regarded as the basic ground water resource.
The total annual basic water resources of the country are thus 185 Mham comprising 135 Mham of surface water resources and 50 Mham of ground water resources.

There is, however, interchange at various stages between the surface water and ground water besides some recirculation. Both get augmented as a portion of surface water on use or otherwise goes to ground water and a substantial portion of ground water reappears as surface water. The present total ground water is thus of the order of 65 Mham of which 45 Mham regenerates during the non-monsoon period as surface water bringing the surface water total to 180 Mham. On full development of water resources, the total ground water would increase to 85 Mham and the surface water to 185 Mham including 45 Mham regenerated from ground water. As explained later, not all of that is utilisable.

Besides the renewable water resources, there are water resources which have accumulated above and below ground over long periods. Above the ground, these are glaciers and permanent snow-caps on high mountains, which make some steady contribution to the flows of the Himalayan rivers. There is trapped ground water in certain geological formations. These trapped waters when mined are not replaced and are, therefore, an exhaustible asset. But locally these are of immense value, particularly in arid regions such as west Rajasthan. As ground water explorations proceed, more fossil water in arid regions is likely to be discovered.

Along the coast, sea water can be a source of fresh water on desalination. Desalinated water is, however, expensive and therefore its use can be contemplated mainly for domestic and industrial purposes. With the present technology, it would be generally too expensive for irrigation.

The total water resources of the country thus comprise the annually replenishable surface water and ground water resources indicated earlier, the fossil water under ground which is an exhaustive asset, glaciers and permanent snows which make some steady contribution to river flows and the expensive desalinated water which can be produced on the coast.

Of the moisture which appears over India during a year only about 25 to 30 per cent precipitates there. It should be possible, by inducing artificial rainfall, to take some more water from this moisture. More than 50 countries have been conducting experiments in rain-making by cloud seeding. In India, such experiments have been carried out, in a modest way, since 1952. However, til further advance is made in the technique of artificial rain-making to ensure dependable results, it would be premature to take this source into account in an assessment of water resources of an area.

b) Utilisable water resources.

Because of concentration of rain in most parts of the country during a few months of the year, maximum river flows occur during that period. During the non-rainly months the river flows dwindle to a fraction of their flood flows and some streams dry up altogether. As rainy season flows cannot be fully utilised during that short period, the waters have to be stored in reservoirs for regulated release for subsequent use.

Large storage reservoirs can only be built in the hills but suitable sites for dams are limited and in consequence on some major rivers enough storage capacity is not available for completely harnessing the river flows.

Also, most irrigation projects in the country are designed for a dependability of 75 per cent, which means that in 25 years there is some excess over the quantity planned for utilisation on the project.

Some flood flows, therefore, have to continue to go to the sea. This is not altogether a waste of water resource, as these flood flows help in river conservancy by flushing the waterways, keeping the river mouths open for navigation and preventing sea water intrusion further upstream.
The Brahmaputra valley in Assam is quite narrow having a mean width of only about 90 kilometers. For the enormous size of the river, there is not enough land to utilize its water. Most of its water, therefore, has to flow down to Bangladesh and on to the Bay of Bengal. Similarly, because of their short length to the sea and the consequent constraint of paucity of land, the west flowing rivers south of the Tapi do not offer much scope for utilising their waters.

The average annual flows of the various rivers or groups of rivers and the amounts at present considered utilisable excluding evaporation losses from reservoirs and streams are shown below.

	(million hectare metres)		
	Average annual flow	Utilisable flow	Approximate present (1974) Utilisation
Indus Basin	7.7	4.6	3.7
Ganga Basin	51.0	25.0	8.5
Brahmaputra Basin (including Barak)	54.0	2.4	0.5
Mahanadi and other east flowing rivers up to Godavari	12.3	8.1	2.8
Godavari, Krishna and other east flowing southern rivers	22.5	19.0	7.3
West flowing rivers south of Tapi	21.8	3.0	1.1
Narmada and Tapi	6.2	4.9	0.6
West flowing rivers north of Narmada	2.5	2.0	0.5
Total	178.0 or 180.0	70.0	25.0

Of the utilisable surface waters, the Ganga basin has the maximum potential followed by the Godavari and the Krishna. The Mahanadi is another river which has considerable water available for use.

As regards ground water, the utilisable amount depends not only on the quantity of water available in an area but also its quality. Excluding exploitation of fossil water, the upper limit for exploiting ground water would be the annual recharge including induced recharge reduced by whatever is lost by evapotranspiration and subsurface runoff or is otherwise unutilisable. On expansion of irrigation with new projects there would be more recharge due to seepage from canals and in spite of emphasis on lining irrigation channels, there would be a net increase in infiltration.

c) Optimization of water resources by using new techniques.

In arid areas, ground water is very valuable. In most situations, however, it is saline and in places unusable. With the new knowledge of plant physiology, soil science and modern irrigation techniques, it is possible to grow some selected crops with moderately saline water and secure reasonable yields. Where good surface water is available in arid areas either locally or by transfer from another basin, it can be utilised for diluting saline ground water for irrigating a larger area.

The available water resources in an area can be made to confer increased benefit through re-use and recycling of water. For example, water received in a drain from an irrigation system can be used for irrigation in areas lower down or pumped back into the canal for re-use if suitable in quality. This is already being practised in certain rice areas in Kashmir valley and can possibly be adopted in flat rice areas elsewhere, say, in Kerala and Orissa.

Using treatment municipal waste water is especially attractive for irrigating certain crops on lands close to cities as the plant nutrients in the sewage water ensure good yields.
Recycling and re-use of water in industries, with proper treatment, can also extend usable water resources. Altogether the utilisable surface flows aggregate to about 70 Mham and ground water about 35 Mham. Not all this water would be available for irrigation as there would be demands for other purposes like municipal, industrial including thermal and nuclear power, etc...

According to the broad assessment made the use of water for different purposes has been of the following order :

	(million hectare metres)
1. Irrigation	35.0
2. Domestic & Livestock	1.3
3. Industries	0.5
4. Thermal Power	1.0
	37.8 say 38.0

2.2.4. Present water planning system.

a) Historical background.

As will be seen from the previous paragraph out of the total water resources being used in the country, agriculture accounts for about 90 % share.

It may be mentioned in this context that out of India's population about 600 million 70 % are involved in agriculture which accounts for about 45 % of the gross national production. Agricultural products and agro-based industries also provide large percentage of India's exports of which important items are jute, tea, cotton goods, etc... Water is considered to be the master input for agriculture.

Irrigation has, therefore, been practiced in India from pre-historic times and ancient Indian literature refers wells, tanks, canals, etc... which have been said to have been maitained efficiently with a State taking the responsibility of their maintenance and operation. The entire landscape in central and southern India is studded with numerous irrigation tanks some of which have been constructed centuries ago. There are number of small canals in the upper valleys of the rivers of Northern India which are also equally old. In the British period a large number of irrigation works were constructed during the 19th Century and the earlier part of the present century in different regions of the country. Some of these have been serving large areas for more than a century now.

Government of India embarked upon First Five Years Plan development programme from 1950-51. Development of agriculture was given highest priority among different sectors proposed to be developed. Consequently a very large programme of development of irrigation was taken up in the country. Fundamental to all planning of water resources development is the availability of reliable and adequate data ; lack of data was the biggest bottleneck that was experiences when this planned development was launched upon.

b) To-day organization.

Under the Constitution of India water is a State subject. Therefore, the states were called upon by the Central Government to draw up plans for development of irrigation in their respective areas. Government of India, however, laid down certain guidelines which the States were required to follow in formulation and implementation of irrigation projects. Irrigation projects were classified in three categories : Major irrigation projects, medium irrigation projects and minor irrigation projects. Schemes costing more than Rs. 50 million were classified as major irrigation projects, projects costing up to Rs. 50 million were classified as medium irrigation projects and the smaller irrigation schemes to provide local benefits costing up to Rs. 2.5 (*) million in the plains and Rs. 3 million in the hills were classified as minor irrigation schemes.
Recently the criteria for classification of major schemes has been changed to projects having culturable command area above 10,000 hectares and the medium schemes having culturable command area up to 10,000 hectares. Criteria for minor schemes is also proposed to be changed on similar area basis. Ground water development takes place through various types of structures, and are, classified under minor irrigation sector.

(*) The financial limits of minor irrigation schemes were even lower in the earlier plan projects.

c) Results and perspectives.

The States took up the challenge and considerable progress has been made in development of irrigation potential in the country since the beginning of the Plan era.
The country has passed through four Five Year Plans and the Fifth Five Year is about to end. At the beginning of the first Five Year Plan, the total irrigated area from all sources was of the order of 22.6 million hectares. This was made up of 9.7 million hectares from major and medium irrigation schemes and 12.9 million hectares from minor irrigation schemes (6.4 million hectares from minor surface water schemes and 6.5 million from ground water schemes).
The gross irrigated area represented 17.1 % of the total cropped area fo 131.9 million hectares at the end of 1950-51.

By the end of the Fifth Five Year Plan, i.e., by the end of 1977-78 the progressive, actual and likely achievement under major, medium and minor irrigation schemes are shown in the table below :

	(in million hectares)				
	1950-51	1960-61	1968-69	1973-74	1977-78
1. Major-medium irrigation	9.70	14.30	18.10	20.70	25.00
2. Minor irrigation :					
a) surface water	6.40	6.45	6.50	7.00	7.80
b) ground water	6.50	8.30	13.00	17.50	21.00
Total :	22.60	29.05	37.60	45.20	53.80

The gross irrigation potential which will be created at the end of 1977-78 will be of the order of 53.8 million hectares. This works out to about 31.7 % of the total cropped area of 169.54 million hectares.

The achievements in the field of irrigation, though impressive do not go far enough to meet the country's requirements. More than two-third of the cropped area is still dependent on the vagaries of monsoon. There is, therefore, great anxiety to accelerate the pace of development of irrigation in different regions of the country by harnessing surface and ground water resources available.
It has been proposed to develop irrigation potential in an additional area of about 17 million hectares during the next 5 years which will consist of 10 (*) million hectares from surface water source and 7 million hectares from ground water source. This will mean that the rate of growth will have to be double the rate achieved during the last 5 years.

(*) Major & Medium - 8 million hectares / Minor surface - 2 million hectares

As has already been mentioned earlier the basic planning of development of water resources in different parts of the country has been primarily the responsibilities of the States. The Central Government, however, has been providing necessary guidance and assistance to the States in investigation and formulation of irrigation schemes. Several storage, reservoirs, diversion works and multipurpose projects have been executed in the country during the last 27 years and these have been serving very useful purpose.

2.2.5. Flood control in India.

As has already been mentioned earlier, the country is traversed by a large number of river systems and seasonal floods are experienced in some part of the country or other. In some areas the losses are considerable. There was a devastating flood in the year 1976 which caused loss of nearly Rs. 8.860 million.
Earlier efforts for flood control were intended for the protection of local interests and consisted mainly of short-embankments.
Though flood·control is also a State subject, after the devastating floods of 1954, a coordinated action was considered necessary by the Central Government and a comprehensive national policy programme for flood control was drawn up for the country.

The programme was divided mainly into three categories of works : immediate, short-term and long-term.
In the first catagory of works the collection of field data and protection of important towns were taken up. In the second category channel divorsion and improvements, raising of villages and construction of embankments and other town protection schemes were started. Long-term programme envisaged flood storage reservoirs, detention basins, additional embankments, excavation of drainage channels, etc...

Besides construction of about 10,260 km of new embankments and 17,850 km of drainage channels, protection of 251 towns and raising of about 4696 villages, a number of multi-purpose schemes like DVC dams on Damonar, Hirakund Dam on Mahanadi, Bhakra on Sutlej and Ukai Dam on Tapi river provide flood moderation by suitable operation.
The works have afforded reasonable protection to large areas. It has been assessed that by March, 1977 an area of 9.5 million hectares has been afforded reasonable protection out of about 25 million hectares considered to be prone to floods.

Apart from the above works considerable progress has been made in flood forecasting starting with an experimental flood forecasting centre on the River Jamuna in Delhi in 1959, the Central Water Commission took up the work of flood forecasting on major inter-state rivers prone to floods in 1969.
At present, 11 flood forecasting centres are functioning in various parts of the country. These have proned to be of immense help in timely vacation of population from unprotected areas as well as in taking measures to safeguard existing flood control works.

2.2.6. Future water resources planning in the country.

a) Setting up of organization.

There are 20 or more river systems flowing in the country. Almost all the major rivers are inter-state in character. It is increasingly felt that water resources can be developed in an optimum measure if the river basins or water shed is taken as a unit for planning and development. This has, however, not been possible as the rivers or a river basins cover many states who plan their development according to the local needs.
It has been seen that in many rivers considerable surplus water, particularly during the monsoon months, flow out to the sea unutilised to a large extent due to non-availability of storage sited within the State or due to non-availability of sufficient irrigable area or due to the area coming under high rainfall zone. It is felt that a sizable portion of this surplus water could be stored or utilised if the same could be diverted to areas outside the State.

It is, therefore, considered necessary to draw up master plans for development of water of inter-state rivers which may involve transfer of water from one basin to another. Such master plans have to be within the frame work of the national policy and such plans can only be drawn up and implemented under the overall guidance of the Central Government.
Such guidance is already being made available to the States and a number of projects have been implemented or have been taken up with inter-state collaboration. There is, however, need to accelerate this process to remove present imbalance in availability of water in different parts of the country as far as possible.

The Government of India have set up a Central Ground Water Board to conduct investigations in regard to ground water potential in different regions. Though development of ground water has been going on for many centuries in the country in a very limited way, large scale development through tubewells (deep and shallow) has virtually started from 1940 onwards. The total number of tubewells operating in the country during 1950-51 was only about 6000 and the number has gone up now to about 1.75 million. The number of electrical pump-sets fitted to tubewells and wells in 1950-51 was only 21,000 as against 3.3 million pump-sets operating at present. In addition many farmers are using diesel pump-sets where electricity is not available.

Nearly 60 % of the country is covered with hard rocks. Some of these areas do not have surface water resources and the people have to depend on ground water resources harnessed through dug wells, or bore-wells or dug-cum-bore-wells. To meet their water requirements the Central Ground Water Board in cooperation with the State Ground Water Organizations are conducting studies to develop suitable methodology to assess and develop available ground water resources in hard rock areas besides the other investigations which are being conducted all over the country through systematic hydrological surveys and exploratory drilling.

Ground water schemes are mostly financed from the institutional sector and this has become a farmer's own programme. On the basis of area schemes formulated by the State Ground Water Organizations, with the overall guidance of the Central Ground Water Board, farmers are provided with long-term loans by the financial institutions and they are encouraged to have their own tubewells which are mostly shallow and do not require heavy investments.

b) Programme for integrated development.

In addition to bringing more areas under irrigation through new projects an important programme for integrated development of command areas of irrigation projects has been taken up to optimise agricultural production by reducing the gap between potential created and utilisation thereof, through better land and water management.
The National Commission on Agriculture set up by the Government of India have recommended in their report that much coordinated work was required to be done by the Departments of Irrigation and Agriculture to organize the best use of the irrigation systems by modernising the same and adjusting the cropping patterns to the soil and agro-climatic conditions of the commanded areas.

Besides modernisation and efficient operation of the irrigation system up to the delivery point to the farmers' blocks of 40 hectares, the integrated development of the command areas has been suggested in respect of the following points :

- Development of main drainage system beyond the farmer's block of 40 hectares where it does not exist now and its improvement and modernisation to secure desired agricultural production.
- Development of the field channel and field drainage system within the farmer's block under each delivery head of the irrigation system so as to minimise water losses, prevent water logging and enable a proper system of Warabandi (rotation) irrigation for fair distribution to individual fields.
- Land shaping of a water shed area in the command for the type of irrigated crop that is being allowed in the command in each farmer's block.
- Exploitation of ground water to supplement the surface water and ensure conjunctive use.
- Fixing and enforcing of suitable cropping schedule for the various blocks in the command keeping in view the following objectives :
    - . when water availability is plentiful, maximum output per unit of land ;
    - . where water availability is medium, maximum output per unit of water ;
    - . where water is scarce, selection of crops requiring low duties of water and immunising as large area as possible from the effect of drought.
- Preparing a plan of input supply for credit, seeds, fertilisers, tractors and sprayer services, etc...
- Arranging the inputs and services.

- Planning the necessary marketing and processing facilities and the communication for maximum benefit to the farmer and maximisation of employment to the local population.

- Arranging the marketing and processing facilities and the necessary communications.

This programme has been initiated in 47 major irrigation projects in 12 States in the country and is proposed to be extended to other irrigated areas in due course.

c) Flood control.

With regard to flood control taking into account that considerable experience has been gained in planning, implementation and performance of flood control measures during the last 20 years and that technology has also advanced not only in India but also in other countries, a National Commission on Floods has been set up to make a comprehensive review of the policy and flood control measures that should be undertaken in different regions of the country in the coming years. It is fully realised that absolute immunity from flood damage is not physically possible even in the distant future because of unpredictability of several natural forces which might cause unprecedented situation. Even so with proper planning and continuous efforts it is reasonable to look forward to an appreciable diminution of human distress with an accelerated implementation of flood control and management measures.

2.2.7. Drinking water supply.

There are about 576,000 villages in the country. Out of this a small percentage have piped water supply and the rest have either access to wells, springs canals or river water. Special efforts are being made under the National Water Supply and Sanitation Programme to extend piped water supply at a much faster pace to the rural areas.

With the rural water supply problem of the country being so extensive in shape and diverse in character, it was inevitable that attempts should have been made to attack the problem through different agencies and the different ways in order to make the best use of the available material and manpower resources at the centre and State levels. As a result of the endeavours made during the Five Year Plans tangible progress has been made in the respect. A very large step-up in this field is projected during the next five years.

2.2.8. Conclusions.

In view of the wide ranging topographical, climatic and hydrological contrasts prevailing in India, as described in the earlier paragraphs, it is imperative that the institutional arrangements have to ensure complete coordination between all bodies responsible for the investigation, development and management of water resources in the country.

For a developing country like India, with a predominantly agricultural economy, the basic requisits is to assess and evaluate the total water resources available in the country both surface and sub-surface. The present efforts have to be vigorously pursued to refine the broad assessments made so far.
On the basis of a national policy inter-regional cooperation has to be achieved for optimum development of water resources keeping in view the existing regional imbalances.

To optimise agricultural production the present efforts to bring about properly, integrated management of land and water resources have to be followed up continuously and it should be ensured that all known techniques for controlling land and water degradation resulting from improper management are adequately applied.
Alternative development proposals taking into account environmental, social, technological and economic factors should invariably be considered before decisions are taken in respect of major water harnessing projects. The country is forging ahead keeping these objectives in view.

2.3. DISCUSSION OF MR. BANERJEE'S EXPOSE.

Mr. THORPE :
"There are in your country a million villages suffering from water deficiency. Which organization is responsible for these villages ?"

Mr. BANERJEE :
"It is the Central Government which is responsible for drinking water planning. A very slow equipping process is being undertaken, but we have still not been able to do all we would like to."

Mr. RANGELEY :
"Mr. BANERJEE's exposé fortunately complements that of Mr. HARIRI and reveals contrasts all the more interesting for they are marked between the two countries.
In the case of Iran, from the very beginning, planners were faced with competition between the agriculture and the energy needs. It was energy, which should have come in second place, which was victorious.
The case of India is very different : irrigation predominates, but the conflict this time is between agricultural and urban needs.
In addition, India has managed to prepare large-scale master irrigation schemes (although the Krishna development project is still missing), but she still has no precise plan for urban water supply.
Also, more attention must be paid to untapped water utilization."

Mr. BANERJEE :
"I have treated the Brahmaputra case for there are disastros floods in Bangaldesh. The diverting of its surplus waters towards the Ganges was studied with Bangladesh authorities."

Mr. AYIBOTELE :
"In the table presented in paragraph 8 of your document, small-scale irrigation schemes are noted. Cannot they be associated ? Would not this have the same effect as large-scale projects ?
Could not this be an interesting subject for research, capable of rendering enormous services ?"

Mr. BANERJEE :
"In India, the same means are devoted to small as well as big projects. The scale of the project depends on the regions concerned, but, like you, I think that small projects can better satisfy the needs."

Mr. ROWNTREE :
"I would like to ask Mr. ETIENNE if small-scale project experts can be obtained ?"

Mr. WIENER :
"I have three questions :

a) Do the wells only concern the small agriculturers having only one hectare and who have the most crying needs ?

b) Is ground water storage studied ?

c) What are the repercussions of these investments on food ?"

Mr. BANERJEE :
"Here are the answers I can provide :

a) Agriculturers having less than a hectare are considered marginal. The implementation of very small works being difficult to finance, grants of say 25 % are given. If they groupe together, the grants are increased. This encourages them to associate with each other.

b) This question is very interesting. We are studying ways of increasing the percolation, for exploitation of nappes and their storage capacity would open great possibilities.

c) Our integrated programme only concerns agricultural production development."

Mr. KABURU :
"We have in our country a centre for training technician trainers and agricultural personnel. Does this exist in your country ?"

Mr. BANERJEE :
"We have such courses whicn are patronised by UNESCO. The institute I spoke of deals with different types of water works : how to recharge over-exploited zones, without affecting the irrigation network too much ? How to exploit ground waters without reducing surface water flow too much ?"

Mr. CAULFIELD :
"There has been much talk about hydroelectricity. In India, you have changed your organization : water has passed from Energy to Agriculture. What are your intentions ? Which of the two has the upper hand ?"

Mr. BANERJEE :
"In India, energy depends a lot on coal resources. In addition, as water is utilised 90 % by agriculture, we deemed it more rational to confide water management to this ministry. I can however add that this does not exclude a good coordination with hydroelectrical energy producers."

Mr. JOHNSON :
"Are your big projects in the act of being implemented ? Are they known by the public at large ? What is their reaction ? How is the water rights problem solved ? How is irrigation preserved ?"

Mr. BANERJEE :
"All this is yet at the studying stage.
It is however to be noted that transfers take place only during flood periods. This implies storing which can only be envisaged up river, in collaboration with Nepal. Reservoirs must exist for dispensing complementary energy. Concerning water legislation, state agreement must be obtained, except for surplus monsoon waters for which this necessity is not felt !"

Mr. HARIRI :
"The areas concerned by your irrigation projects are very vast. I would like to know if they are former irrigation zones or zones as yet to be tackled. I wonder also if, in your projects, you are concerned with individual blocks and if you develope the "capillary irrigation network" (3rd and 4th degree canals). Should not this be envisaged since your development plans are foing to modify the agriculturer's style of living. Finally, how much will all this cost ?"

Mr. BANERJEE :
"The figures mentioned correspond to irrigation potential ; they concern the forty hectares irrigation network. This network will extend over 17 million hectares (major project), but seven million hectares development schemes (minor project) will be the responsibility of agriculturers, who will have to dig wells and undertake pumping.
We are trying to reduce the gap between the irrigable potential and actual exploitation, but this gap is inevitable."

Mr. ROWNTREE thanks the participants and comes back to Mr. KABURU's intervention, which constitutes a good example of the questions to be discussed in the workshops. He then requests Mr. VALIRON to give the inaugural day's third exposé.

3. REGIONAL WATER PLANNING IN AN EUROPEAN COUNTRY.

3.1. MR. VALIRON'S EXPOSE.

Following Mr. BANERJEE, Mr. VALIRON was to present the French example in a conference centered around four main points :

- An historical background of the political and administrative structures related to water resources management and introduction to the notions of Financial Basin Agency and Basin Commettee.
- The exposé of the actual organisation of the basins and their connections with former structures.
- Progress achieved till 1969.
- Water management instruments and quality objectives policy.

The speaker was to conclude his exposé by drawing up some conclusions and perspectives as regard the future.

3.2. INTEGRAL TEXT OF MR. VALIRON'S COMMUNICATION : "REGIONAL WATER ORGANIZATION IN FRANCE".

3.2.1. Historical introduction.

For two reasons, the centralized nature of French Government and the relative abundance of water supplies, hydraulic management has been based on a breakdown by which each of the specialized Ministries concerned dealed with the water problems over which it had authority. This was the situation until 1964 (see table next page).

Water control is shared between Development and Agriculture, according to the size of the river, Industry being given authority over groundwater considered as a mineral resource.

In this plan, there was no such thing as a management unit, each one managing independently a commodity assigned to a certain use. This autonomy was only modified by the effects of inter-departmental conferences answerable to the Préfet of the region, and the possible arbitration of the Prime Minister or, after World War II, due to economic development plans.

	Ministry in charge of management	Ministry responsible for State financing
Ports	Development	Equipment
Inland waterways	"	"
Work on State rivers	"	"
Water supply and sewarage in urban districts	"	Home Office
Water supply and sewarage in rural districts	Agriculture	Agriculture
Irrigation	"	"
Drainage	"	"
Ditch cleaning along rivers other than in State property	"	"
Dams (hydroelectric)	Industry	none
Quality of potable water	Health	"

a) The first attempts at regionalization were made after 1920 but remained centered on a certain type of water utilization.

Thus the Compagnie Nationale du Rhône was founded in which the State was associated with the local authorities in order to contribute to the development of the Rhône valley and with the production of hydro-electric power, following the transformation of the river into a navigable waterway. As a secondary activity, the Compagnie was authorized to set up industrial zones and divert the river waters for the benefit of agriculture. But the field of action was limited to the Rhône itself, to the exclusion of its affluents, and C.N.R. achievements were above all centered on hydro-electric power and navigation. However, the C.N.R. played an important part by revealing the links between development and the water factor and the resource unit for a variety of utilizations. The work done in common by the different collectivities and the State also played a pilot role.

And so, after the second World War, this model served, under the auspices of the Ministry of Agriculture, as a basis on which all Compagnies Nationales were founded, for the development based on the use of water to the benefit of farming by irrigation and, as a sideline, the supply of water to villages vehicled by the same structures. Here again, we find an association between the State and municipalities and users, on local Boards, and management orientated towards the satisfaction of multifarious uses.

Four out of the five compagnies established, Rhône-Languedoc, Canal de Provence, Coteaux de Gascogne and the Corsican development company, that have been operating for over twenty years and built very impressive structures, represent regional instruments that already come very close to the management units with an enlarged objective, even if their activities have excluded numerous uses of water owing to their limited scope.

b) The Law of 1964.

These precedents had great weight when the law sought to modernise the regulations on water, pushed by ever more noticeable stress on potential water resources, increasingly solicited by growth in the needs for water and by the rapid deterioration of quality due to man-made or man-induced pollution.

Of course, a comfortable margin of the bulk quantity appears since only 20 % of the total resources are being tapped; as can be seen from the following table :

WATER RESOURCES IN FRANCE *	
Rainfall	460 mrd. m3
Evaporation and evapotranspiration	260 mrd. m3
Waterflows (streams & rivers)	80 mrd. m3
Groundwaters	120 mrd. m3
Collected (1975) (EDF, Industries, drinking water, agriculture).	23 mrd. m3
* for average years	

However, the low-water levels often coincide with the seasonal increase in the amount of water drawn off, multiplying the low-water rated by 1.5 and dividing the available resources by 4 to 5. Deficits existing in the South of France thus spread to highly populated regions such as Paris.

These difficulties are increased by a deterioration of the quality due to an increase in polluted effluents. In 1960, less than 5 % received previous treatment and the flow reaching the rivers was estimated to be in the region of 110 mio. population equivalent.

It was therefore advisable to set up an overall system of management and give up the existing method consisting of decentralized management.

What choice had to be made between the possible solutions ?

Wipe out the complete organization formerly existing, that broke down administrative and regulatory authority between different trustees representing the users : Agriculture, Development, Industry, Health, Home Office, etc..., and set up a new administrative unit responsible for all French water resources and distribution.

Maintain the existing structures in the essential points and create a system of coordination between the different trustees to confer unity on the various actions obligated by shortage or lack of quality.

As everyone knows, the Government decided on the second solution and largely associated thereto all the water users. Thus completed regulatory and normative action by economic and financial measures, thanks to the establishment of a compulsory mutual system for all water users in the same basin.

Without going into all the details of the law, stipulations of which applied to tangible cases are given in chapters 3.2.2. and 3.2.3., it can be said that the present organization results from some of the essential provisions of that law.

Water management is organized according to the big hydrographic basins, because decisions have to be made within this framework to ensure a rational management of water resources.

This organization closely associates Government Offices and Consumers, both public and private, who are directly concerned either as consumers or as decision-makers.

It sets up a special investment fund supplied by compulsory contributions. This compulsory mutual association, that makes the various consumers pay water rates in proportion to the advantages or the drawbacks of their activities, redistributes the total amount to aid the building of structures in the common interest, attenuating drawbacks and sharing out the advantages.

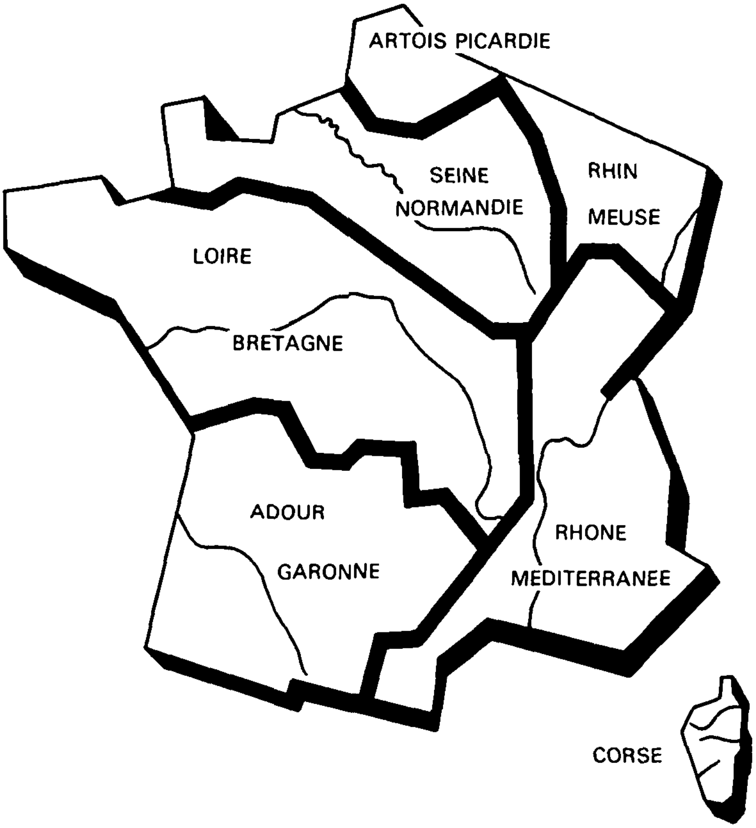
Naturally, State supervision of the whole arrangement, through different means, has been provided to avoid that efficiency due to decentralization does not jeopardize the indispensable unity of policy.

The organization on which this new arrangement is based is the Basin Committee that manages the resources with the backing of the Basin Financial Organization, its executor. State control is exerted by means of trusteeship and through the centralising and coordinating offices : the Interministerial Water Commission and the National Water Committee that controls.

3.2.2. Basin organization and links with former structures.

a) Basin Committee.

The Basin Committee gathers in each of the 6 big French basins (see following map) the consumers and decision-makers in 3 categories :



SIEGES DES ORGANISMES DE BASSIN

ARTOIS/PICARDIE
764, boulevard Lahure, 59508 DOUAI
Tél. 87.01.94

RHONE/MEDITERRANEE/CORSE
31, rue Jules Guesde, 69310 PIERRE-BENITE
Tél. 50.16.40

SEINE/NORMANDIE
10-12, rue du Cap Ménard, 75732 PARIS CEDEX 15
Tél. 578.12.00

ADOUR/GARONNE
84, rue de Férétra, 31078 TOULOUSE CEDEX
Tél. 53.21.51

LOIRE/BRETAGNE
Avenue Buffon, 45018 ORLEANS CEDEX
Tél. 63.08.16

RHIN/MEUSE
Lieudit «Le Longeau»
Rozerieulles 57160 MOULINS-les-METZ
Tél. 60.36.78

- representatives of municipalities elected by the Conseil General of the region concerned.
- representatives of consumers (industrial, farming, fishing and tourist associations, professional sea fisheries, etc...).
- Civil Service representatives, among whom the Regional Préfet.

In bulk, these 51 to 63 official members, plus an equal number of deputy members, make up the deliberative Basin organization.

Each Basin Committee elects a President and a Vice-President among members other than the State representatives.

The Committe is consulted on the intervention programs presented by the Authority. It gives its opinion on the rate-base and percentage proposed by the Authority in view of the finances required for its interventions. It can be questioned, either by the Ministry in charge of cultural and environmental affairs, either by the relevant Ministers or Regional Préfets, on differences of opinion that may arise between water consumers and, more generally speaking, all matters covered by the above-mentioned law.

This constitutes, in fact, a real little "Water Parliament", since no program for the improvement of the quantity or quality of water resources can be financed, within the scope of this new system of solidarity, without an affirmative vote on both the project concerned and the means of financing proposed.

The action taken through each of these Basin Committees is an overall one and takes place on three integrated levels.

- *Technical level.*

The Basin Committee fixes its objectives, in varying perspectives, for the Basin as a whole, for the sub-basin, a river, for the upstream or downstream zone and takes into consideration both quantitative and qualitative aspects.

- *Economic level.*

It works out price forecasts for the actions envisaged, measures the contribution for each party concerned, then decides on programs according to the ability of each of these parties to stand the burden thereof. It provides financial assistance for those who really do something.

- *Lastly, the political level.*

Decision-making belongs to those to will have to commit themselves or those they represent. They do so in the course of a session of deliberations and have their decisions applied by an "executive, issue from these deliberations".

b) Basin Authority.

The Basin Authority, set up under article 14 of the Law, completed by the decree of September 1966, is a public institution of an administrative nature, having a corporate identity and financial autonomy, and whose aim is to facilitate actions in the common interest of the Basin. To achieve this aim, the Authority is entitled to collect rates from consumers of water, whether public or private entities, insofar as the latter make it necessary to do so, and this with a view to assisting financially the construction of the necessary plant for the improvement of resources or to counteract pollution.

In fact, the role of the Authority is, therefore, to create solidarity between the users of the same Basin, and to promote a true economic management policy of water as an indispensable raw material. Beyond this vital function, the Authority contributes to the implementation of research, surveys and the drawing up of general basin development programs.

The Authority is run by a Board of Directors comprising 20 members, of whom 10 are Civil Service representatives from the competent Ministries in affairs concerning water, 5 representatives from the municipalities concerned, members of the Basin Committee, and 5 consumer representatives, also designated by the Basin Committe. Since 1974, representatives of the marine environment have been included in the Authority and the Basin Committee and the objectives have consequently been extended to include the protection of the coasts from pollution. A manager heads the Authority and ensures that the whole operates properly. He is appointed by the State.

The close link between these two organizations should be noted since at least half of the Authority directors are appointed by the Committee and rates, that are the sole resource of the Authority to keep itself operating and finance the programs, cannot be established without the Committee's agreement.

The Authority is the executive instrument of the Committee and implements all the policies fixed by the latter.

Finally, thanks to the structures conferred on the Authority and the Basin Committee, as well as their operating rules, a permanent discussion is open between the State, local authorities and consumer representatives in order to promote a water policy that everyone agrees with, and this is one of the great innovations of the Law of 16th December 1964.

It does not appear to compete with the entrepreneurs of public or private works since it simply brings possible financial support in the execution of their projects. The Committee is never the Sponsor of works, such responsibility being left, as in the past, to the traditional channels, mayors, industrialists, municipal and département syndicates.

c) Strategy.

This depends on the Basin Committee and Financial Authority whose actions are invariably joint : One (the Authority) is the other's (the Committee's) executive and emanates from the latter.

- The long-term "WHITE BOOK".

Long-term reflexion is based on a statement of facts and prospective studies, published in a White Book. This document is both :

- Technical : it defines objectives, proposes choices and, depending on these, makes a projection of the different actions at different dates in both the field of adapting available resources to fereseeable needs and that of pollution supression.
- Financial : it valuates the available monetary resources required for carrying out the works according to the different assumptions. It situates the main origin of such funds (State, Municipalities, Industries) and proposes a corresponding level of water rates to the share expected from the Authority.

This document that is the largest consulting procedure devised for all categories of water consumers, by whom it is widely appreciated, has today become the reference publication accepted in all proceedings on the water policy of the basin.

- Medium term : the program of intervention.

Considered as medium-term in scope, the action takes place as part of a several-year intervention program resulting from the White Book, the duration of which matches that of the Plan. In conformance with national directives, established in agreement with those responsible for devising and implementing the Plan, especially with regional authorities and professional bodies, the program is discussed by the Financial Authority and adopted by the Basin Committee, i.e., in fact, by the elected representatives of future sponsors.

It, thus, becomes a "contractual undertaking" between the different parties coming into the picture :

- The State that decides on objectives and partly subsidizes the works,
- The sponsors (municipal or industrial) by whom and on whose behalf the works are to be performed,
- The Basin organizations (both the State and the entrepreneurs) who define the objectives at Basin level, deciding on intervention flow-diagrams and lists of operations, and bring extra help.

d) Means of financing.

Defined by the technical options, the content of the program is fixed at the same time as the financial package. The latter results both from State underwritings in favour of the municipality (about 30 % of the cost of works), commitments on the part of industrialists within the scope of the regulations concerning them, the Financial Authority's resources calculated at the level of the Basin Committee (40 to 50 %) exceptionally 60 % of the cost of works, in favour of the municipalities and industrialists.

The Authority's resources enabling it to grant assistance as defined by the program come mainly from the water rates voted by the Basin Committee to finance the following commitments :

- rates for "collection" and "consumption" based on the quantities of water collected or consumed.
- fees "for the deterioration of the water quality", based on the quantities of pollutant matter discharged (assessed in population equivalents for local communities, according to a flat-rate or measurements table applicable to industries).

The annual budget of the Authority is fed by such incomings that confirm the physical solidarity of water users and, by the feedback in the form of loans and advances, and shares out financial assistance as subsidies, loans or advances to the different public or private sponsors. It also covers its own operating costs and expenditure on studies that never exceed 15 % of the total amount (1).

e) Coordination.

Coordination is a necessity because water interests all the economic operators and decision-makers, and experts its authority, therefore, at the national, regional and département levels.

At the national level, the point is to avoid a non-coherent policy for the 6 basins. The National Water Committee keeps watch over technical and financial coherence and the Interministerial Mission, whose job is to approve Basin decisions, makes sure that affairs are coordinated on an administrative level.

At Basin level, the Basin Delegate Mission of which the secretarial department is managed by the Authority, sees that programs are fully coherent with those of the technical authority and intervenes to ensure that regulatory actions are in harmony with the actions planned by the program.

As far as the Region is concerned, it is the Technical Committee depending on the Préfet and the C.A.R. (Regional Admin. Conference) that plays this role.

(see table next page)

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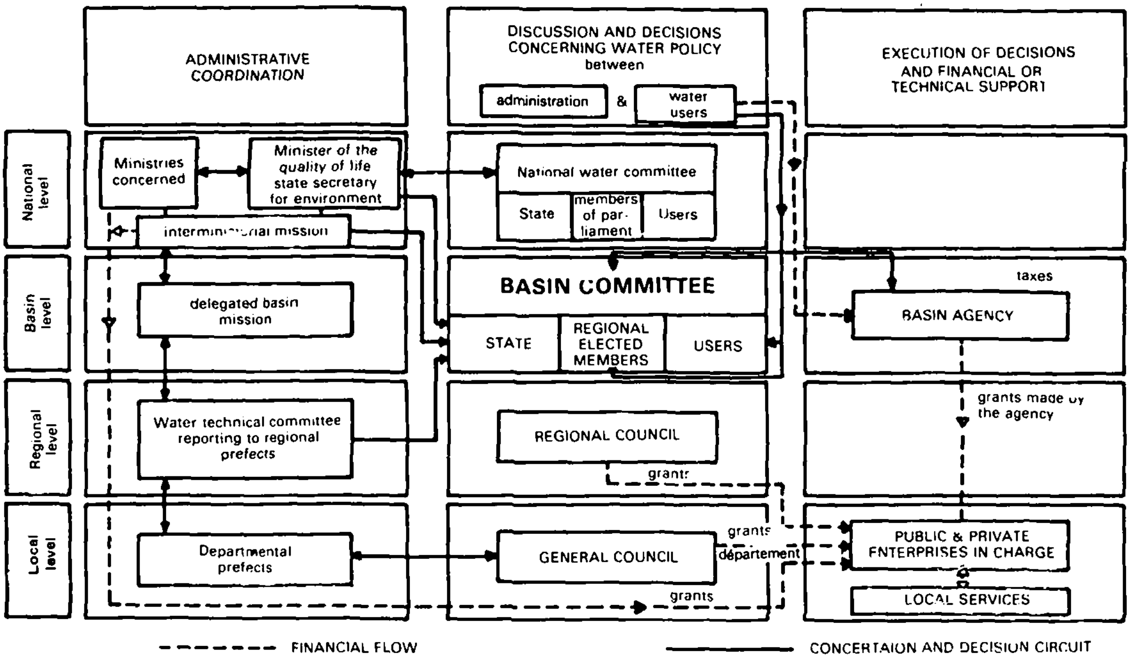
(1) This rate changes from one Authority to another according to the budget's importance. It is lower when credits voted are the highest. Thus, it does not reach 10 % for Seine-Normandie Authority.

ORGANIZATION CHART OF WATER POLICY



3.2.3. Action taken since 1969.

After the Law was voted, and during the stage of reflexion that preceded the creation of the Basin Authorities, the authorities first thought over the possibility of economic incentives that these new institutions offered. At the time, the marginal theories were the great fashion and it was believed that, thanks to the "truth of prices", economy could expand harmoniously.

In particular, to reach this result the external costs had to be internalized so that the prices integrated the costs for the community and not only the direct cost of enterprise.

The Basin Authority made it possible to price water in its natural environment and to have the services rendered by a waterflow evacuating waste paid for accordingly.

Thus, it can be seen that in a basin where the water supply needs developing, it is enough to have the net consumption paid for, at the marginal production cost of the quantities required, in order to optimalize the bulk costs, for the community, of the water used.

Likewise, a fee in proportion to the quantity of pollution discharged, equal to the marginal cost of de-polluting to the required quality level, fulfils this "lowest-cost" objective.

These theories that originated in the U.S.A., especially in "Future Resources" inspired by Doctor KNESE, contended that, if the system was to work properly, the money collected in this way should not be returned to the rate-payers.

It was hoped that, on the strength of such theories, management could be based on the price of the resource, thus obviating regulations as such.

However, when the Authorities had been installed and the first programs were discussed with future rate-payers (industries and municipalities), it appeared that the maximum permissible rates were about 20 % only of the amount that would have resulted through applying the foregoing theory and, even now, the rates are still way behind these theoretical levels - see table next page.

Two rate bases were set forth :

- A base evaluating the collection and consumption of water (i.e. collection without return, like agricultural use, or in certain industrial processes in which the water is evaporated). These rate bases are computed as volumes and some kind of meter normally keeps count of the quantities of water used.
- A base bearing on the quality of the water poses the same problem concerning the choice of parameters (that should be representative and measurable), of their summation (it must be easy, e.g. adding up) and of a weighting system to grade them in importance (this must be fair to all users).

Currently, in France, out of about 50 parameters by which the quality of water can be determined, we have kept the most important parameters from the point of view of quantity, being careful to be able to measure same quite easily. These are :

- suspended solids (S.S.)
- oxidizable solids (D.S.) composed 1/3 the chemical oxygen demand (COD) and 2/3 the bio-chemical oxygen demand at 5 days (BOD 5)
- salinity (S) expressed by the conductivity of the solution
- toxic matter (T) taken as a whole by means of a biological test using daphne and the normal toxic solution concept.

The units of measure are variable (grams or kilograms/day for S.S., grams or kilograms/oxygen/day for DS, mho (reverse of ohm)-cm for conductivity, number of dilutions required to obtain a normal toxicity rate). These measures are all of the flux type (generally a mass flux) and not concentrations. They are directly summated :

$$\text{pollution} = (S.S) + (D.S.) + (S) = (T)$$

Different financial rates apply to each of the factors expressed.

Despite the fact that the rates are still too low, the management of resources has largely developed since 1969 due in a great part to the Basin Authorities.

QUALITY IMPROVEMENT

TAXES PAYABLE ANNUALY BY 1 INHABITANT DISCHARGING THE POLLUTION LEVEL FIXED BY THE ORDER OF 28.10.75 AT 90 g of MES (Oxydable matter) 57 g of MOS (suspended matter)

IN FRANCS

At annual rate :		Adour-Garonne	Artois-Picardie	Loire-Bretagne	Rhin-Meuse	Rhône Méditerranée Corse	Seine-Normandie
Rejets aboutissant dans les eaux souterraines :		—	4	—	7,80	—	—
	maximum	1,50	3	3,08	5,46	2,70	3,31
1970	weighted average	1,50	2,28	2,25	2,45	2,70	2,35
	minimum	1,50	2	1,75	0,78	2,70	1,10
	minimum sea	0	0	1,75	—	0	1,10
Affluents discharged into underground water		—	4	—	7,80	—	—
	maximum	1,80	3	3,08	5,46	2,70	3,31
1971	weighted average	1,80	2,28	2,25	2,45	2,70	2,35
	minimum	1,80	2	1,75	0,78	2,70	1,10
	minimum sea	0	0	1,75	—	0	1,10
Affluents discharged into underground water		—	7,80	—	15,30	—	—
	maximum	6,00	5,85	9,34	10,71	10,50	11,625
1976	weighted average	5,50	5,05	7,70	6,10	7,10	8,35
	minimum	5,00	3,90	5,82	1,53	7,00	7,75
	minimum sea	0	3,90	5,92	—	0	7,75

It is certain that, among the causes there is the underlying search for economic efficiency that served as a model for the first programs drawn up and the first systems of rates. It is still present in the current system, even if coming face to face with realities has greatly blurred the stringent logic of the original model.

a) Basin Authority interventions in the field of quantities.

In this field, the diversity of Basin Authority actions reflects the diversity of the situations to be found in France owing to the geological and climatological circumstances that are extremely varied in nature and of a wide contrast in economic development.

Thus, the Seine Basin where a program to support low-water levels is in progress byt where the infrastructures are not very highly developed, the Authority has been able to fit in easily with the existing programs and facilitate the implementation thereof, taking the place of the municipalities in financing the big dams.

On the contrary, on the Mediterranean coast where old needs had already led to the setting up of highly organized development companies, the Authority's interventions have remained more on the margin.

It is, however, in those places where there remained unsolved problems that the Authorities were instrumental in procuring rapide progress :

- The "Loire-Bretagne" Basin Authority was able to foster the launching of great development plan for the River Loire and another development program for the River Vilaine,
- The "Rhin - Meuse" Basin Authority has drawn up and partly implemented a program for the development of the Moselle,
- Several Basin Autorities have intervened in the field of groundwaters which is an important innovation. It was the Basin Authorities that made possible the practical realisation of a simultaneous and coherent plan of management covering both ground and surface waters. "Artois-Picardie" Basin Authorities were the initiators of this policy which they have developed on the largest scale, but a similar approach is to be found in other Authorities : "Seine-Normandie" with the Caen and Le Havre districts, "Rhin-Meuse" with the Daller sheet, and soon that of the Vosges lands, and at Adour-Garonne for the Bordeaux district.

b) Basin Authority intervention in the field of pollution.

Since the beginning of the VIth Plan, the struggle against pollution in France has made considerable progress : in seven years, the purification facility has almost tripled. Pollution that was making headway from one year to the next for nearly thirty years was at last stabilised and is now beginning to retreat. Of course, this is due to State action with the contribution of greater sums of money for anti-pollution measures and whose departments have shown far greater efficacy than in the past. Notwithstanding, the part played by the Basin Authorities has been a fundamental one.

The first Basin Authority contribution was to procure knowledge on the discharge of pollution. The rate base is an essential element of this knowledge. In particular, in the industrial field, it is the precise knowledge of the pollution being discharged by factories and of the rates paid, compared with the added value of firms, that made it possible to determine the industrial policy for the Quality of Life Ministry and led the State to supply extra assistance within the scope of industrial branch contracts where the struggle against pollution represented a charge that was difficult to assume.

The data supplied by the Basin Authorities has given a basis on which it is now possible to draw up a plan for the recovery of a river in fifteen years.

Another contribution made by the Basin Authorities has been the planning of plant and equipment on the basis of the hydrographical basin independently of the traditional administrative limits. Thus, priorities could be defined and thanks to modifying the water rates and assistance procedures, the Authorities have been able to orientate the choice of operations undertaken. However, in this field, results are not entirely satisfactory for two apparent reasons : the highly variable action from one département to another of those entrusted with water policing and a tendency to scatter credits from the State, reinforced by centralization. The necessity for a voluntary planning of State and Basin Authority actions is obvious, and the application of the quality objectives policy during the next few years should be a means of doing so.

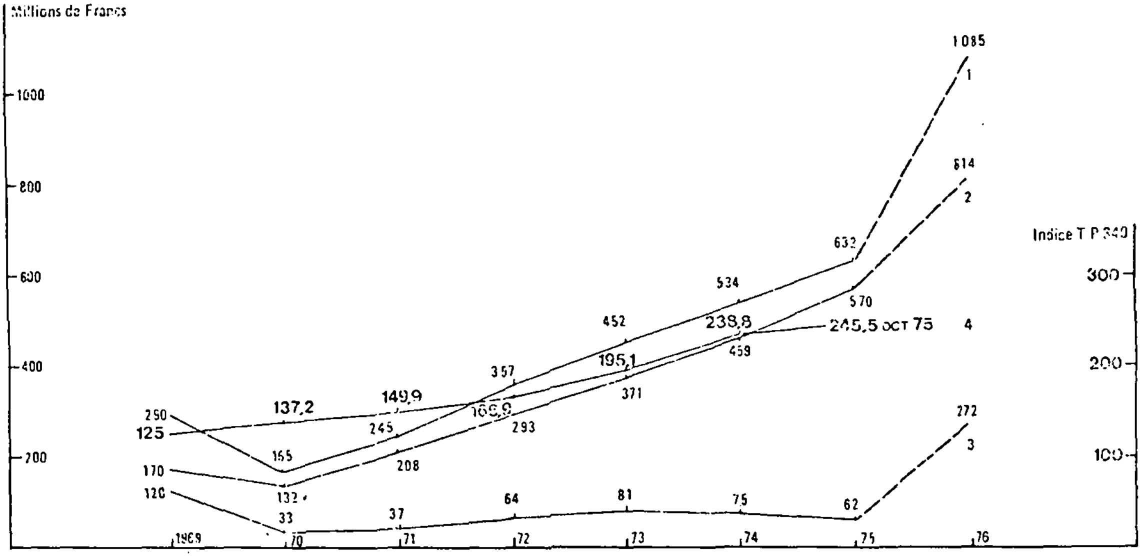
The role of the Basin Authorities in Technical Advice to users, municipalities and industrialists has been an essential factor. The lack of technical authority on the part of the government departments was wellnigh general seven years ago. People just contented themselves with applying the national circulars laying down standards, without being capable of advising polluters as to the means of complying therewith. And too often the latters' demonstrations that it was technically impossible to satisfy requirements were too easily accepted. Thanks to the technicity of Basin Authorities associated with the necessary financial means, made available to pollution generators, the fight against pollution has been able to make much progress within a few years.

The following tables show the importance of the financial effort and the results obtained in limiting the amount of effluents.

Thus, in under ten years we have gone from circumstances in which the water condition began to pose serious problems to the implementation of a rational policy enabling us to make up for lost time. In this recovery, the Basin Authorities have played an important part due to a number of special features which go to make up the originality of these public institutions in the French Civil Service system.

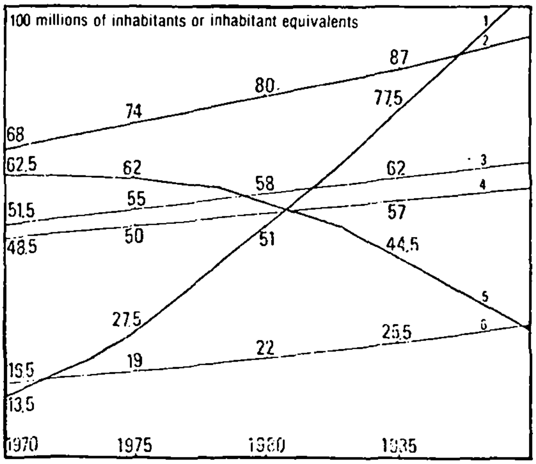
Their success is attributable to :

- firstly, the fact that the Basin Authorities have geographical authority corresponding to the hydrographic basins and that, only geographically, it is possible to define a coherent policy of water resource management.



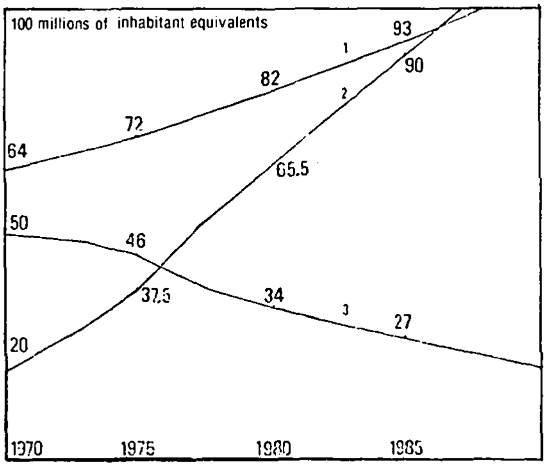
1 Sum total of grants
2 Quality improvement
3 Quantity
4 Index T P 340
— — — Forecasts

Evolution of the annual sum total of decisions to grant financial aid, made by the Basin Financial Agencies



1 Service capacities
2 Total raw pollution
3 Raw pollution - household and similar utilization
4 Permanent and seasonal pollution
5 POllution evacuated locally
6 Raw pollution of connected industries

Local communities, domesic pollution
and connected industries



1 Raw pollution
2 Service capacities
3 Pollution discharged locally

Industries not connected
(Classical pollution)

- then comes the close collaboration with municipalities and users in the decision-making within the scope of a coherent policy. On the one hand, the Basin Committees vote the water rates, on the other, a local management policy is determined by the Basin Committees and Boards of Directors who dispose of the financial means affected to its implementation : each decision to intervene is, in fact, the subject of a decision made by the Board of Directors or a specialized commission created by the latter.

- Lastly, the creation of a financial circuit affected independently of that used for financing productive investments. Thanks to these financial means, the industrialists accept more readily certain restrictions imposed on them insofar as they are not in competition with productive investments they would like to make and this advantage is the greater as credit is more difficult to obtain.

3.2.4. A method of water management - quality objectives policy.

As soon as they were founded, the basin organizations sought to rationalise anti-pollution actions by fixing objectives, the outlines of which have been defined in each of the six basin White Books. Whilst stressing the solidarity that unites the users of the same waterflow, both upstream and downstream, they first attacked the problem by limiting the geographical zones of intervention, giving them different priority levels. The method followed bore in mind the following points :

- evaluation of the quantities of pollutant matter discharged,

- decision to set up standard purification plant, to de-pollute as best as possible in view of the technically classical means available,

- drawing up of a program with figures, mentioning the priority contributions to be obtained from State financing systems, the départements and the Basin Authority.

It must be acknowledged that the then current notion excluded the idea of utilization as a decisive factor in reclaiming rivers. The idea of quality objectives had not been fiven its full importance either.

Quite quickly, therefore, the Authorities sought to develop in accordance with article 3 of the Law, an action depending on the uses to which the water was put, but on the opposite of what had been formerly done, without any omission. This involves fixing, be decree if necessary, stretch by stretch of the river, the technical specifications and physical criteria as well as chemical, biological and bacteriological standards to which the water quality must be made to comply in order to satisfy the recognized priority uses of the water.

Surveys conducted have shown the efficiency of this method which offers the advantage of a logical construction for all those living on a basin.

Moreover, it enables the establishment of coherent and possibly progressive programs, the effects of which on the natural surroundings are clearly announced at the outset.

In order to build programs, however, four minimum conditions must be observed :

- a good knowledge of the quality of the river water must be available.
- one must know how to associate a number of criteria for each different utilization, with a maximum value that must not be exceeded if satiffactory use is to be obtained.
- the exact knowledge on pollutant effluents must be had, together with possible developments over time.
- the effect of these pollutant effluents on the natural environment must also be known.

We must admit that we have not yet accumulated all the knowledge required to satisfy those four conditions. A pragmatic approach has been preferred to a strictly scientific one which opens up development on the lines of a quality objectives policy.

For this reason it was necessary to begin by rough preliminary operations, sufficiently thorough to facilitate gearing to the new method, the more so as the level of knowledge of the natural environment and effluents had made progress at the same time.

And so we began, in 1975, to set up the new method along bigger and bigger rivers. We indicate hereunder the different stages of such an action.

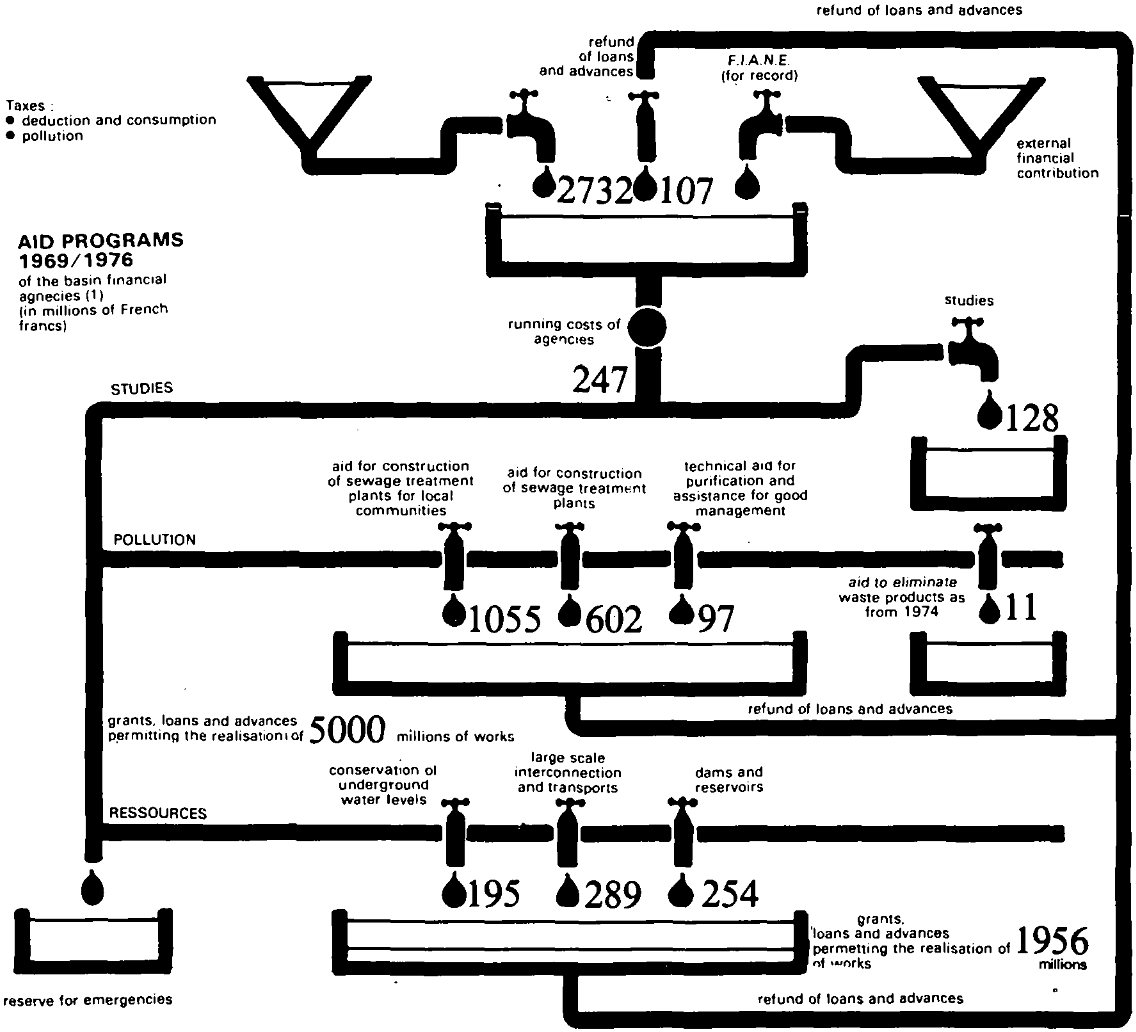
a) The uses of water.

To each utilisation, a list of parameters must be attached the maximum values of which must be fixed that must not be exceeded if the utilization is to be respected.

An initial grid of this type was adopted (see appendix 1). This grid of a very general nature made it possible to tackle roughly the problems of the link between utilization and quality. Then specific grids for each utilization were drawn up by the European Community. A directive dated 16th June 1975 (see appendix 2), published by the EEC Official Journal on 25th July 1975, defines the quality required for surface waters intended for the production of potable water. This directive was enforced in France in July 1977. Others grids are being drawn up viz :

- the quality required for fresh water fish-farming
- the quality required for fresh and salt water bathing sites.

Thus, step by step, it will be possible to associate a grid of parameters with each main utilization of water. It must be remarked, however, that if drawing up such a grid is somewhat laborious, the passage from the quality of water environment to the quality imposed on effluents is tricky.



AID PROGRAMS 1969/1976
of the basin financial agnecies (1)
(in millions of French francs)

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(1) This chart takes only into account the programs voted before December 31.1973

We have very few transfer functions on which to compute without making a mistake, the flow to be imposed on such and such a constituent of an effluent, based on the limit concentration allowed for the same constituent in a natural environment.

b) Development possibilities.

This is a fundamental part of the quality objectives policy. Indeed, the natural environment has characteristics that are clearly defined and that can only rarely be altered. For each section of a waterflow and for each utilization, there are limits that must not be exceeeded when introducing pollutant matter. In this respect, there is complete opposition between uncontrolled development and the respect of defined utilizations.

The quality objectives studies must associate development situations with utilizations and clearly indicate at what stage of effluent increase the objectives likely to be adopted will no longer be compled with.

Let us take an example : a town has spread along a small stream, the quality of which had been safeguarded at a certain moment by the building of a treatment station, but the town has grown continuously and it is discovered that the water quality has been spoiled dowstream from the town. It is likely to be too late to do anything, the quality of the water having been sacrified (often unconsciously) to the desire to expand. However, this situation would have arisen much later on, and perhaps never, if the town had been on the banks of a big river. There are economic rents on location.

c) Foreseeable objectives.

- *The different situations.*

The reference quality of rivers being a known factor, it is possible, with the elements mentioned above (definition of utilization, development hypotheses), to build several quality objective situations. Obviously, these hypothetical situations must reconcile the desire for expansion with the concern for water protection. In order to throuw a maximum of light on the options that can be taken, it may be interesting to define, on one document, the restrictions that weigh on a natural environment. Very soon two antagonistic factors appear :

The concern for protection

- intake of river water
- fishing and fish-farming stretch
- estuaries, swamps
- natural sites

Concern for development

- the configuration of the different zones of population and industrial growth.

- *Measures required to enact the objectives.*

Unless the pollution assimilation of waterflows can be modified (this will be mentioned hereunder), the observance of objectives will have to resort to taking action against effluents and mastering the dimensions of such effluents in the course of time. In this light, the situation at a given moment must always be compared with the hypotheses drawn up in the case file, especially as regards the pace of development.

Action against effluents :

For each stretch of river where a certain utilization of the water has been decided upon and to which certain physical, chemical and bacteriological characteristics must be applied, limit values of each release of effluent must be assigned that will make it possible to respect in that river the characteristics relevant to such utilization.

This implies, firstly, that the effluent-to-natural environment transfer function as a whole must be known for a number of parameters and, secondly, the technologies to reduce these parameters must be perfectly mastered. As has already been said, total know-how on this point has not yet been reached.

- Difficulties of modelisation.

  The computing of the maximum admissible flow of a certain type of pollutant in terms of the desired water quality of a waterflow receiving the effluents incriminated, implies that we know to establish a mathematical ratio existing between the quantities discharged and the concentrations of pollutant in the river downstream.

  This can be done without any great problem for those elements that are easily dissolved and that do not undergo any noteworthy transformation in the river (e.g. salts such as chorides, sulfates, etc...).

  Difficulties arise, however, when it comes to substances that are transformed by the water. This is the case for biodegradable oxidants, measured in terms of DOB which, while degrading, consume oxygen. There are currently methods for experimenting on site, and calculations that make it possible to estimate how the BOD will degrade in the river and, consequently, how the dissolved oxygen will vary downstream of the effluent.

  For certain substances that are transformed in the rivers, know-how is slight as regards the ratio between the pollutant discharged and the evolution of the corresponding content in the river water.

  This is the case, in particular, for pollutants that are important : ammonium (NH_4+), bacterial and viral pollutions, certain heavy metals.

  As calculation and forecasting are the more complicated for this type of parameter when the general level of pollution is high, it was decided to proceed by stages.

  For example : if the desired long term vocation of a river are such things as fishing as a sport and bathing, the first step would concern obtaining a quality of water suitable for the former. The pollution parameters studied, and on which the efforts toward improvement will be based, would be for instance the temperature, the amount of dissolved oxygen and BOD.

Only after this first stage would it be possible to propose the objective "bathing" and specify the methods required to neutralize the effluents (disinfection of urban-type effluents with norms that must be respected), measuring, at the same time, the technical and economic impact.

- The present limits of purification technology.

  In numerous cases, it will doubtless be necessary to look beyond just reducing the amounts of suspended solids and oxydants in effluents by familiar and tested processes.

  Analysis of the results of the 1971 National Pollution Inventory shows that we must tackle both ammonium and bacterial and viral contamination. Surveys performed on several rivers also showed that the phosphate and nitrate content is likely to become critical in some sectors for normal fish life.

  In the same way, we must, in the near future, start using techniques for getting rid of the nitrogen compounds in certain effluents to reduce the ammonium content in certain rivers.

  All these points are strong arguments in favour of extra effort in developing new technologies.

- Necessary development of purification technology.

  What will happen, indeed, when the quality objectives policy will have been applied to a fraction of the basin ? The residual pollution left by the production of the structures will flow into the rivers and any new activity will result, even if it is run jointly with a purification plant, in an increase in damage to the natural surroundings. The objective that has been reached will once again be in jeopardy, as soon as economic development will have got beyond the level integrated to the definition of the objective itself.

  To avoid this inevitable backsliding, the only means consists in either stopping all development or improving the performances of structures which, in any case, would be lower than 100 % efficient. The last solution could be to work towards less pollutant manufacturing methods. All these points must be tackled at once to develop both purification technology and non-pollutant processing.

  It is vitally urgent to get such a policy under way, helping the creation of technological novelties and their rapid integration, via the laboratory, to the field.

Action on the characteristics of the natural surroundings :

If we do not develop "clean" manufacturing processes - i.e. clean effluents - all growth will result in deterioration of the quality of our rivers. However, changes in processes take a long time to put into practice. Are we going to be forced, in years to come, to relinguish all the nobler utilizations of rivers, little by little, or curb economic growth ? A pause, during which the process could mark time while technological improvements catch up, might prove to be vital.

The construction of dam-reservoirs increases the low-water flow-rates, bringing an answer to the query because the possibility of accommodating effluents grows proportionately to the increased flow-rate provided by these structures. We should, therefore, in each case examine the possibility of building a regulating-dam as part of each of the quality objective situations studied as one of the technical and economic elements of choice.

d) Widening the quality objectives policy.

In the long run, this policy will go beyond the level of quality reached by river waters. Full benefit must be derived from the existence of rivers of satisfactory quality. In fact, environment is all one and the different natural media are inter-reacting elements resulting in a certain habitat. The quality objectives policy cannot be confined to the definition of purification plant or regualtor-dams for the satisfaction of given utilizations. It will also be necessary to study supporting measures to give full value to the actions undertaken.

e) Supporting measures.

This type of policy on effluents means that the following problems will have to be solved :

- proper supply to treatment stations, hence the establishment of programs for the collection of sewage and the control of runoff waters.
- possibility ditch cleaning and surface cleaning of water flows.
- measures to avoid accident pollution.
- removal of rubbish dumps from alongside rivers and action against industrial waste.

Lastly, once an objective has been reached, its enhancement may lead to the development of sites and banks with recreational and tourist installations connected with water.

f) Application of quality objectives policy.

To be successful, the quality objectives policy must appeat credible and, thus, all live forces in the basin where it is being applied should take part in the operation and see to its proper throughput.

- Need for discussion.

In view of economic restrictions and limitations on national development that could result from this policy, it is of fundamental importance that those who are to bear the consequences of the choice made should influence the preparatory stages and take an active part in that choice, hence the aim pursued, whilst being fully acquainted both with the advantages and the constraints involved in improving the water's quality.

During the stage at which the quality objectives are defined, a standing discussion group should be organized, the level of which would come closer to factual matters as the studies progress.

Onece the round-table opinion has been defined, the choice of objectives is submitted for the opinion of political bodies (Conseils Généraux, Conseils Régionaux, Basin Committees).

This is the way we conducted work on the first quality objective case in France.

Appendix 3 gives the possible organization chart for this procedure in respect of quality objectives and a brief description of the different discussion levels.

Necessity of controlling quality objectives.

The implementation of a quality policy in a given basin must be supported by specially adapted monitoring of effluents being discharged in the environment. Monitoring should meet two requirements :

control that the quality of the host environment is really compatible with the objectives and, if not, identify the causes thereof, in particular by means of checks on the flow of pollutants discharged by the effluents that must comply with the Orders concerning discharge.

carry out checks in such a way that they bring out more obviously the quantitative relation between the effluents and the receiving waters for the pollution parameters selected as being characteristic of the quality level required. The future must also be prepared by measuring other parameters that might, in the long run, give rise to a later stage of improvement.

g) How far has the new policy been actually applied ?

It has been experimented in some of the test basins : Vire, Haute Moselle, Oise, and gradually extended to wider geographical zones. In the Seine-Normandie Basin, more advanced in this field (see supplement IV its real cost), it is actually being set up over half the basin.

3.2.5. Conclusions and future prospects.

In 1978, depite the economic situation which has already burdened basin authority actions, the total budget is close on 1200 mio. Fr.F. providing help in finding almost 3000 mio. Fr.F. of basic investment on water. The progress corresponds to an appreciable increase in water rates, even if these remain inferior to what is needed in order to recover normal environmental conditions within 15 years, as we had hoped in 1976.

Some delay is foreseeable but the flexibility of the system could catch up on lost time if the economic situation were to improve.

This should, moreover, be an incentive to improve still further the system of planning and change to an overall water management pattern in each basin.

We should like to mention, in conclusion, some of the topics that need reflexion and which could help achieve this aim :

- extend the rate base to include nitrogen, phosphates and possibly heavy metals
- take into account the pollution generated by rainwater in the cities and help to reduce same
- reduce wasting water
- develop technological improvements
- help to train operators in charge of structures.

We should then be on the road to rational water management - the target that will become more and more necessary as good quality water shortage sets in. How can this be done ?

- As regards the management of resources, we must complete our knowledge of the parameters of the water that is already getting cleaner by watching the rate bases of a number of different users. The development of the metering network (rain - level, flow-rate and quality of rivers, level and quality of sheets - quantity samples - quantity and quality effluents) is necessary, as well as the creation of corresponding card indexes. At the same time, models for data processing must be worked out and also for forescasting resources from rain data, sample and effluents. We could then take preventive action, either on a long-term basis when drawing up programs, or in the immediate future depending on the weather, helped by weather forecasting over a few days.

- Medium and long term management would automatically result from the quality objectives policy that must be developed for all the rivers together, river banks and water sheets. Auditing management will lead to important developments in the means of metering and this will provide factors for short term management which is the final target to be reached.

- This policy will be fulfilled the more easily as the economic means, fees and other assistance will dovetail with regulatory means, and insofar as it has been the subject of adequate discussion at all levels beforehand. This will be the standing job of all basin authorities, Committees and Financial Authorities who will organize such discussions and who will have to go down the line from the central to the local level - firstly to explain and discuss objectives and then, once these are reached, to ensure the daily management of basin waters.

APPENDIX 1

DESCRIPTION OF THE QUALITY OF A WATERFLOW, STRETCHES OF A STREAM, LAKE OR POND. GENERAL OBJECTIVES FOR WATER QUALITY.

TABLE 1 - QUALITY OF WATER

SALINITY	1A	1B	2	3
0	1A.S0	1B.S0	2.S0	3.S0
1	1A.S1	1B.S1 DRINKING WATER (simple or standard treatment) FOOD INDUSTRIES	2.S1 IRRIGAT'	3.S1
2	1A.S2	1B.S2 DRINKING WATER FOR ANIMALS	2.S2 INDUSTRIAL WATER - drinking water (intensive treatment)	3.S2 IRRIGATION
3	1A.S3	1B.S3 BATHING, LEISURE FISH (living & spawing normally)	2.S3 DINKING WATER FOR ANIMALS	3.S3 SELF-PURIFICATION NAVIGATION COOLING
4	1A.S4	1B.S4	2.S4 Leisure (exceptional contacts with water) Fish (living normally but doubtful reproduction)	3.S4 Self-purification (survival may be doubtful in some circumstances

TABLE 2 – : CRITERIA ON WHICH TO ASSESS THE GENERAL QUALITY OF WATER

		S0	S1	S2	S3	S4
I	1. Conductivity S/cm at 20°C	400	750	1 500	3 000	3 000
	2. Total hardness Fr.°	15	30	50	100	100
	3. Cl mg/l	100	200	400	1 000	1 000
	4. Adsorption capacity Na (1)	2	4	8	>8	

		1A	1B	2	3
II	5. Temperature	<20°	20 to 22°	22 to 25°	25 to 30°
III	6. O_2 dissolved in mg/l (2) O_2 dissolved in sat. %	7 >90 %	5 to 7 70 to 90 %	3 to 5 50 to 70 %	aerobic medium to be maintained permanently
	7. BOD_5 raw water mgO_2/l	≤3	3 to 5	5 to 10	10 to 25
	8. Oxydant mgO_2/l	≤3	3 to 5	5 to 8	
	9. COD raw water mgO_2/l	≤ 20	20 to 25	25 to 40	40 to 80
IV	10. NO_3 mg/l			44	44 to 100
	11. NH_4 mg/l	≤0.1	0.1 to 0.5	0.5 to 2	2 to 8
	12. Total N mg/l Kjeldahl)				
V	13. Saprobes	oligosaprobe	β mesosaprobe	α. mesosaprobe	polysaprobe
	14. Biotic indicator deviation compared with normal (3)	1	2 or 3	4 or 5	6 or 7
VI	15. Iron (total mg/l precipitate and soil	≤0.5	0.5 to 1	1 to 1.5	
	16. Total Mn mg/l	≤0.1	1.5 to 0.25	0.25 to 0.50	
	17. Susp. Solids total mg/l (4)	≤30	≤ 30	≤30 (des.m≤0.5 ml/l)	30 to 70 (des.m≤1 ml/l)
VII	18. Colour mg Pt/l	≤ 10 (no visible colour)	10 to 20	20 to 40	40 to 80
	19. Smell	imperceptible		no abnormal smell or sapidity	no perceptible smell at a distance
	20. Chlorof. extractable substances mg/l	≤0.2	0.2 to 0.5	0.5 to 1.0	>1
	21. Oil and grease	nil		traces	present
	22. Phenols mg/l	≤0.001		0.001 to 0.05	0.05 to 0.5
	23. Toxins	permissible norm for the most demanding vocation especially preparation of drinking water			Traces innocuous for fish life
	24. pH	6.5 - 8.5 6.0 - 8.5 if TH 5° f		6.5 - 8.5 6.0-8.5 if TH 5°fr 6.5-9.0 active photosynthesis	5.5 - 9.5
VIII	25. Coliform bac./100 ml		<5 000		
	26. Esch. Coli/100 ml		<2 000		
	27. Fec Strept./100 ml				
IX	28. Radioactivity	SCPRI Category 1		SCPRI Category 2	

(1) C.A.S. = $\frac{NA\sqrt{2}}{\sqrt{Ca + Mg}}$ contents in me/l

(2) The dissolved O_2 content is binding

(3) The normal indicator is taken as 10 if it has not been determined

(4) The SS (MES) content only applies when water is high.

APPENDIX 1 : COMMENTS

MINIMUM QUALITY ACCORDING TO THE VOCATION OF THE WATERFLOW

Only the main vocations of the water have been mentioned in this grid.

When a vocation is positioned in capital letters indicates the minimum normal quality.

In small letters - minimum quality that may be tolerated.

Water in which the different contents exceed quality 3 limits are unfit for the majority of uses and can be a danger for the public health and environment. Because of this, quality 3 constitutes a minimum objective, even if some waters in their natural state are, presently, at an inferior level. When drawing maps showing present qualities this type of water be coloured in red.

NATURE OF CRITERIA TAKEN INTO ACCOUNT

The criteria used have been grouped into 9 big families. Some of the criteria such as toxic matter (n° 23) and radioactivity (n° 28) already represent a set of specific measures.

An accurate judgement on water quality needs knowledge of one or several criteria in each family, according to the pollutions expected upstream.

Good knowledge of the 3 first families is indispendable.

The saprobe system and above all the biotic indicator bring essential information, especially in cases of industrial pollution. In this case, it is also advisable to have specific data concerning families VI, VII and possibly IX.

Moreover, bacteriological analyses are absolutely necessary downstream of big conurbations.

VARIATION IN CONTENT WITH TIME

As the quality of waters varies a great deal with time, depending on different factors, it is necessary to take the most unfavourable situations into account.

Exceptional excess of these limits may be permitted - except for the dissolved oxygen content - over a frequency of 5 to 10 % of the time (20 days in average years), or when the flow-rate goes lower than the critical value, called "reference flow-rate" and which has to be determined for each separate case.

APPENDIX 2 : QUALITIES REQUIRED OF SURFACE WATERS FOR POTABLE USE.

	PARAMETERS		A1 G	A1 I	A2 G	A2 I	A3 G	A3 I
1	pH		6.5-8.5		5.5-9		5.5-9	
2	Colour after simple filtration	mg/l Pt scale	10	20 (0)	50	100 (0)	50	200 (0)
3	Total suspended solide	mg/l MES (SS)	25					
4	Temperature	°C	22	25 (0)	22	25 (0)	22	25 (0)
5	Conductivity	micron s/cm^{-1} at 20°C	1 000		1 000		1 000	
6	Smell	(dilution factor at 25°C)	3		10		20	
7*	Nitrates	mg/l NO_3	25	50 (0)		50 (0)		50 (0)
8(1)	Fluorides	mg/l F	0.7/1	1.5	0.7/1.7		0.7/1.7	
9	Organic chloride (total extractable)	mg/l Cl						
10*	Dissolved iron	mg/l Fe	0.1	0.3	1	2	1	
11*	Manganese	mg/l Mn	0.05		0.1		1	
12	Copper	mg/l Cu	0.02	0.05 (0)	0.05		1	
13	Zinc	mg/l Zn	0.5	3	1	5	1	5
14	Bore	mg/l B	1		1		1	
15	Beryllium	mg/l Be						
16	Cobalt	mg/l Co						
17	Nickel	mg/l Ni						
18	Vanadium	mg/l V						
19	Arsenic	mg/l As	0.01	0.05		0.05	0.05	0.1
20	Cadmium	mg/l Cd	0.001	0.005	0.001	0.005	0.001	0.005
21	Total chromium	mg/l Cr		0.05		0.05		0.05
22	Lead	mg/l Pb		0.05		0.05		0.05
23	Selenium	mg/l Se		0.01		0.01		0.01
24	Mercury	mg/l Hg	0.0005	0.001	0.0005	0.001	0.0005	0.001
25	Baryum	mg/l Ba		0.1		1		1
26	Cyanure	mg/l Cn		0.05		0.05		0.05
27	Sulphates	mg/l SO_4	150	250	150	250 (0)	150	250 (0)
28	Chlorides	mg/l Cl	200		200		200	
29	Surface agents (react to methylene blue)	mg/l (lauryl-sulphate)	0.2		0.2		0.5	
30*(2)	Phosphates	mg/l P_2O_5	0.4		0.7		0.7	
31	Phenols (phenol indicators) paranitralinine 4 aminoantipyrine)	mg/l C_6H_5OH		0.001	0.001	0.005	0.01	0.1
32	Dissolved or emulsified hydrocarbons (after extraction by petroleum ether)	mg/l		0.05		0.2	0.5	1
33	Polycyclic aromatic carbon	mg/l		0.0002		0.0002		0.001
34	Pesticides-total (parathion, HCH, dieldrine)	mg/l		0.001		0.0025		0.005
35*	Chemical oxygen demand (COD)	mg/l O_2					30	
36*	Dissolved oxygen saturation rate	% O_2	> 70		> 50		> 30	
37*	Biochemical Oxygen Demand $(BOD)_5$ at 20°C	mg/l O_2	< 3		< 5		< 7	
38	Kjeldahl Nitrogen (except NO_3)	mg/l N	1		2		3	
39	Ammonia	mg/l NH_4	0.05		1	1.5	2	4 (0)
40	Chloroform extractable substances	mg/l CES	0.1		0.2		0.5	
41	Total organic carbon	mg/l C						
42	Residual organic carbon after flocculation and diagram filtration (5 microns) TOC	mg/l C						
43	Total coliform bact. 37°C	/100 ml	50		5 000		50 000	
44	Fecal colli.	/100 ml	20		2 000		20 000	
45	Fecal Streptococci	/100 ml	20		1 000		10 000	
46	Salmonella	/100 ml	Nil in 5 000 ml		Nil in 5 000 ml			

I = imperative. G = Guide. O = exceptional climatic or geographical circumstances. * = see article 8 d)

(1) Values indicated are upper limits determined on annual average temperature (high and low temperatures)

(2) This parameter is included to satisfy the ecological requirements for certains environments.

APPENDIX 2 : DIRECTIVES GIVEN BY THE COUNCIL OF JUNE 16, 1975

concerning the required quality of surface water intended for supplying potable water in member States.

Excerpts from the EEC Official Journal of July 25, 1975. (75/440/EEC)

ARTICLE 1

1. This directive concerns the requirements that must be satisfied in respect of the quality of fresh surface water supplies in the production of potable water, hereinafter called "surface water", after treatment thereof, groundwater, salt water and water intended for the replenishment of underground watersheets is not included in this directive.

2. For the purposes of applying the present directive, all surface waters intended for human consumption, and supplied by the public utility pipe-systems provided therefor, are considered as potable.

ARTICLE 5

1. As regards the application of article 4, surface waters are assumed to comply with the respective parameters if samples of this water, taken at regular intervals at the same place of extraction and used for the production of potable water, show that it complies with the parameter values applicable to the water quality in question :

   - 95 % of the samples in the case of parameters conforming to those specified in columns 1 of the table.
   - 90 % of the samples in all other cases,

   and if, for the 5 to 10 % of waters, as the case may be, that do not comply the following conditions prevail :

   a) the water does not differ by more than 50 % of the parameter values concerned, excepting temperature, the pH measure, dissolved oxygen and microbiological parameters ;

   b) no danger can result for the public health ;

   c) consecutive water samples, collected at the appropriate statistical frequency do not vary as regards the relevant parameter values.

ARTICLE 8

Waivers to the present directive are provided as follows :

a) In the event of floods or natural disasters ;

b) for certain parameters marked (0) in the table because of exceptional weather or geographical conditions ;

c) when the surface waters undergo a natural increase in certain substances resulting in characteristics beyond the limits as regards categories A1, A2 and A3 of the table ;

d) in the case of shallow lakes where the water is more or less stagnant, for certain parameters marked with a star in the table, this waiver not being applicable to lakes over 20 metres deep in which it takes one year for the water to be entirely renewed and for which there is no discharge of sewage waters in the water sheet.

By "natural increase" is meant the process whereby a given mass of water receives from the soil certain substances contained in the latter, without any human intervention.

In no event can the waivers set forth above ignore the requirements imposed to protect the public health.

When a member State resorts to a waiver, it will immediately inform the Commission, stating the motives and the time limit.

ARTICLE 10

The member States enact the legal provisions, regulations and administrative decisions required to comply with the present directive within 2 years with effect from due notification. They will immediately inform the Commission.

APPENDIX 1

Definition of standard treatment procedures by which surface waters of categories A1, A2 and A3 can be turned into drinking water.

CATEGORY A1

Simple physical treatment and disinfection, e.g. quick filtration and disinfection.

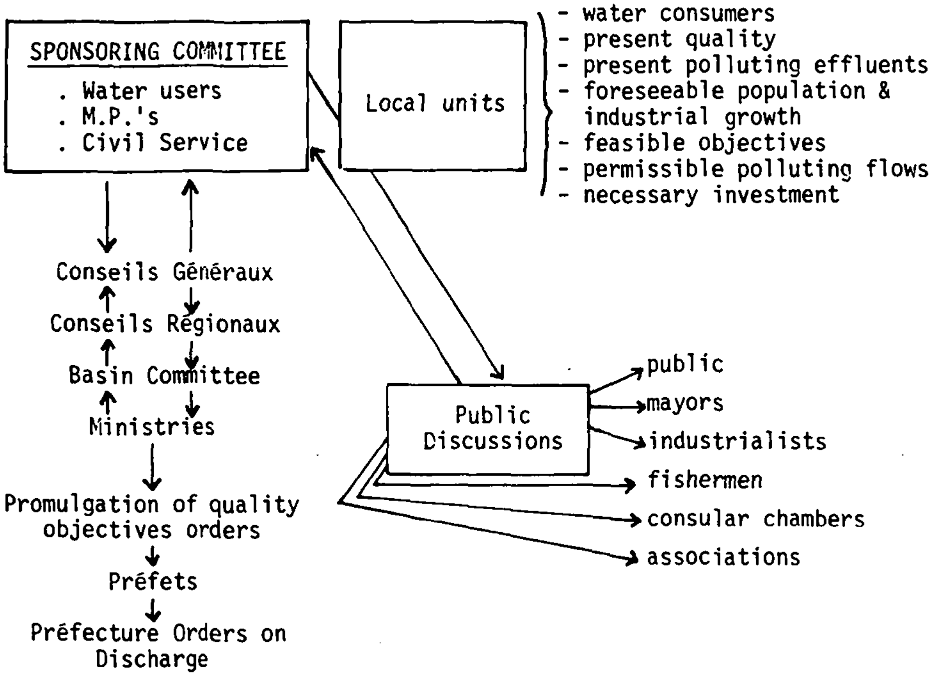
CATEGORY A2

Normal physical treatment, chemical treatment and disinfectant e. g., pre-chlorination, coagulation, flocculation, clarification, filtration, disinfection (final chlorination).

CATEGORY A3

Physical treatment, intensive chemical treatment, taste-adjustment, disinfection e.g., break point chlorination, filtration, refining (activated carbon), disinfection (ozone, final chlorination).

APPENDIX 3 : LOCAL ORGANIZATION OF QUALITY OBJECTIVES.



APPENDIX 4 : FINANCIAL MEASURES IN SUPPORT OF QUALITY OBJECTIVES POLICY 1975-1990.

FIRST LEVEL OF DISCUSSION.

Sponsoring Committee.

The above Committee, locally established on the same lines as the Basin Committee, consisting of third parties, water users, M.P.'s, Civil Servants whose activities or responsibilities occur in the basin concerned, is meant to guide the work of preparing the choices, fix priorities in this work, decide which of the water utilizations are to be taken into account, give its advice on the first outlines of the required plant and equipment program in the light of the utilizations under study.
At present, the sponsoring committees are organized and operating in the Vire, Aisne, Oise and Risle basins.

When the preparatory work enters the final stage, it leads to a technical and financial program for each possible option. The possibilities of choice then bear on the scope of the objective and the speed at which it is to be reached.

SECOND LEVEL OF DISCUSSION.

With the agreement of the sponsoring committee, the time has then come to widen consultancy, bringing discussion closer to the field (e.g. a particular stretch of a river), embracing all the authorities connected with the basin. The Chambers of Commerce, the Chambers of Agriculture, the Town Councils, Fishing Association and industrialists should take part in these discussions, through public meetings, in particular, like those that were held in the Vire Basin. Future contractors should also be consulted since they will eventually be called upon to build the structures required for reaching the objectives.

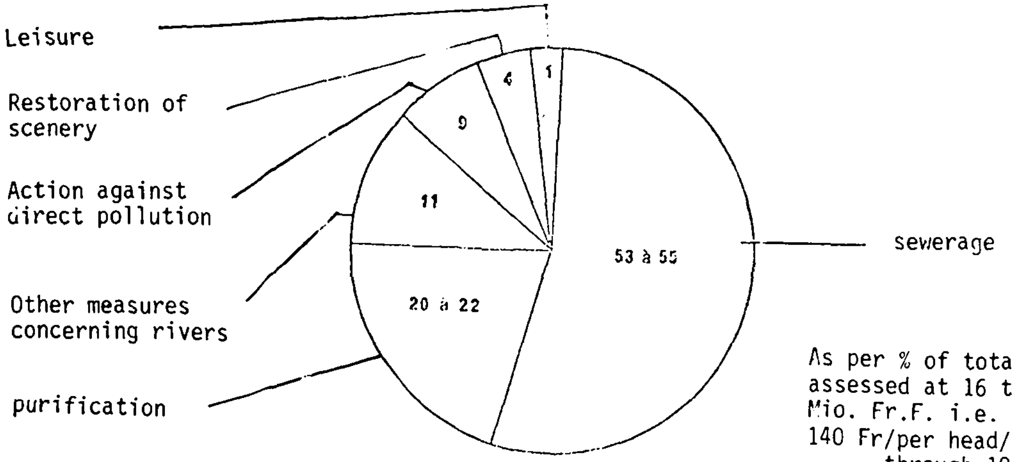
FINAL DISCUSSIONS.

The Conseils Généraux finally express their choice after this last counsel takes place, followed by the Economic and Social Committee, the Conseil Régional and the Basin Committee, before the case is sent to the Ministry for the Quality of Life in order to have the objectives transformed into Decrees.

Appendix 4 (cont.)

	Mio. F.F.	Sub-totals
Purification & Detoxication	3200 to 4700	3200 to 4700
Direct processing of river water		
Sewage	8800 to 11400	10600 to 13800
Ditch cleaning	500 to 800	
Surface cleaning	5	
Measures against accidental pollution	100	
Monitoring and metering systems	100	
Low-water level support (dams)	1100 to 1400	
Action against indirect pollution likely to damage rivers		
Refuse discharge areas and dumps	600 to 900	1400 to 2000
Effluents reaching groundwater	400 to 600	
Measures against atmospheric pollution (connected with river quality objectives)	400 to 500	
Restoration of scenery		
Development of sites (experimental programs)	100 to 600	600 to 900 600 to 900
Development of banks and islands	400 to 600	
Protection of gravel pits (may include purchasing the land)	100	
Parks and gardens	2	
Leisure developments		
Along riversides	100	200
Water surfaces	100	
Total	16000 to 21600	

Financial measures in support of quality objectives policy 1975-1990



As per % of total costs assessed at 16 to 21.6 Mio. Fr.F. i.e. 107 to 140 Fr/per head/per year through 10 years

3.3. DISCUSSION OF MR. VALIRON'S EXPOSE.

Mr. THORPE :
"The history of institutions plays an important role which explains the fact that we have adopted somewhat different solutions in England. It was in 1950, at Sir Norman ROWNTREE's instance, that water management was undertaken by establishing inventories.
Towards the end of the 60s, the first effects of this undertaking were felt".

"In the United Kingdom, although reorganisation was less radical than in France, the Agencies have greater responsibilities, notably those of all the Water Services".

"Whatever may be the case, two preoccupations are common to all developed countries :

- not to stop at quantity problems but manage the quality,
- adopt a much more adequate global approach."

Mr. SANTEMA asks Mr. VALIRON a series of questions :

a) "What is the relationship between the Basin Agency and the local authorities ?"

b) "What kind of decisions does the central power take in matters of objectives ?"

c) "In what manner do the Government authorities take into account decisions made by international organisations ? Do Basin Agencies have the possibility of opting for the recommendations of one or the other ?"

Mr. VALIRON provides Mr. SANTEMA with the following details :

a) "The question of administrative division was relatively delicate in the case of numerous basins of the English Channel and Atlantic coast ; decisions had to be made for in any case these small basins had to be grouped together so as to confer sufficient economic importance to the Agencies. The only moment of great hesitation was in the case of Brittany, capable of constituting an isolated entiry. The Central Government however felt that it was preferable to group it with another basin and overcome local difficulties by compensations at the level of dues (the rates of which therefore vary within the same basin), and of local representation, which is largely ensured."

b) "In France, the Basin Agencies have no control over water policies : they do not therefore have the responsibility of defining evacuation norms."

"Nevertheless, on the one hand, representative of the ministeries form a part of the Basin Committees and Basin Agencies, and, on the other, there exists a Basin Mission, where water policy decisions are taken and where the Director of the Basin Agency has his head office, which manages a secretariat."

"Such dispositions ensure a close and satisfying link between the legal and executive powers."

"Besides, decisions made by the Basin Agencies are enforceable only when the Central Government has approved of them. It must be noted, in this connection, that the decisions of the Basin Agencies are not taken in an isolated manner and that particularly in the case of quality objectives, the concerned Basin Agencies consult, and associate with, one another.
Of course, the norms proposed depend on the state of technologies, except in certain threatened sectors. The role of the Basin Agencies is to ensure financial equalization.
Therefore, there also exists a permanent link between economic and political management instruments."

c) "If an international decision is taken (and, in this case, it is ratified by the French Government), the Basin Agency must adapt and conform to it.
In any case, the Basin Agency programmes must be compatible with the national policy. Thus, we had to modify our investment level on account of economic difficulties.
A link is to be found here between the role played by the Agencies and the national political will."

Mr. WIENER :
"Regional management appears to have many advantages and to facilitate the solving of interfacial problems, such as transfers between Basins, the Rhine pollution or that of the Mediterranean."

Mr. VALIRON says that he is also of this opinion.

Mr. GUGGINO :
"In concluding his exposé, which presents, in an extremely clear and precise manner, the organisation problems arising in water management, Mr. VALIRON has expressed the wish that we move towards rational water management.
At the University of Catania (Italy), we are doing research on mastering the consequences of drought by :

- increasing the water resources (by studying the joint utilisation of surface, ground and unconventional waters)
- reducing the negative consequences of drought
- reducing the water demand."

"I think that this objective-wise management method, which aims at defining a global strategy, is moving in the right direction, and must be accompanied, as Mr. VALIRON so correctly points out, by the setting up of a global management system, which would substitute management divided according to uses. Could not this new strategy be the object of a recommendation ?"

Mr. VALIRON :
"It is in fact an extremely interesting subject, which must incite the organisation of seminars and training."

"Mr. HARIRI had already refered to it in his exposé : it does not suffice to act on resources (which can be indefinitely increased), but on the need ; in industry, there should be recycling ; in agriculture, a reduction in consumption. In any case, in our countries, the consumption, per inhabitant, has reached intolerable levels, and developing countries must, in no case, derive their inspiration from these bad examples.
This provides, for ITCWRM, a research axis of the highest interest.
It has, for example, been shown in France that water economy in industry is not necessarily expensive.
It has also been noticed in France that it is not enough to construct purification stations, but these must function properly and this is not a simple task : finer technics rely heavily on men, and competent men.
These are but two of the many examples, and first of all, we must define what are the best targets for us."

Mr. GUGGINO :
"One of the interesting problems would be the study of the means of dominating negative drought consequences."

Mr. DA CUNHA :
"... We have had in Portugaln a certain devoted attachment, whose distant roots can be found in history, to French organization ; our water laws are therefore very similiar to French law. I would like to pose two very specific problems :

a) concerning the insertion of the Basin Agencies programme into national planning, I have noted that if, in the past, the Water Committee was an integral part of the Plan, this is no longer the case today. Why ?

b) Your Basin Agency structure appears very complicated (cf. your chart § 2.5). Could it be made simpler or is this complicated aspect necessary ?..."

Mr. VALIRON :
"Here are, in fact, two points which need to be cleared :

a) The coordination structure, has, in fact, been modified two years ago. The Water Commission is today inactive, which I personally deplore. This is because the Regions are endowed with ccrtain powers, and programme coherence is now ensured at this level.

b) Concerning the chart, I willingly recognise its complicated aspect. But is not this complexity, which we have made no efforts to hide out of a sense of accuracy, the result of the multiciplicity of levels and interests present ?"

Mr. NEGULESCU :
"I would also like to ask a series of questions :

a) What do you think of the progress accomplished in the field of automatic measure apparatus and notably of the number of parameters which can now be evaluated by this means ?

b) After how long are your programmes brought up to date ?

c) To which routing models do you have recourse ?"

Mr. VALIRON :

a) "We do not believe in the "miraculous role" of automatic apparatus, and we continue to have confidence in simple measures which we correlate.

b) The very first "white books" did not contain integrated development plans ; but we are going to undertake new "white books". They will be, this time, integrated development plans, for now we are in a position to formulate them.

c) We dispose of a certain number of routing programmes, which are generally based on works realised out of France and adapted to our needs.
Let me cite by way of example :

   - river models which function correctly and in which nitrogen parameters have now been introduced.
   - economic models describing the water needs evolution and water quality for the next 10 or 15 years."

Mr. LAWSON :
"The structural complexity is, as Mr. VALIRON said, a reflection of the complexity of the problems. This complexity is even greater when there are frontier problems. Do you have European examples of this kind which would help us solve our African problems ?"

Mr. VALIRON :
"In Europe, common dispositions have been taken by the Environment Commission, whose head office is in Brussels, on evacuation norms.
There exists an Inter-State Commission (of which Dr. COIN here present is a member) to tackle the difficult Rhine problems. This Commission has already succeeded in establishing an inter-state financing plan in order to reduce, and this at the request of Holland, the evacuation in great quantities of sodium chloride in the upper basin.
In the final analysis, great progress has been made in Europe these last fifteen years, and it can now be certain that most of the studies undertaken have proved extremely beneficial."

SUB-SECTION E2

COMMUNICATIONS TO THE WORKSHOPS

- SOMMAIRE -

ATELIER N° 1

ATELIER N° 2

ATELIER N° 3

ATELIER N° 4

WORKSHOP N° 1

TECHNICAL AND TECHNOLOGICAL ASPECTS

"INVENTORY OF USEFUL REGIONAL WATER PLANNING DATA"

Nii Boi AYIBOTELE

This Workshop is one of four being organized in this Seminar. As has been explained by the Chairman, Sir Norman ROWNTREE, our role is to assist the Scientific Council of the ITCWRM to decide on the orientation of the research and training activities of the Centre for the next few years.
We shall do this by relying on your special knowledge expertise and experience in the water planning field through the discussion and recommendations which will take place after the subject has been personally introduced by the speakers.

As you will notice the theme for our Workshop has been subdivided into two. The first deals with an Inventory of regional water planning data, and the second deals with Available and applicable technology.

Today, we shall deal with the first sub-theme : INVENTORY OF USEFUL WATER PLANNING DATA.

It goes without saying that water planning for any area requires inputs of data from a wide range of disciplines. These data can be broadly divided into two.

On one hand is what we shall call hydrométéorological Data, dealing with rainfall, evaporation temperature, runoff, water level, water quality, ground water, soil moisture, etc... These data help us to assess the quantity and quality of the available water resources, and its ability to cause damage.

On the other hand we have the other broad group of data which we shall call socio-economic data. These deal with population and its growth, industrial development, energy development, food production, health, etc... With these data we are able to estimate the amount and quality of water required to meet the use demand and also to protect ourselves from its noxious effects.

So in short we can say that the planners need for data is twofold. First he needs it to estimate the quantity and the quality of the water resources to be managed and secondly to estimate the demand for water that is to be met in developing the water resources, both for the present and the future.

For the planners two conditions must be satisfied if he is to make his estimates reliably and efficiently. First the data must be available as they must have been acquired, primarily proved, and published. Secondly he must have at his disposal effective tools by which he can make those estimates required as inputs to the planning process.
These estimates are for (1) the present conditions and (2) the future.

Our task in this Workshop is :

- First to identify the problems associated with the acquisition, processing and dissemination of data for the present and the future, and the tools available for estimating inputs into the planning process.
- In identifying these problems we have to bear in mind the role played by institutional sittings, social and economic conditions and how they are related to the other Workshops.

- Our second task is to assess with particular reference to the present situation, the problems identified earlier on.
- Our third task is to collate the problems that we identify in our first and second tasks and go on to identify the training and research needs that arise out of them.
- The fourth and final task is to find out :
    - . which of the identified training and research needs are being covered by training institutions elsewhere,
    - . which of the training and research needs the ITCWRM should concentrate upon.

With me to speak on the subject are :

. Prof. NEMEC
. Prof. NEWSOME.

After them we shall have short communications from Messrs. ROCHE and NEGULESCU.

"INVENTORY OF USEFUL REGIONAL WATER PLANNING DATA"

David NEWSOME

"Data" and "Information" are words which are often used as though they are interchangeable ; strictly speaking they are not - information is digested or processed data. It is important to make this distinction because data are usually a series of alpha numeric characters which convey little to the reader but, when translated into information, become meaningful to the reader. Also, it is interesting to note that what is information at one level is data at another (usually a higher) level.

Data are archived to provide a record in a convenient and easily accessible form. The records are then available for analysis perhaps to determine trends or for research or planning purposes. In the water resources field, for example, a water archive framework has been designed in the U.K. which reflects the activities of the water authorities and is divided into five elements (cf. Figure 1). While the Policy Group guides the general direction of development, it is the task of the Systems Group to ensure that each element of the total archive is developed independently at a pace to meet the users' requirements. Each element will nevertheless be compatible with each of the others. Thus, it will be possible to relate data in the different elements e.g. it may be possible to equate improvement of river water quality with capital expenditure on effluent treatment plant (if this is of interest and the appropriate data are collected). In other words, it will be possible in many cases to relate "cause" and "effet" thereby making it easier to devise remedial action if the effect is harmful. Ultimately it may even be possible to predict "effects" from potential "causes" and, if necessary, formulate plans in advance to mitigate harmful effects.

Water of course is only one of the environmental sectors ; a possible scheme for the integration of information from all sectors is shown in Figure 2.

It is clearly advantageous to try to make the data collected serve more than one purpose. For example, date collected for local operational control of effluent quality may be capable of being utilised on a river basin scale for river pollution abatement strategic planning ; nationally to analyse trends in river water quality and perhaps even to meet international commitments for the exchange or publication of information. A typical information flow diagram which will meet these needs is shown in Figure 3.

For convenience, it may be thought preferable that all the data gathering, processing, transmission, storage, analysis and publication should be within one organisation, but other considerations may preclude this. In the latter case, the secret of success is to "harmonise" the data requirements so that the data are readily transmitted in an understandable and usable form from one level to another regardless of organisation.

The foregoing remarks apply to all forms of technical data - hydrometeorological and water quality in this case - but the collection of socio-economic data is very different.

These types of data are gathered usually by questionnaire and may relate to subjects as diverse as the recreational use of water, finance, the accidental spillage of pollutants or population statistics. Their assessment and comparison is much more difficult in most cases (financial data usually being an exception), frequently they have to be related to technical data.

FIGURE 1

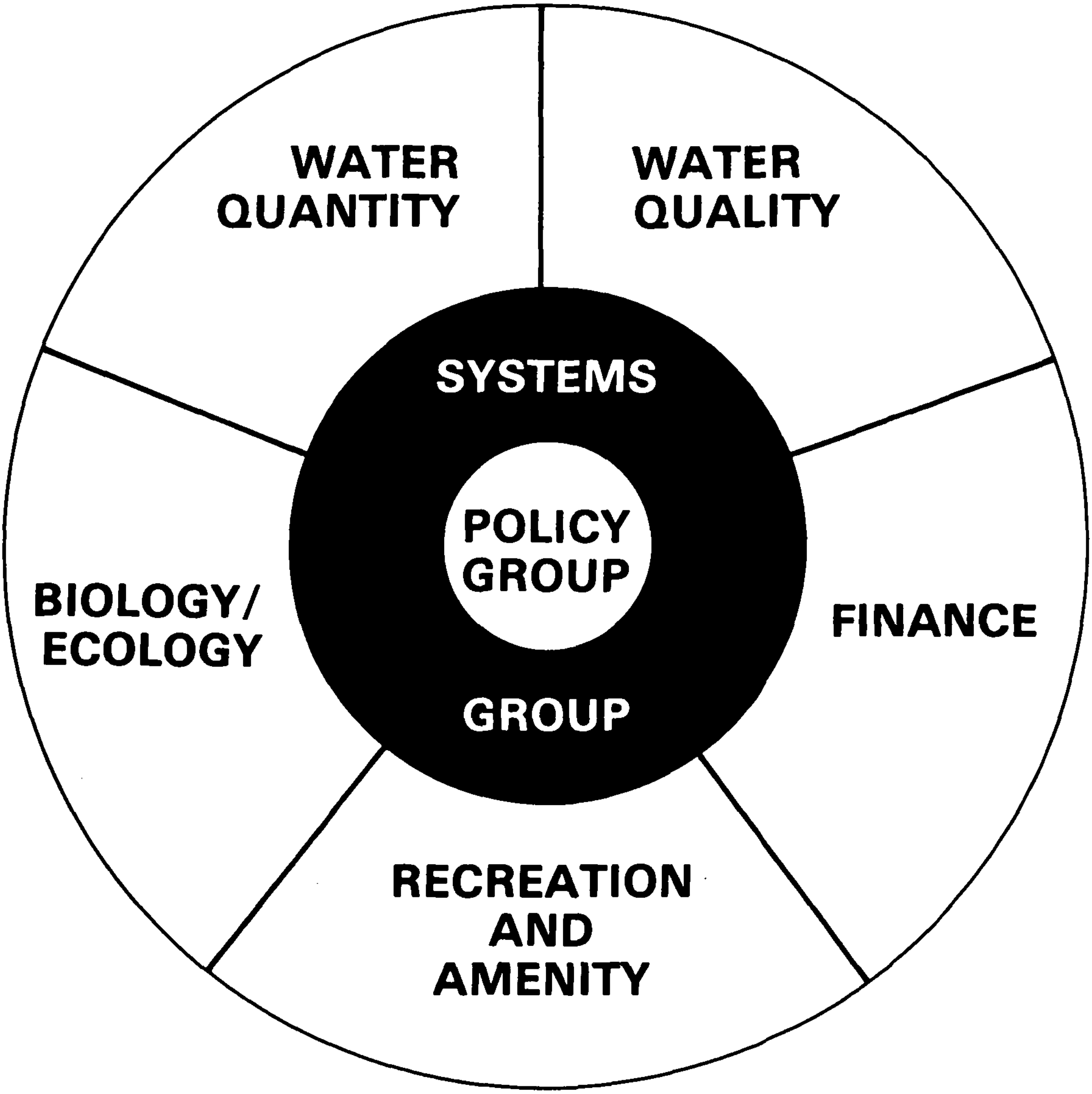

WATER QUANTITY
WATER QUALITY
SYSTEMS
POLICY GROUP
GROUP
BIOLOGY/ ECOLOGY
FINANCE
RECREATION AND AMENITY

FIGURE 2

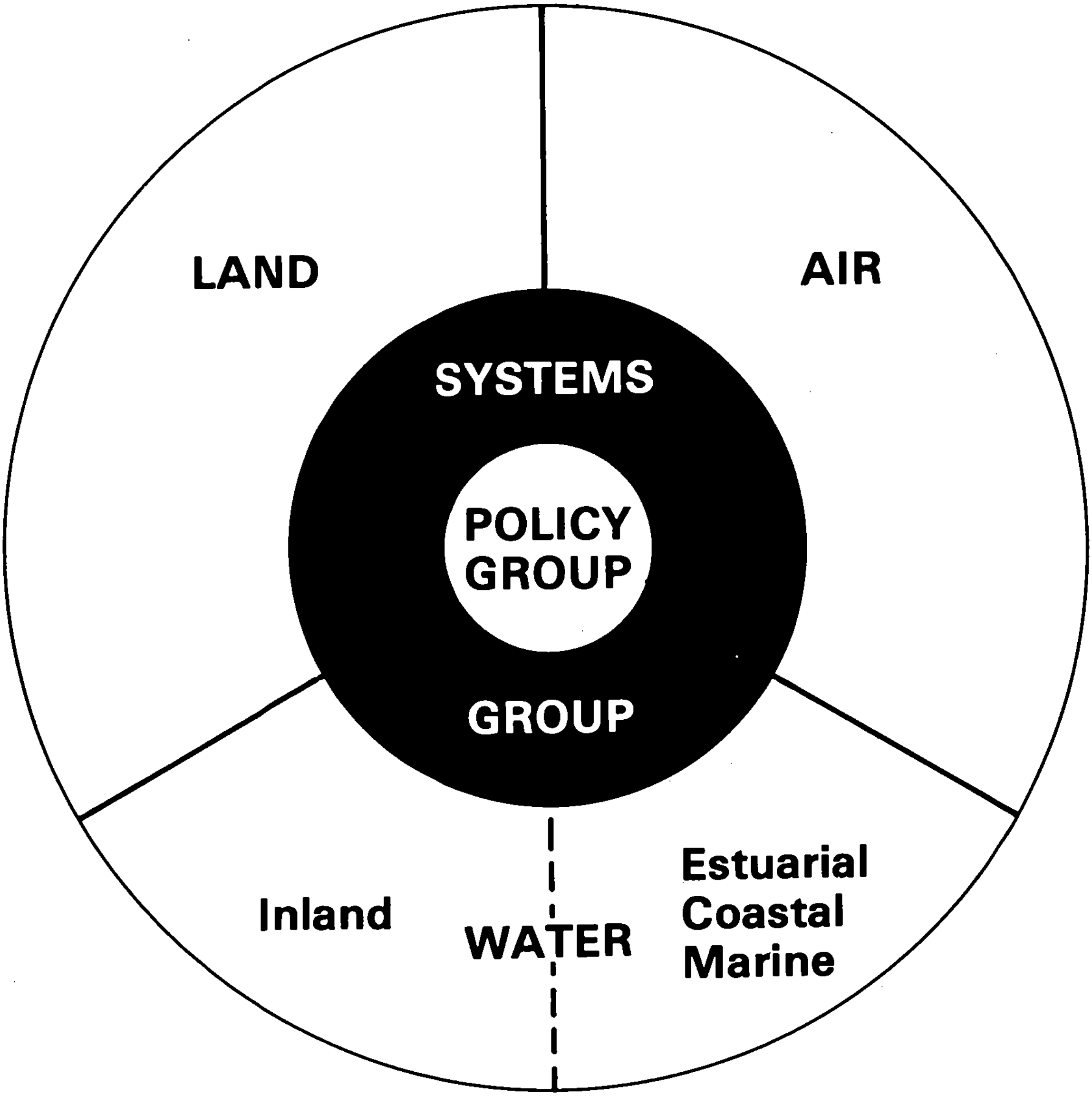
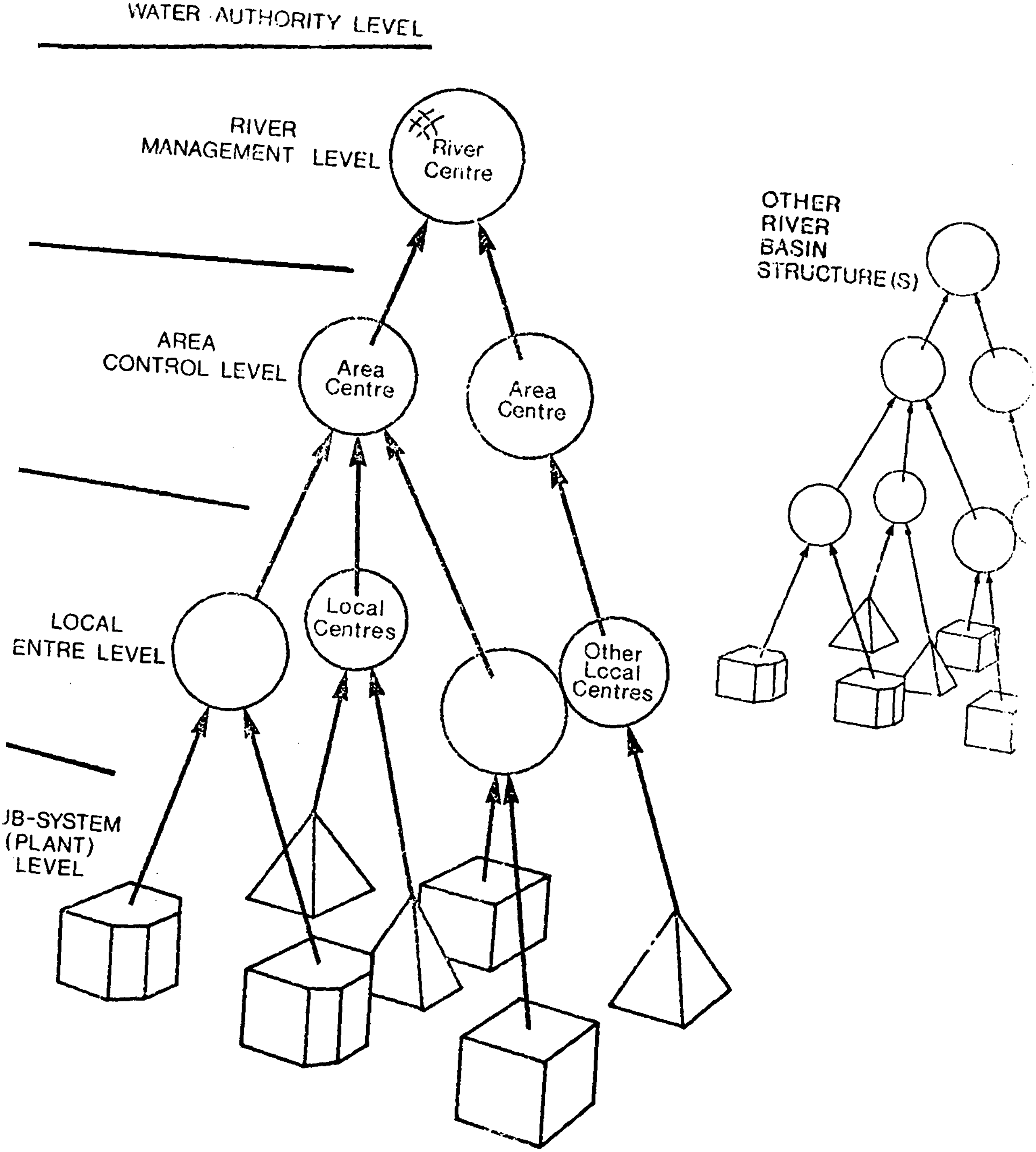

LAND
AIR
SYSTEMS
POLICY
GROUP
GROUP
Inland
WATER
Estuarial
Coastal
Marine

FIGURE 3


WATER AUTHORITY LEVEL
RIVER MANAGEMENT LEVEL
River Centre
AREA CONTROL LEVEL
Area Centre
Area Centre
LOCAL ENTRE LEVEL
Local Centres
Other Local Centres
JB-SYSTEM (PLANT) LEVEL
OTHER RIVER BASIN STRUCTURE (S)

The design of the questionnaire is therefore of fundamental importance if the right data are to be gathered for these purposes. There have been many cases where, having received completed questionnaires, the design has had to be modified substantially so that the "right" data are collected. (Indeed, on being presented with either the information derived from a data set or the data set itself, a decision maker or researcher will frequently find that they are not precisely what is needed and more data have to be collected to enable an appropriate decision to be made or to aid the research work).

At present, there is little difficulty in measuring most of the "quantitative parameters" i.e. rainfall, flow and ground water levels. More difficult to measure are the constituents of water quality, but the World Health Organisation Report (ICP/CEP 212) on the Optimization of Water Quality Monitoring Networks not only presents ideas on the organization of water quality monitoring networks, but suggests the constituents which can usefully be measured.

Data collection is the foundation stone upon which all water resources planning, development and operation are built. Without adequate technical data, properly processed into useful, reliable information, water resources development may not be efficiently carried out. Similarly, without the collection of the appropriate socio-economic data, the wrong resources may be developed at the wrong time or their environmental impact may be wrongly assessed.

Thus the importance of a well-organized and administered data collection service cannot be over-emphasized. Of equal importance however is the presentation of information derived from the data collected. Without adequate data summaries which highlight the important points to be considered or which present the facts in a clear and unambiguous way, the decision maker or designer is in trouble. It is therefore suggested that CEFIGRE might consider that "methods of presenting information" could be a useful training topic.

"TECHNOLOGIE DISPONIBLE ET APPLICABLE"

- INTRODUCTION À LA DISCUSSION -

Germain LEYNAUD

1. QUELQUES CRITERES GENERAUX D'APPRECIATION DES TECHNOLOGIES DANS L'AVENIR.

Les solutions proposées doivent être adaptées aux caractéristiques géographiques et socio-économiques des régions en cause. De ce point de vue, il convient de considérer non seulement les performances absolues mais aussi la rusticité et la fiabilité des procédés et des matériels. Dans bien des cas, les procédés les plus sophistiqués, bien que plus performants en apparence, ne sont pas les plus satisfaisants.

Il convient de disposer pour chaque problème de solutions alternatives permettant d'effectuer le meilleur choix en fonction des conditions locales.

Quelles que soient les conditions locales, les économies de matières et d'énergie devront être généralement recherchées.

La mise en oeuvre des technologies est toujours coûteuse ; le choix des meilleures solutions suppose une connaissance approfondie du milieu, non seulement des cours d'eau et des nappes mais des bassins versants dans leur ensemble : géologie, pédologie, végétation, ... (cf. sous-thème 1.1.)

Les coûts seront d'autant plus faibles que les interventions seront effectuées plus "en amont" dans le cycle de l'eau (par exemple prévention de la pollution plutôt qu'épuration des eaux). Une législation adéquate (homologation préalable des produits chimiques) peut permettre aussi des économies considérables. Les progrès de la technologie et l'urgence de certaines situations incitent cependant souvent les responsables à reporter l'effort des collectivités vers "l'aval", au niveau des utilisations (traitement avant utilisation).

2. REMARQUES PARTICULIERES.

2.1. DEVELOPPEMENT, REGULARISATION, PROTECTION DE LA RESSOURCE.

La régularisation est souvent recherchée au moyen de barrages réservoirs mais une solution alternative particulièrement intéressante peut être apportée par la généralisation à l'échelle du bassin versant des techniques de conservation des sols et de l'eau comportant des ouvrages de faible importance unitaire mais très nombreux et susceptibles de conduire à des résultats égaux ou supérieurs (stockage souterrain).
Cette solution atteint d'autre part plusieurs objectifs (lutte contre l'érosion, amélioration de la qualité des eaux et des ressources halieutiques, amélioration de la production agricole). Elle est particulièrement adaptée aux pays en voie de développement et complète une régularisation par barrages (si nécessaire) en protégeant ces ouvrages contre les risques de comblement accéléré).

Par ailleurs, une certaine cohérence s'impose entre les travaux de lutte contre les inondations et ceux de soutien des étiages.
Le recours à des travaux de rectification, recalibrage, etc..., pour les premiers aboutit généralement à une accélération du transit vers la mer et à l'affaiblissement des débits d'étiage.
Des besoins de formation et information existent dans ce domaine pour éviter certaines erreurs.

En ce qui concerne les barrages, on dispose actuellement pour leur construction de techniques adaptées aux diverses conditions géologiques locales (dont une connaissance précise est absolument nécessaire). Une attention croissante est apportée aux questions de sécurité (effets sur les séismes, risques de rupture, propagation de l'onde de rupture vers l'aval).
Les prises d'eau doivent être conçues de façon à donner le maximum de souplesse à la gestion et à pallier certaines évolutions de la qualité des eaux (niveau de prise d'eau).

L'effet de ces ouvrages sur la qualité des eaux et la pêche, dans la retenue elle-même et en aval, doit être considéré avec attention.
L'efficacité de certains ouvrages annexes, comme les passes à poissons destinés à limiter cet effet, n'est souvent que partielle ou aléatoire.

2.2. L'EAU, MILIEU VIVANT.

L'importance de la protection de la qualité hydrobiologique des cours d'eau est souvent sous-estimée ; elle conditionne cependant :

- le pouvoir autoépurateur des eaux (grâce à des peuplements aquatiques diversifiés),
- la qualité de l'environnement général,
- la production piscicole.

Or, les peuplements aquatiques et la qualité des eaux sont menacés non seulement par les modifications physico-chimiques induites par les rejets polluants mais aussi par les modifications de l'habitat aquatique consécutives aux travaux d'hydraulique (curages, rectifications, dragages, barrages, extractions de matériaux). Les conceptions et les techniques dans ce domaine qui aboutissent généralement à une homogénéisation excessive de l'habitat aquatique devraient donc être rapidement revues.

La préférence devra être donnée autant que possible au stockage souterrain (réalimentation des nappes) qui protège le mieux la qualité de l'eau et de l'environnement ; des besoins existent pour améliorer encore les techniques dans ce domaine et mieux apprécier à partir des caractéristiques géologiques les possibilités réelles d'intervention et les risques.

L'intérêt des épandages de crues soit pour la recharge des nappes, soit pour la fertilisation des sols, ne doit pas être sous-estimé.

2.3. L'EAU ET L'AMENAGEMENT DU TERRITOIRE - LES TRANSFERTS.

L'aménagement du territoire devrait si possible se baser sur les potentialités (notamment des ressources en eau) des diverses régions et les implantations d'activités devraient être décidées en fonction de ces ressources.

Dans les pays à ressources hydriques moyennes ou faibles, les transferts d'un bassin à l'autre peuvent être source de conflits sauf s'il est possible de trouver des compensations. De tels transferts peuvent accentuer les déséquilibres entre régions.
Toutefois, comme dans les cas cités par M. BANERJEE en Inde, les transferts d'eaux nettement excédentaires et même nuisibles ou dangereuses vers des zones moins pourvues peuvent constituer des solutions intéressantes.

Parfois justifiée pour d'autres raisons socio-économiques, la concentration des activités polluantes nécessite, pour une protection équivalente du milieu récepteur, des niveaux d'épuration plus poussés mettant en oeuvre des technologies évoluées et coûteuses ; il convient donc d'en tenir compte dans les calculs économiques et d'évaluer conjointement d'éventuelles solutions alternatives (activités décentralisées et procédés extensifs d'épuration).

2.4. UTILISATION DES EAUX.

Ainsi que l'a souligné M. VALIRON l'équilibre ressources-besoins peut être atteint aussi bien en diminuant la demande qu'en augmentant les ressources. Il est possible d'agir sur la demande par l'emploi de technologies nouvelles plus économes et aussi par l'incitation financière (politique tarifaire).

2.4.1. Alimentation en eau potable.

La protection et le développement des ressources souterraines (recharge de nappes) revêtent une importance particulière dans ce domaine : elles permettent d'éviter la généralisation des systèmes de distribution "centralisés" nécessaires lorsque la qualité des eaux impose un traitement poussé. L'attention des décideurs devra être attirée sur ce point afin que les mesures nécessaires soient prises à temps et que les études permettant une bonne connaissance quantitative et qualitative des ressources souterraines soient entreprises également en temps voulu. En effet, même en l'absence de pollution caractérisée, certaines eaux souterraines riches en fer et manganèse ne peuvent être utilisées sans traitement préalable pour l'alimentation en eau potable.

2.4.2. Hydraulique agricole : irrigation - drainage.

Une bonne connaissance du milieu (cf. sous-thème 1.1.) : pédologie, climatologie, végétation, et de la physiologie des plantes cultivées est nécessaire pour l'évaluation précise des besoins et la conception correcte des installations.

Le développement rapide de l'irrigation, même dans les zones tempérées (irrigation de complément) constitue un facteur d'augmentation des besoins en eau d'autant plus important qu'il s'agit d'eau consommée et qui doit donc retenir toute l'attention des autorités chargées de la gestion de l'eau.

Des techniques nouvelles (goutte à goutte et systèmes voisins) permettent de réaliser des économies importantes et doivent être encouragées.

Des solutions alternatives ou complémentaires peuvent être apportées par la sélection de plantes à faibles besoins en eau ou à cycle de végétation adapté à celui des ressources en eau, par l'utilisation des eaux usées (éventuellement après traitement)... Il apparaît souhaitable d'orienter les recherches agronomiques dans cette voie.
De même, une formation adéquate des agriculteurs irrigants est indispensable à une bonne utilisation de l'eau d'irrigation. Dans ce but, il serait également souhaitable de réaliser un contrôle suivi de l'irrigation.

Les techniques et les matériels de drainage ont effectué ces dernières années de gros progrès (drains en matière plastique, machines à drainer). Un fonctionnement correct des réseaux nécessite toutefois des études préalables sérieuses assez rarement réalisées. Dans certains sols, les risques de colmatage des nouveaux drains peuvent être élevés.

Une attention insuffisante est portée aux conséquences de la généralisation du drainage agricole sur le régime (crues) et la qualité des eaux (entraînement d'engrais et de pesticides). Des études semblent encore nécessaires pour préciser ces aspects.

2.4.3. Utilisation de l'eau par l'industrie.

Le choix des technologies au niveau des fabrications peut réduire de façon considérable les charges de pollution, la consommation unitaire d'eau, les pertes de matières premières et d'énergie.

Des progrès importants restent à accomplir dans ce domaine de même que dans celui de la récupération des sous-produits et du recyclage. Les progrès technologiques peuvent être accélérés par la pression de la réglementation ; on peut s'interroger à ce sujet sur le rôle des "normes" qui basées sur la situation actuelle tendent à la pérenniser. Il serait souhaitable de fixer des niveaux de qualité croissants pour l'avenir afin d'orienter les industriels vers la recherche de technologies "propres". Cette orientation est d'autant plus nécessaire que les objectifs de croissance de l'activité sont fixés à un taux plus élevé.

2.4.4. Assainissement - épuration.

Une attention insuffisante est apportée à l'étanchéité des réseaux. Il en résulte une dilution des effluents ne permettant pas un traitement efficace.
La concentration géographique des rejets doit être évitée et il est souhaitable dans ce but de faire appel à des procédés dérivés de ceux applicables en assainissement individuel pour les petites collectivités.

En milieu rural, l'intérêt des procédés extensifs d'épuration (lagune, épandage) se confirme à la fois par la rusticité, la fiabilité et le niveau élevé de traitement si les installations sont bien conçues.

Le rendement effectif de stations d'épuration conventionnelles peut être amélioré par une meilleure formation du personnel et l'automatisme.
Ce rendement est souvent exprimé par le taux d'abattement de la D.B.O. qui est supérieur en fait à la diminution réelle des effets du rejet. Il apparaît en effet de plus en plus nécessaire de limiter dans les milieux aquatiques les teneurs en éléments fertilisants (N, P, ...) dont les taux d'élimination dans les stations conventionnelles sont beaucoup plus bas que celui de la D.B.O.

L'utilisation du pouvoir épurateur des sols dans le cadre d'une exploitation agricole rationnelle permet de réaliser à la fois l'épuration des eaux et le recyclage des éléments fertilisants ; toutefois, cette solution séduisante suppose l'élimination préalable des éléments toxiques ou inhibiteurs et celle des germes pathogènes. Une action de prévention (homologation préalable des produits chimiques) évitant la dissémination des produits dangereux dans l'environnement devient de plus en plus nécessaire en raison de la multiplication de produits de synthèse nouveaux.

2.5. L'EAU : MOYEN DE TRANSPORT ET PRODUCTRICE D'ENERGIE.

L'influence des ouvrages de génie civil sur la qualité de l'eau a été déjà soulignée. La navigation elle-même perturbe fortement la vie aquatique (disparition de la végétation, destruction du frai, ...). Ces effets pourraient être atténués par une amélioration de la conception des ouvrages (zones de bordures préservées des effets des vagues, peu profondes, garnies de végétation et comportant des abris pour les organismes aquatiques).
Des solutions alternatives à l'extension des gabarits doivent pouvoir être fournies par une conception différente des engins de transport. De même des économies peuvent être réalisées par recirculation de l'eau aux écluses.

L'utilisation de l'eau ne constitue pas, comme on le croit, une source "propre" d'énergie neutre vis-à-vis de l'environnement. Les effets sur l'environnement des installations hydro-électriques et, notamment, ceux relatifs aux modifications du régime des eaux peuvent être très importants mais sont généralement méconnus ; des recherches sont encore nécessaires pour permettre une bonne prévision dans ce domaine. Il en est de même des effets du réchauffement artificiel des eaux utilisées pour le refroidissement des centrales thermiques.

2.6. SOLUTIONS PARTICULIERES - DESSALEMENT.

Le dessalement actuellement très coûteux en énergie ne se justifie guère que dans des situations particulières et après épuisement des autres "recours". Toutefois, l'utilisation d'énergies nouvelles (solaire) ou la récupération d'énergie en parallèle avec d'autres activités peuvent permettre une évolution importante du domaine accessible à ce procédé.

"AVAILABLE AND APPLICABLE TECHNOLOGY"

Nii Boi AYIBOTELE

The objectives of comprehensive water resources planning and development are to attain :

- efficient economic development - benefits should be equal to or greater than costs.
- environmental quality maintenance and enhancement.
- social satisfaction.

These objectives are achieved through developments in the fields of :

- domestic and municipal water supply,
- agriculture,
- industry and energy,
- navigation,
- recreation,
- protection from harmful effects :
  . floods and drought
  . water quality degradation or pollution
  . water associated diseases.

These developments can be achieved through :

- structural means like dams, dykes, treatment work, etc...
- non-structural means like preventing people from building in flood prone zones.

The particular structural or non-structural means chosen become inputs into as well as sub-systems of the overall basin plan. The interest of this workshop is in the choice of these sub-systems which when put together can be provided an optimum solution to the overall planning and development objectives.

It seems that the choice of these inputs are constrained by one or a combination of factors :

- the quantity and quality of the available water resources to meet the quantity and quality specifications of present and future water demand.
- cost of the technology or means to be selected.
- ability to operate and maintain the selected technique. This in turn will depend on the level of development of the country.

The task in this Workshop is :

- First to find what problems if any planners face in getting exposed and acquainted with the range of technologies available for solving particular water development problems.
- Secondly to find what problems if any planners face in selecting the most appropriate technologies to apply in a given situation to achieve planning objectives in a maximum way.

- Thirdly to collect the problems identified and to determine the training and research needs arising out of these problems.
- Fourthly to find what training and research is going on elsewhere with regard to the problems identified and to determine which of them the ITCWRM should concentrate its training and research efforts in the next two years.

"INVENTAIRE DES DONNÉES UTILES A LA GESTION RÉGIONALE DE L'EAU"

Jean MARGAT

1. OBSERVATIONS GENERALES.

1.1. L'UTILITE.

L'utilité des données à acquérir, vis à vis de l'objectif de gestion de l'eau, est bien le critère essentiel qui doit orienter les actions de formation du CEFIGRE sur ce thème, c'est-à-dire qu'il conviendra d'apprendre surtout à subordonner la collecte ou l'acquisition des données à l'appréciation préalable des besoins d'information (besoins en nature, en type d'information, et besoins en degré de précision) appelés eux-mêmes par les objectifs de la gestion ; ce sont ces besoins qui doivent commander l'acquisition des données et déterminer leur présentation.

Cela revient à distinguer clairement :

- les données : "offre" des possibilités technologiques actuelles d'acquisition,
- les informations : "demande" d'éléments de décision.

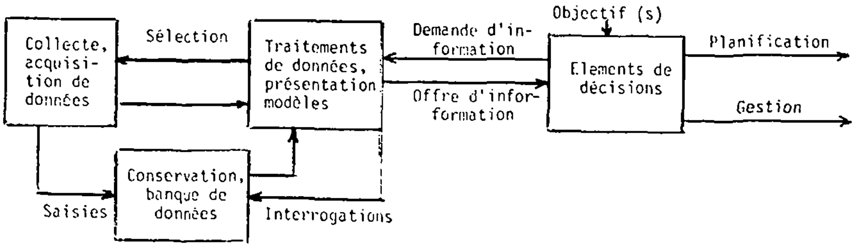
L'enseignement des techniques d'acquisition de données, de conservation et de traitement primaire ou secondaire en vue de produire les informations voulues, ne devra donc pas constituer l'objet essentiel du CEFIGRE (même si quelques rappels minimaux pourraient se révéler nécessaires) ; il s'agira plutôt d'enseigner l'art de choisir à bon escient les techniques à mettre en oeuvre - types, quantité - pour obtenir au mieux les résultats voulus. En d'autres termes, la stratégie de l'acquisition des données devra l'emporter sur sa tactique.

1.2. LE CHOIX.

Le choix des données à collecter - en nature, en quantité, en précision - est aussi dans une grande mesure orienté et contraint par les techniques de traitement disponibles : notamment par les diverses techniques d'extension de données, et les modèles de simulation à finalité explicatrice servant à vérifier des cohérences de données ou à optimiser la recherche de données manquantes.

Les interactions entre les collectes et acquisitions de données (dans l'espace, dans le temps) et les traitements d'information devraient être clairement mises en relief dans les séminaires de formation du CEFIGRE sur ce thème.

"L'approche systémique" pourrait utilement éclairer les liaisons réciproques entre la collecte des données, leur traitement et les éléments de décision :



Ce sujet encore insuffisamment traité devrait donner lieu aussi à des recherches particulières - surtout en ce qui concerne le volet valeur d'usage des informations, ou à l'inverse le préjudice causé par les insuffisances des données.

Il devrait de toute façon être traité à partir de l'analyse de cas historiques concrets, y compris de leur analyse critique (exemples de cas d'insuffisance ou de surabondance de données...).

1.3. L'OPTIMISATION.

La confrontation entre les offres de données et les besoins d'informations doit être faite aussi sur le plan économique, moins abordé dans les enseignements techniques conventionnels, mais qui devrait constituer l'une des originalités du CEFIGRE :

- évaluation des coûts d'acquisition de données,
- estimation des valeurs des informations vis à vis des services attendus (fonction d'utilité...).

L'économie de la collecte et de la conservation des données pourrait constituer un sujet spécifique de formation comportant des essais d'application de l'analyse coût/avantage à l'optimisation de la collecte des données.

2. CARACTERES PARTICULIERS A L'ACQUISITION DES DONNEES SUR LES RESSOURCES EN EAU SOUTERRAINE.

2.1. PREMIERE REMARQUE.

Malgré la spécificité des techniques d'investigation et de mobilisation des ressources en eau souterraine, il n'est pas souhaitable que la formation relative aux eaux souterraines soit conçue et dispensée indépendamment de celle relative aux eaux de surface. Il est rare qu'à l'échelle régionale les eaux de surface et les eaux souterraines constituent des ressources indépendantes et entièrement additives (cela dépend beaucoup des conditions géologiques et climatiques). Aussi, est-il bon que dès le stade de la collecte des données et de l'élaboration des informations le principe d'unicité des ressources en eau soit respecté.

2.2. DEUXIEME REMARQUE.

L'évaluation et la gestion des ressources en eau souterraine présentent bien néanmoins des aspects spécifiques :

- d'abord, les conditions physiques d'occurence des eaux souterraines : extension spatiale tridimensionnelle et permanence dans le temps, conjonction des fonctions de conduction et de capacité par les mêmes milieux (aquifères), caractère très déterministe de la dynamique naturelle des eaux souterraines et des lois sur lesquelles se basent tous les projets d'exploitation ;
- en fonction de ces caractères propres, la connaissance des conditions physiques de gisement et de renouvellement naturel des eaux souterraines nécessite davantage une distribution détaillée des mesures dans l'espace que l'observation de variables chronologiques pendant de longues durées (ordre de plusieurs dizaines d'années).

Autrement dit les collectes de données nécessitent des efforts plus amples mais moins longs que les acquisitions de données sur les eaux de surface.

- On doit encore observer que le rendement de ces acquisitions de données dans l'espace est généralement décroissant : il n'y a pas de relation linéaire entre le coût des actions d'investigation et la valeur des informations obtenues ; la progression des connaissances sur un domaine aquifère défini, en terme de "valeur ajoutée" par de nouvelles données, est plus lente que la croissance des coûts d'acquisition (il faudra par exemple décupler les efforts d'investigation pour seulement doubler la précision des connaissances ou la représentativité d'un schéma modélisant un système aquifère).

2.3. EQUILIBRE ENTRE COLLECTE ET INVESTIGATIONS.

Par ailleurs, la "mise en valeur" des eaux souterraines est progressive et flexible, et les actions de mobilisation sont rarement irréversibles.

Les résultats des premières phases de développement des exploitations d'eau souterraine peuvent apporter, pour un faible coût marginal, autant sinon plus d'informations utiles pour la gestion ultérieure des ressources que les investigations initiales.

Autrement dit, en matière d'eaux souterraines, la collecte de données et les investigations sont interactives avec les aménagements.

Il est souvent préférable de lancer la réalisation de premières tranches d'exploitation, après un minimum de reconnaissances sommaires et rapides, plutôt que de procéder à de longues et coûteuses opérations d'investigations pour établir un plan d'aménagement présumé complet et définitif, en acceptant de procéder à des réajustements progressifs sur la base des enseignements apportés par l'observation du comportement de la nappe exploitée en première phase.

Mais cela implique un contrôle précis et continu des débits prélevés et de toutes les répercussions de l'exploitation (niveaux, débits de cours d'eau ou de sources éventuellement influencés dans le domaine considéré, qui doit être bien délimité).

Un thème important à traiter dans la formation dispensée par le CEFIGRE dans ce domaine paraît donc être le choix du compromis optimal entre les actions d'étude nécessitées pour établir les projets d'aménagement et les mises en oeuvre par étapes de ces aménagements dans une optique "d'apprentissage".

2.4. PARTAGE ENTRE ACTIONS D'ACQUISITION ET OPERATIONS D'ETUDE.

A ce thème s'apparente celui du partage entre les actions d'acquisition de données "a priori", entreprises sans finalité particulière (intérêt général : action de "service public") telles que l'exploitation de réseaux d'observation, la cartographie hydrogéologique..., et les opérations d'étude à fin plus définie (locales ou régionales) comportant des acquisitions de données plus intensives mais plus sélectives.
Ce partage ne dépend pas seulement des conditions physiques d'un pays, mais surtout du contexte socio-économique (niveau de développement, degré d'interventionnisme de la puissance publique et dynamisme des administrations publiques vis à vis de secteurs privés d'entreprises d'études...).

La rationalisation et l'optimisation des actions de service public en matière de collecte et d'acquisition de données, tant vis à vis de la finalité "planification" de l'allocation des ressources, que de la finalité "police des eaux" (contrôle), pourraient donc constituer également un sujet à traiter.

En résumé, en matière d'inventaire des données utiles à la gestion régionale de l'eau et plus particulièrement pour ce qui concerne les eaux souterraines, les sujets paraissant les plus importants pour le programme des stages de formation, sont :

a) sélection et rationalisation des données à acquérir en fonction des objectifs de gestion (à court ou long terme) et en fonction des instruments de traitement d'information disponibles.

b) adaptation des systèmes de conservation de données (fichiers, banques de données) aux besoins (demandes d'informations).

c) économie des inventaires de données : essai d'optimisation des collectes de données.

d) équilibre entre les collectes de données préalables aux aménagements, et l'exploitation des données fournies par un contrôle adéquat des effets de phases initiales de développement des exploitations de ressources ("couplage exploration-exploitation").

e) équilibre entre les collectes de données à fins générales opérées a priori par le Service Public, et les investigations plus sélectives commandées par les études de projets d'aménagement particuliers.

"INVENTAIRE DES DONNÉES UTILES À LA GESTION RÉGIONALE DE L'EAU"

- LES PROJETS "PRODUCTIFS" -

Marcel ROCHE

1. CADRE DE REFLEXION.

Du point de vue de la collecte, du traitement primaire puis de l'utilisation des données, il est bon de distinguer deux aspects du problème ayant une influence directe sur les méthodes et les techniques les concernant.

1.1. ASPECT PROJET D'AMENAGEMENT.

Très schématiquement, il y a à l'origine :

- une ressource en eau potentielle globale (eau souterraine, eau de surface plus éventuellement des sources secondaires), définie (plus ou moins approximativement) en quantité et en qualité ;
- des besoins qui se traduisent au niveau du projet par une demande ;
- un système d'eau qui au départ peut être naturel (réseau hydrographique : cours d'eau, lacs, etc...) ou déjà modifié par l'homme, que l'on puisse remanier par des nouvelles structures (réservoirs, transfers, usines diverses, zones d'utilisation ...), parties intégrantes d'un projet "d'aménagement".

Le jeu consiste à régler les paramètres "structuraux" du "système d'eau" pour faire coïncider la "demande" caractérisée par une quantité et une qualité à la ressource" caractérisée par des paramètres analogues.

1.2. ASPECT EXPLOITATION.

Un projet étant réalisé, il s'agit de le faire fonctionner de manière à obtenir au jour le jour une satisfaction aussi complète que possible de la demande réelle.
Le jeu consiste, avec des paramètres "structuraux" fixés par la réalisation du projet, à utiliser des consignes d'exploitation, généralement éditées au moment de cette réalisation, mais susceptibles d'évoluer avec l'expérience de l'exploitation.

2. SPECIFICITE DES DONNEES.

Dans les deux cas, ces données sont relatives à la ressource et à la demande si l'on met de côté l'information relative à la technologie des aménagements. Mais suivant qu'on a affaire à l'un ou l'autre des aspects, l'essence des données et les méthodes de collectes peuvent être différentes, de même que le traitement.

2.1. DONNEES "RESSOURCE".

En simplifiant beaucoup les choses, ainsi que dans tout ce qui suivra, les données "ressource" nécessaires pour l'évaluation d'un projet se situent à l'origine dans un cadre statistique spacieux et temporel. Exemple : série de 25 ans de débits moyens journaliers observés en un point donné d'une rivière, bien entendu préalablement à la réalisation de l'aménagement. En soi, cette série ne présente aucun intérêt pour le futur car on est absolument certain qu'elle ne se produira plus jamais ; par contre, on peut considérer qu'elle est représentative de la "structure statistique" d'une population dont elle constitue un échantillon permettant d'enévaluer les paramètres statistiques avec plus ou moins de "confiance". Considérée sous cet angle et ainsi traitée, notre série constitue une information utilisable pour l'évaluation du projet. La constitution d'une certaine méthodologie (structures d'observation, méthodes d'analyse, d'interpolation, de transposition) et d'une certaine technologie (techniques de mesures, d'installation et d'exploitation des réseaux).
La caractéristique essentielle de telles données et de leur collecte provient de leur utilisation en "temps différés" qui ne pose pas, par exemple, de problème de transmission en centre traitement.

Les données "ressource" pour l'exploitation d'un système d'eau présentent de toutes autres caractéristiques : elles doivent être disponibles en temps utile au centre de traitement pour permettre de prendre à temps les mesures nécessaires afin de ménager l'avenir. Cela peut poser des problèmes de transmission rapide pouvant entraîner une technologie particulière de la collecte (par exemple : réseaux automatiques).

2.2. DONNEES "DEMANDE" (EN QUANTITE ET QUALITE).

Pour l'évaluation du projet, l'interruption des demandes à prendre en compte relève de deux démarches :

- enquête sur les besoins actuels,
- estimation de l'évolution des besoins dans le temps en se basant sur le passé et la tentative de projection dans le futur (établissement d'une prospective).

Du point de vue opérationnel (exploitation de l'aménagement), la demande à satisfaire s'impose au jour le jour. Si le système en distribution est à la commande "par l'aval", ce qui est généralement le cas, le fonctionnement doit s'ajuster automatiquement dans la limite des possibilités de la ressource et du système lui-même (structures). Le seul moyen de pallier les insuffisances de l'un ou de l'autre est l'application d'une politique de restriction qu'on a du reste intérêt à définir au moment de l'établissement du projet, quitte à l'affirmer en cours d'exploitation.

3. PRINCIPAUX POINTS A DEBATTRE EN MATIERE DE DONNEES.

3.1. ACQUISITION ET MISE A DISPOSITION.

A l'origine des données "ressource" est le réseau de mesures dont les principes et les modes d'exploitation ne concernent peut être pas directement le CEFIGRE mais des points particuliers relevant de l'aspect exploitation peuvent faire l'objet d'une formation spéciale au sein de cet organisme :

- acquisition automatique et monitoring,
- transmission rapide des données (en temps réel) par :
  - . télétransmission au sol
  - . télétransmission par satellite.

Pour l'aspect établissement des projets d'aménagement :

- télédétection (avion et satellite),
- banques de données.

Enfin, dans la manipulation des données, on peut envisager deux sujets principaux :

- traitement systématique des données et évaluation statistiques,
- modélisation :
  - . des bassins,
  - . des systèmes.

"TECHNOLOGIE DISPONIBLE ET APPLICABLE"

Mircéa NEGULESCU

CORAPPORT CONCERNANT LE RAPPORT DE MONSIEUR G. LEYNAUD

Je suis tout à fait d'accord avec le rapport de Monsieur G. LEYNAUD et j'espère que ces propositions seront introduites dans la synthèse.

Compte tenu de ce rapport et des mots-clé qui figuraient au programme de cet Atelier, je désire que soient seulement ajoutés les points suivants :

1. LA POLLUTION.

Dans le cadre de la lutte contre la pollution, il est nécessaire :

- d'étudier et d'intervenir, le cas échéant, dans les processus industriels, par exemple, pour éliminer les substances nocives qui sont utilisées dans le processus ;
- procéder au recyclage de l'eau ;
- valoriser les substances utilisables contenues dans les eaux usées, par exemple les substances fertilisantes (Na, N, etc...), les huiles de pétrole, etc... ;
- valoriser les eaux usées et les boues au maximum, par exemple en agriculture.

2. LES RESSOURCES EN EAU.

En ce qui concerne les ressources en eau :

- de point de vue économique et même technique, on devra toujours préférer, dans presque toutes les conditions, une couverture à l'échelle régionale (tant pour la ressource que pour la distribution) des besoins en eau des villes et des industries ;
- compte tenu de la qualité des eaux souterraines, ces eaux seront utilisées avec priorité pour l'alimentation en eau des agglomérations ;
- la navigation devra s'intégrer dans l'ensemble des travaux hydrotechniques du bassin et dans le cadre d'une raisonnable gestion régionale de l'eau ;

- Compte tenu de l'augmentation prévisible des besoins en eau, pour le futur il faudra :
  - . utiliser le plus grand nombre de cas possible, des quantités de plus en plus importantes d'eau de mer,
  - . économiser et réduire au maximum la consommation en eau et en priorité la consommation à usage industriel.

3. LES RECHERCHES.

En ce qui concerne les recherches, je propose :

- l'examen de l'état des connaissances sur le dessalement de l'eau de mer, technique qui doit s'insérer dans des schémas d'optimisation des ressources en eau ;
- l'étude de méthodes efficaces d'exploitation des retenues et de protection contre l'alluvionnement des lacs de barrages.

4. L'ENSEIGNEMENT.

En ce qui concerne l'enseignement, je suggère une formation sur les sujets suivants :

- l'épuration des eaux usées des principales industries ;
- la protection de la qualité des eaux ;
- l'exploitation des stations de traitement des eaux d'alimentation et usées (à l'attention des techniciens ayant la responsabilité du fonctionnement de ces stages).

"AVAILABLE AND FEASIBLE TECHNOLOGIES"

W. Robert RANGELEY

This note discusses Sub-theme 1.2. within the context of Aim (2) of the Seminar given on page 2 of the lettre of invitation. The note thus focuses on THE NEEDS FOR TEACHING IN THE AVAILABLE AND FEASIBLE TECHNOLOGIES FOR REGIONAL WATER PLANNING.

As a preamble I first give my views on the definition and scope of regional water planning and on the need for an integrated approach by a multi-disciplinary team.

1. DEFINITION OF A REGION IN WATER PLANNING.

The region, when treated as a planning entity can be hydrological, geographic or even political, but a hydrological unit is the most logical choice. In fact, it is usually a river basin and often an international one. Here I would use the definition given in Article II of Chapter 1 of the Helsinki Rules (*), namely "An international drainage basin is a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus". The basin thus described is the entire area of the catchment and includes all sections that contribute water, both surface and underground, to the main river, stream or lake or other common terminus. It thus includes underground water that may emanate from areas without ascertainable limits and from areas beyond the limits of the conventional geographic boundary of the surface water catchment.

2. AIMS AND PROCEDURES FOR REGIONAL WATER PLANNING.

The process of REGIONAL WATER PLANNING is similar to that generally adopted for MASTER PLANNING in other sectors. A MASTER PLAN for a river basin should present an inventory of resources and potentials. Through a process of project identification, optimization and comparative evaluation it should set out a programme of project implementation that will utilize the water resources in the best way towards meeting given human needs. The programme should be formulated in detail in the short term and in perspective thereafter. Finally, the programme should be evaluated as a whole in terms of benefits (production response) and costs. As with all planning functions it should deal almost exclusively with those issues on which early decisions have to be made. Planning effort should not be devoted to matters that can reasonably be left for decision at a later stage.

(*) Helsinki Rules on the uses of the waters of international rivers adopted by the International Law Association, 1966.

The methodology of such planning can be considered broadly under seven main headings :

- Objectives (1)
- Potential (2)
- Identification of constraints (3)
- Project identification and formulation (4)
- Comparative analysis of project ranking and programme preparation (5)
- Expenditure schedules (6)
- Response to Investment (or benefit schedules) (7)

Stage 5 should arrive at a MASTER PLAN for the river basin or region and stages 6 and 7 merely present a final evaluation of the investment programme in terms of what benefits it will bring to the regional economy. Activities in stages 1 and 7 must be closely linked with the objectives and responses projected for the national economies concerned.

The procedures set out above are applicable to most major regional water planning situations especially where water demands have reached a high proportion of the total water availability. It is important however to note that there are numerous cases where complex planning procedures are not required. For example, few of the developing countries in Africa (with the notable exception of the Nile basin countries), have reached a stage in water exploitation when either detailed planning procedures or special water resource allocations are required. Even in India with its advanced irrigation systems, detailed river basin planning procedures have only recently been adopted.

This does not imply that most countries have no need at all for training in regional water planning procedures. It does however mean that needs will vary greatly from case to case and the Training Centre courses will need to be adjusted accordingly. Some countries will wish to receive training in certain specific topics such as water pollution control ; irrigation water management ; data collection and sewage treatment. Other countries with more advances states of water resource exploitation will be interested in training programmes that cover the wider aspects of regional water planning procedures.

3. SCOPE OF REGIONAL WATER PLANNING.

The scope of regional water planning is indicated in page 4 of the programme for the seminar under sub-theme 1.2. This has been done by a list of "key-words" with the notable omission of hydroelectric power. In terms of importance to increasing human needs and thus of priority in resource allocation it is suggested that the key words should be re-arranged as shown on the left hand side of the table annexed to this note.

4. NEEDS FOR TEACHING IN THE AVAILABLE AND FEASIBLE TECHNOLOGIES FOR REGIONAL WATER PLANNING.

As with many international agencies, the ITCWRM should aim to meet teaching and research needs that are not adequately satisfied or provided by national agencies. The centre should at the same time concentrate its efforts on topics which meet the following criteria :

- Have major influence on the planning process
- Can be taught in a reasonably short period of time
- Have special importance to developing countries.

The principal need for teaching is related to those topics which tend to integrate inter-disciplinary activities. The objective should be develop among engineers, agriculturalists and economists a wider and more comprehensive outlook. In the past there has been a strong tendency to focus on individual projects without sufficient regard for alternative projects that will meet the similar or wider objectives and without sufficiently taking into account the interaction between economic sub-sectors.
Admittedly, until recently there has not been a very compelling need to adopt the integrated regional approach to water development because so many areas have been a long way off full utilization of the total available water resources. Now things are changing rapidly in that water resources are becoming scarce and the integrated regional approach to planning is assuming greater importance.

In the table attached to this note an attempt has been made to indicate priority topics for teaching based on my personal experience in river basin planning. The priorities indicated refer to a general need. It does not follow that all these topics are all suitable for teaching at the ITCWRM.

5. TYPE OF TRAINING COURSES TO BE PROVIDED.

5.1. Courses of up to 4 weeks duration - for high level technical and non-technical people - in the general aspects of regional water planning. The aim should be to have up to about 20 people on each course. There should be alternative lectures in the course because not all people will be interested in the same subjects.

5.2. Courses of one or two months duration for middle management level people devoted to specific topics.
Candidates for these courses would need to be carefully selected so that they have sufficient basic knowledge to benefit fully from the teaching.

5.3. Scolarships in specific subjects and in general regional water planning.
Recipients of such scolarships would be based on the Training Centre but might spend much of their time elsewhere in Europe.

The question arises whether the Training Centre can help in the training of sub-professional personnel. Any such help is likely to be indirect rather than direct because sub-professional training should in general be carried out in the country of origine. The help might take the form of training teachers for overseas training schools.

6. NEEDS FOR RESEARCH.

The scope for research is of course very wide indeed but emphasis should be placed on the PROCESSES involved in regional water planning and in the associated system analysis. This applies to hydrology, water distribution, irrigation applications, flood control and flood routing, consumer response, pollution and other matters.

Regional water planning calls for the preparation of a number of dynamic mathematical models (hydrological, hydraulic, economic, financial and operational). Such models have to be developed and proved from a knowledge of many processes and other linkages and in many respects existing knowledge is weak. This whole subject presents a number of fertile fields of research activities. Examples of topics in this catagory are canal conveyance losses and efficiencies ; particle transport ; sheet flood routing and inundated areas ; salinity and chemical transport in ground and surface waters.

Research scholars although based primarily on the Training Centre would need to spend much of their time at other institutes in Europe.

In general the research should be documentary rather than physical.

INDICATIVE TRAINING PRIORITIES IN SELECTED CASES

(Total training needs - not necessarily those suited to ITCWRM)

TOPIC / REGION	Indus	Nile	Ganges	Brahma-Putra	Niger	Mekong	East Botswana	Tehran
A. Resource Potential								
. Surface waters		x			x		x	x
. Ground waters	x						x	x
. Direct precip.				x			x	x
B. Water Utilization								
. Domestic water supply					x		x	x
. Industrial water supply					x		x	x
. Irrigation/land	x	x	x	x	x	x		
. H.E. power	x	x	x		x	x		
. Navigation		x	x	x	x	x		
. Cooling water								
. Fisheries		x			x			
C. Water Abstraction and Storage								
. Dams/barrages	x	x	x	x	x	x	x	x
. Tubewells	x		x					x
. Artificial recharge	x							x
. Desalination								
. Sedimentation	x	x	x				x	
D. Water Conveyance								
. Pipelines							x	x
. Canals	x	x	x					
. Tunnels								x
. Inter basin Trans			x	x				x
E. Water Treatment and Quality Control								
. Treatment							x	x
. Salinity							x	x
. Pollution							x	x
. Re-cycling								x
F. Flood Control and Drainage								
. Flood Protection	x		x	x		x		
. Horiz. Drainage	x		x					
. Vert. Drainage	x		x					
. Salt Balance	x		x			x		
. Erosion Control	x		x					
G. Efficiency in Water Control								
. Urban systems							x	x
. Irrigation systems	x	x	x	x				x
H. Operational and System Analysis								
. Reservoirs	x	x	x		x	x	x	x
. Ground water	x							x
. Linear Programmes	x	x						
J. Social Factors								
. Resettlement	x							
. Consumer Response	x	x	x	x				x
K. Economic Evaluation								
. Economic inputs	x	x	x		x	x		x
. Comparative Eval.	x	x	x					x
. Optimization	x	x	x					x

WORKSHOP N° 2

ECONOMY AND FINANCE

"FINANCING ORIGINS AND COST DIVISION"

- THE EXAMPLE RUHR -

Detlef ALBRECHT

A major problem in financing environmental projects is the fact, that almost nobody wishes to pay for apparently self-evident things. This seems to be the case in most of the countries in the world. Neither the individuals nor the institutions really like to contribute financially.

In order to improve the quality of receiving waters or even to keep the existant conditions incases of increasing pollution load, it is therefore absolutely necessary to have clear and strict regulations for both, financing and implementation of water pollution control measures. Those regulations should be as easy and practicable as possible, as otherwise the improvement of receiving waters may be complicated, delayed, or even avoided. The performance of the new water laws in several European and oversea countries represents examples for this undesired effect. It shall not be doubted that the politicians had a lot of good will to provide good laws, but as a matter of fact there was a lot of confusion after the implementation of the new laws, as we learned from our colleagues from 21 countries at the Specialized Conference on River Basin Management in Essen, September 12 - 16, 1977. New water laws finally provided some additional work for the courts in many cases.

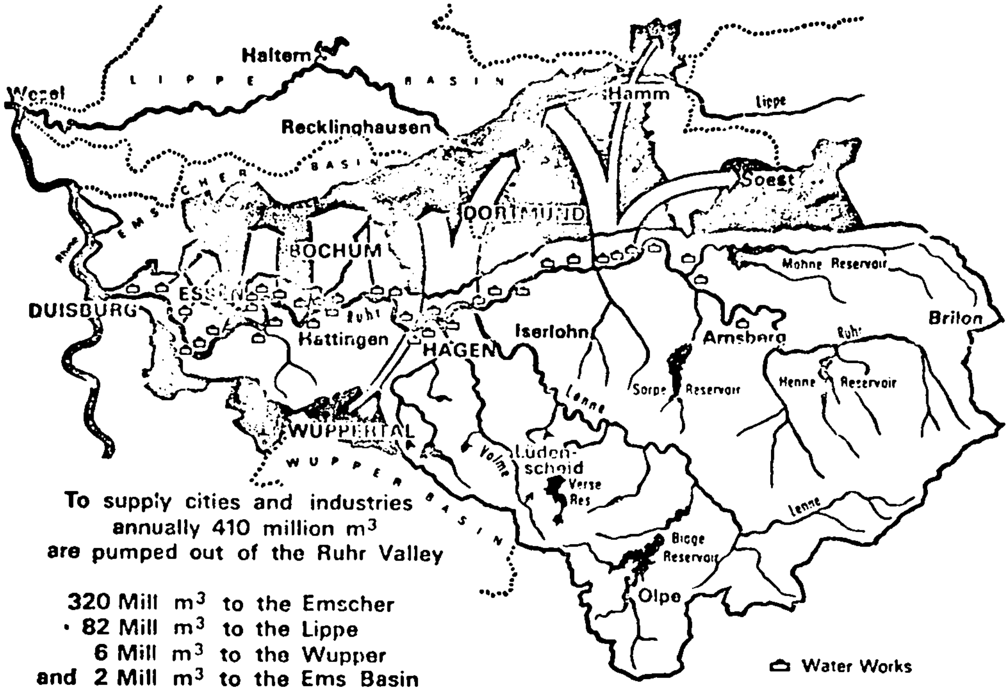
There is at present a great discussion on supplementation or even replacement of the existant regulations for the River Basin Associations in West Germany. But we still have the old ones, and we should be lucky about this. A practicable and reliable principle of assessment and cost distribution should be demonstrated by the example of the two Ruhr Basin Associations.

In 1913 the Prussian Government in Berlin installed two separate laws for water management in the Ruhr basin in North-Rhine-Westphalia.
One for the Ruhr Reservoir Association, which received the responsibility for water quantity management within the entire catchment of the Ruhr River, and one for the Ruhr River Association, which received the responsibility for water quality management in the same basin. Strict regulations became necessary after the water demand of population and industries in the so-called Ruhr district, which covers mainly the Emscher basin, was considerably increased after 1880. Already in the last century the Ruhr was the main source of drinking water for the total region and a great number of water works had been situated at the Ruhr River.

There were, and there are still several reasons for taking the drinking water from the Ruhr. Its water is of low hardness and contains almost no iron and manganese. Moreover, it is available at favourable altitudes by short pipelines between Dortmund and Duisburg (Fig. 1). During the last century only naturally bank infiltrated ground water was pumped from the Ruhr valley for water supply. After 1900 additional recharge basins were constructed in order to increase the infiltration area. Fig. 2 demonstrates the geological situation.

It can be read from Fig. 1 that a great portion of drinking water is exported to neighboring river basins. At the same time the water demand in the Ruhr catchment has to be met and the treated wastewaters of the Ruhr basin are discharged to the river. At present 75 % of the water demand of the total industrial area is provided from the Ruhr.

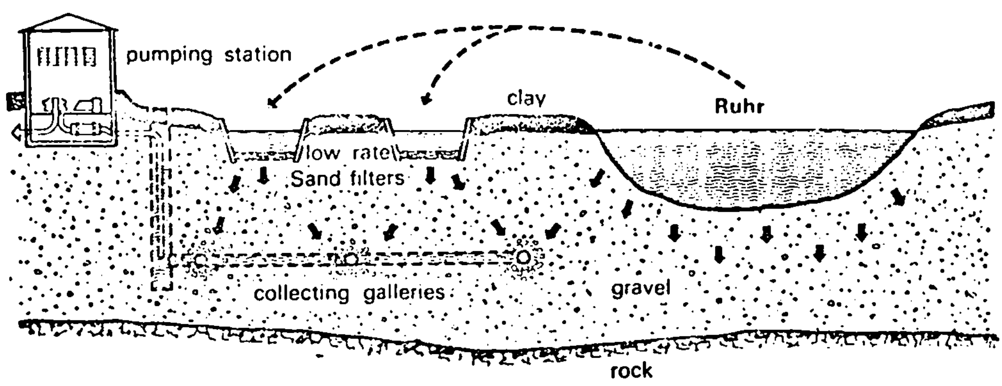
Fig. 1 : Water supply from the Ruhr basin.



To supply cities and industries annually 410 million m^3 are pumped out of the Ruhr Valley

320 Mill m^3 to the Emscher
82 Mill m^3 to the Lippe
6 Mill m^3 to the Wupper
and 2 Mill m^3 to the Ems Basin

Fig. 2 : Scheme of ground water recharge in the Ruhr valley.



The export of water from the Ruhr requires operation of reservoirs to augment low flow in the river. This became obvious in hot summers before 1913, when the river bed was completely dry downstream from Essen by the water abstraction of upstream water works. In this situation everybody understood that a comprehensive water management was necessary. A main question was, how to finance the required measures. The financing system of the Ruhr Reservoir Association was comparatively easy arranged : water works and hydropower station owners pay respective prices for the amount of water they use or abstract from the river.

On the other hand, it was more difficult to find a correct key for the distribution of the expenses of the Ruhr River Association. After a number of serious discussions the Minister in Berlin decided that the three groups of water users : industries, communities and water works (for the abstracted water) had to pay each one third of the annual budget of the Ruhr River Association for the treatment of wastewaters and related measures for water quality control. Later on, the percentage of the water works was increased to 45 % because of the problems arising from the loss of water during dry seasons. The cost distribution within the three groups is regulated according to specified assessment rules. Water works pay according to the amount of water they abstract per year, communities pay according to the number of citizens living in their area and industries are charged after a sophisticated system, according to the amount and the degree of pollution of their discharged wastewater.

In this way, the dischargers into and users of the Ruhr River are enforced by law to make annual contributions which together will cover the association's expenses of operating its treatment plants, paying its salaries and administrative costs, and paying the interest on capital borrowed for investment in new treatment plants and related facilities. Once the total pollution units discharged are determined for the respective groups, they are divided into the total amount of the fiscal contributions required for that particular year. The quotient is the charge for discharging one unit. Each member's contribution is derived from multiplying his pollution units by the charge.

The Ruhr River Association has its own planning section for the design of all plants required. At present 120 wastewater treatment plants exist in the Ruhr catchment, where about 2 mio. people are living and some 2 mio. population equivalents are discharged in addition to the plants from industries. The basis for the plannings of the Ruhr River Association is provided by general water pollution control plans, which represent the actual river quality (to be seen as the lowest residual line in Fig. 3).
General water pollution control plans assure optimal effectiveness of the implemented measures for the river basin and allow the installation of plants according to their priority.

In Germany any use of receiving waters inclusive discharge of even optimal treated wastewaters needs a license of the respective State Government (not from the Federal Government in Bonn). The Minister of Agriculture, Foods and Forestry in Düsseldorf controls whether the River Basin Authorities work according to the laws and statutes. In this respect a state control is given in general, whereas the dicisions of water pollution control measures in detail are made by the self-administrative Associations.

Fig. 3 : Water pollution control plan of the Ruhr River:

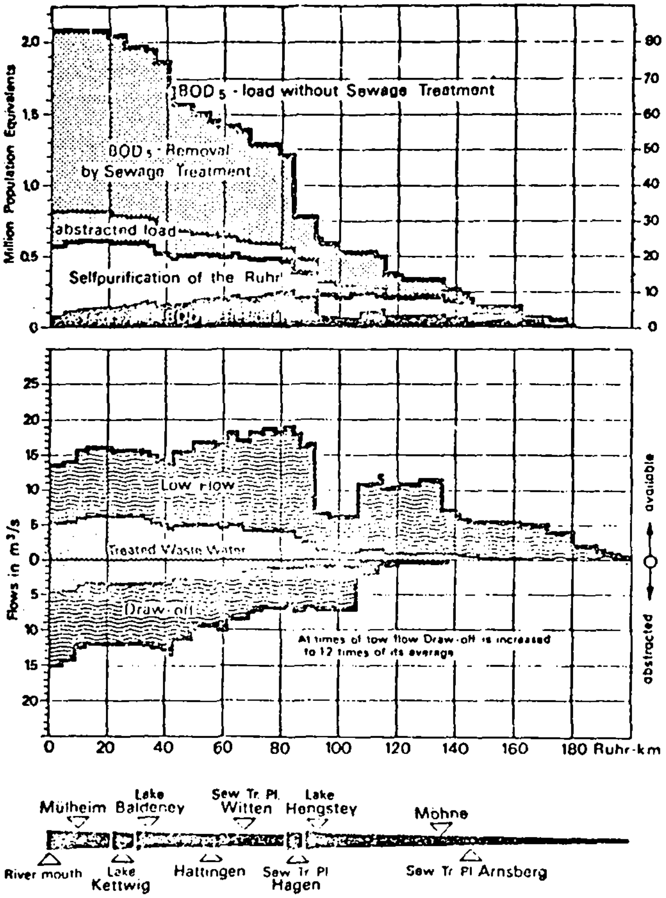
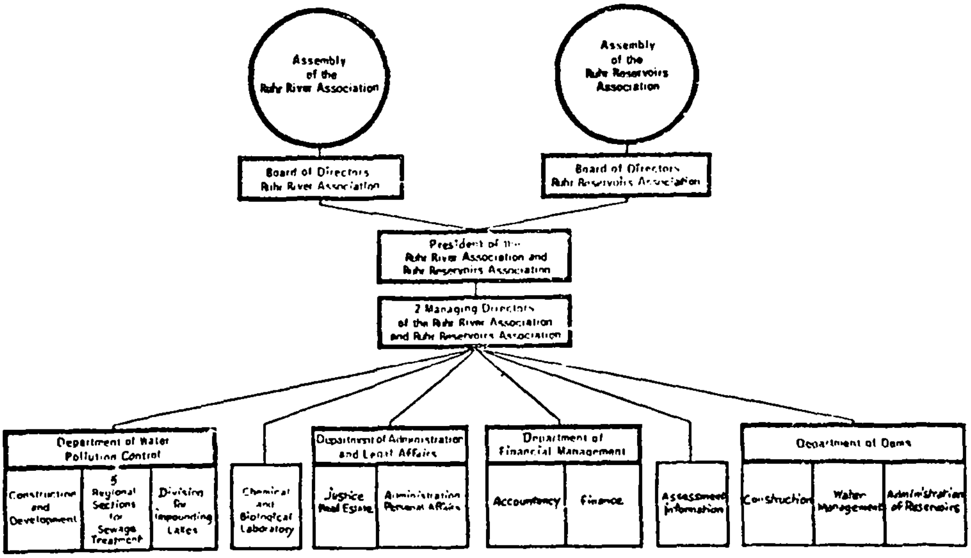


Fig. 4 : Organization scheme of Ruhr River Association and Ruhr Reservoir Association.



the line below is simplified

An organization scheme of both Ruhr Associations is shown by Fig. 4. It must be emphasized, that not only the polluters but also the water works are represented in the boards. This ensures adequate decisions for water pollution control measures.

By self-administration of the Ruhr Associations a convincing effectiveness is achieved. An annual budget of about 250 mio. DM for both Associations managed by only 1000 employees and plant operators. This includes personnel for design, construction, operation, administration, laboratory and others. It has been calculated that a state authority would require about twice that staff.

However, since politicians often tend to follow the natural law of "nothing is constant in the world for all time", a discussion on new regulations for the River Basin Associations has been started. There is little doubt that the effectiveness of water management will be lowered with more state administration at the Ruhr. The problem is, to find practical regulations for the new nationwide law on wastewater charges. This law will be in effect in 1981. In general, this law provides the "polluter pays principle" for the whole nation, which is successfully applied by the River Basin Associations since decades in their catchment basins. On the other hand parts of this law are difficult to perform in areas where River Basin Associations are existant. Some pessimistic people say, that we now have a law with an inherent desire for renovation.

In order to ensure an economic and effective water management at the Ruhr, even in the future, we would be lucky to stay with the old and approved principle of system-wide water management by a self-administrative organization.

WORKSHOP N° 3

STUDY OF SOCIO-POLITICAL PROBLEMS

"LES INTÉRÊTS EN PRÉSENCE POUR L'USAGE DE L'EAU"

Silvio CAMPELLO

Avant de parler des intérêts présents dans l'utilisation de l'eau, il convient de poser une question fondamentale pour la planification régionale de l'eau. Quel est l'objectif d'un programme de développement des ressources hydrauliques ? Il sera peut être d'augmenter la production d'énergie ou d'améliorer les conditions de transport ? Or,, nous savons que tous ces travaux ne peuvent pas être une fin en soi, mais l'un des outils pour obtenir le bien-être de la population, c'est-à-dire pour atteindre un nouvel état d'aspiration de la communauté nationale.

Les intérêts rentrent en jeu en fonction de cet état d'aspiration et varient d'intensité, d'une région à l'autre, selon le niveau d'éducation du peuple et de son niveau de vie, et, par conséquent, de la compréhension qu'il a de ses besoins.

D'autre part, il faut tenir compte de ce que la planification des ressources en eau est une étape du processus de la planification générale. De plus, l'efficacité de la gestion dépend d'une "politique" claire, définie par l'ensemble des objectifs et priorités fixées, ainsi que des principes à suivre pour la répartition des compétences et des ressources financières.

1. INTERETS EN PRESENCE.

Ayant en mémoire les propositions précédentes, nous pouvons penser à la formulation de quelques intérêts en jeu. D'abord, il faut dire que ces intérêts ont une nature et des importances variables. La nature peut être liée aux activités productrices : irrigation, génération d'énergie et navigation ; à la santé publique : alimentation en eau potable et assainissement ; à la préservation et conservation de l'environnement naturel : lutte contre la pollution et conservation des sols.

L'importance d'un intérêt est proportionnelle aux alternatives de remplacement du bénéfice par un autre moins coûteux et à la solidarité des groupes sociaux intéressés.

Il faut dire que chaque individu attache une importance différente aux divers aspects et aux possibilités du développement des ressources hydrauliques, en fonction de ses propres besoins.

Si l'intérêt se traduit directement par une augmentation du revenu national (impôts, emplois), c'est-à-dire, s'il apporte un bénéfice tangible, alors les investissements hydrauliques sont raisonnablement justifiés devant la communauté. C'est à cause de cela que les ingénieurs et les économistes ont tendance à accorder trop d'importance à la rentabilité économique des projets. C'est seulement dans ces dix dernières années que les planificateurs ont porté leur attention sur les aspects intangibles du développement des ressources hydriques (préservation du milieu naturel, aménagement de zones de loisirs).

Quelquefois, on trouve un intérêt bien marqué par un Organisme qui s'occupe, par exemple, de la production d'énergie et qui présente l'alternative la plus économique, même au détriment d'autres possibilités d'usage de l'eau ou de l'exploitation des ressources naturelles adjacentes. Dans ce cas, une telle alternative ne peut être prise en compte que si l'on n'envisage pas d'autres objectifs ni dans le présent ni dans l'avenir. Divers intérêts en jeu conduisent forcément la planification à prendre en considération les buts multiples, malgré une probable baisse de la rentabilité économique si l'on considère les aspects intangibles.

La sélection ou le choix d'un plan réclame aussi une confrontation entre ses objectifs et la politique économique et sociale adoptée pour la région considérée. En outre, si les besoins sociaux sont à l'origine de toutes les activités de planification, il est certain qu'il faudra connaître les aspirations et les revendications de la communauté qui est l'agent et le bénéficiaire des aménagements hydrauliques. La participation de la communauté à travers ses représentants mettra l'accent sur les intérêts les plus significatifs pour elle.

2. CONFLITS D'INTERETS.

Les conflits d'intérêts peuvent se manifester pour une situation actuelle ou pour l'état futur. Les conflits actuels sont cernés par la confrontation entre usages, en tenant compte des zones déficitaires, ce qui exige une analyse des disponibilités en face des besoins en considérant leurs variations dans le temps et dans l'espace. Pour cela on voit rapidement que la gestion des ressources hydrauliques doit se faire au niveau du bassin hydrographique, dès que pour leur aménagement les espaces ou sous-basins sont interdépendants.

Les conflits potentiels, en plus de considérations faites ci-dessus, mettent l'attention sur les projections des besoins à longue échéance. Or, nous savons que les taux de croissance de certains besoins sont définis avec une précision moindre au fur et à mesure que l'on envisage une projection plus éloignée. Spécialement si l'on considère les changements rapides que l'humanité doit subir les prochaines années : avance technologique, croissance urbaine désordonnée, explosion démographique ; tout cela empêche une analyse précise de l'évolution de la demande comme on peut le faire pour les disponibilités.

En tenant compte du scénario décrit ci-dessus, nous devons toujours partir de l'analyse de la "situation actuelle" à la recherche d'une "situation désirable", pour arriver à la "situation possible"

L'établissement d'une "situation possible" exige, en général, la fixation de certaines contraintes, soit d'usages, soit d'investissements, et par voie de conséquence, elle détermine aussi les priorités. Ces priorités et ses contraintes obligent souvent à tenir compte du caractère aléatoire des phénomènes naturels ; par exemple, une disponibilité en eau dans le temps peut être critique pour une demande urbaine et n'avoir pas le même effet sur l'irrigation ou la navigation, quand on prend en compte les risques de défaillance.

De toute façon, la planification doit être un effort organisé pour sélectionner la meilleure alternative, la plus proche de la "situation désirable" et en harmonie avec la politique générale. Les conflits qui découlent du choix fait doivent être analysés par un processus de "feed back" dans le but de déterminer les conséquences de la position adoptée.

3. CONCLUSIONS.

Ce bref aperçu général qui permettra une approche plus détaillée avec des cas particuliers concernant différentes régions du monde, met l'accent sur un point pour nous très important : Les conflits entre usages de l'eau nous montrent clairement que la gestion des ressources hydrauliques doit se faire de façon intégrée (spatialement et sectoriellement) ; elle doit être flexible dans le temps et nous devons avoir toujours en mémoire qu'elle va agir sur l'un des facteurs limitant du développement.

"SOCIO-POLITICAL PROBLEMS"

Pierre NAJLIS

Nobody will doubt the importance of socio-political aspects of water resources development and management whether it be at the local, national or regional level in its broader sense, to remind ourselves of the importance of socio-political phenomena it suffices to recall that on more than one occasion governments have lost elections essentially on the issue of the desirability - or lack of it - of a certain type of river basin development ; or that many projects in developping countries have failed because planners did not take into account the sociological nature of the population and assumed a response on the part of this population that was not forthcoming in the final analysis.

Although essentially I would like to address muself to the question of the perception and definition of the socio-political and economic problems faced by planners at the regional level, I would like to submit that in our external reality there is no such thing as a socio-political phenomena per se. Any more than there is an economic phenomena per se. The use of these words represents a human effort to isolate and classify certain aspects of total external reality in units or compartments that are manageable by the human brain, this is in fact the way the human mind works and how scientific endeavours are born.

While this must be so, there is a danger, and I believe particularly so in the case of socio-political problems of the kind weare dealing with, to make reality fit the boxes invented by man and to cut out that which does not fit the boxes ; rather then to attempt to modify the boxes to fit reality. Hence the economist as is well known, is quite prone to desmiss social variables from his equation as not being sufficiently tangible.

The political and social scientist may likewise neglect or fail to understand the economic variables.

It may well be argued that the way out of such a situation can and is found by ensurring a proper dialogue between representatives of the various social and exact sciences that are involved in the planning and management process. This indeed may be so, but it assumes that all these scientists or policy-makers, as you will, have already developed a sufficiently common language to understand that piece of reality which the other discipline is attempting to explain, and further that such dialogues have a long-lasting impact on the representatives of the various disciplines so as to broaden their perception and interpretation of the phenomena they each deal with.

My purpose in raising this seemingly esoteric point, Mr. Chairman, is to suggest that while CEFIGRE has indeed an important role to play in giving professionals from all over the world an opportunity for further training in their own disciplines, it may have a very important role to play in broadening the scope of these individuals by offering interdisciplinary training to induce a broader understanding of socio-political, as well as economic and technical phenomena, which in turn may lead to more flexible and through problem definition, planning and project implementation in other words greater awareness, better aknowledgement and more efficient action.

Should this approach be of interest to this Workshop, Mr. Chairman, then part of our task would consist in defining in detail the approach to be taken, and the type and lengh of interdisciplinary training to be offered.

"PUBLIC PARTICIPATION AND ACCEPTANCE"

Francis MONTANARI

What is public participation as related to water resources management ?
What are its goals ?

Will attempt to develop four principal points using case histories :

1. Activity is not new in participatory government.
2. Objectives are worthy ; process deserves our best efforts. Each has expertise. Many Pseudo-experts.
3. Process is expensive in terms of effort, time, personnel and money.
4. Consequences of NOT USING may be serious.

Using environmental evaluation as example - Process has two basic points :

1. Scientific evaluation.
2. Public process portion.

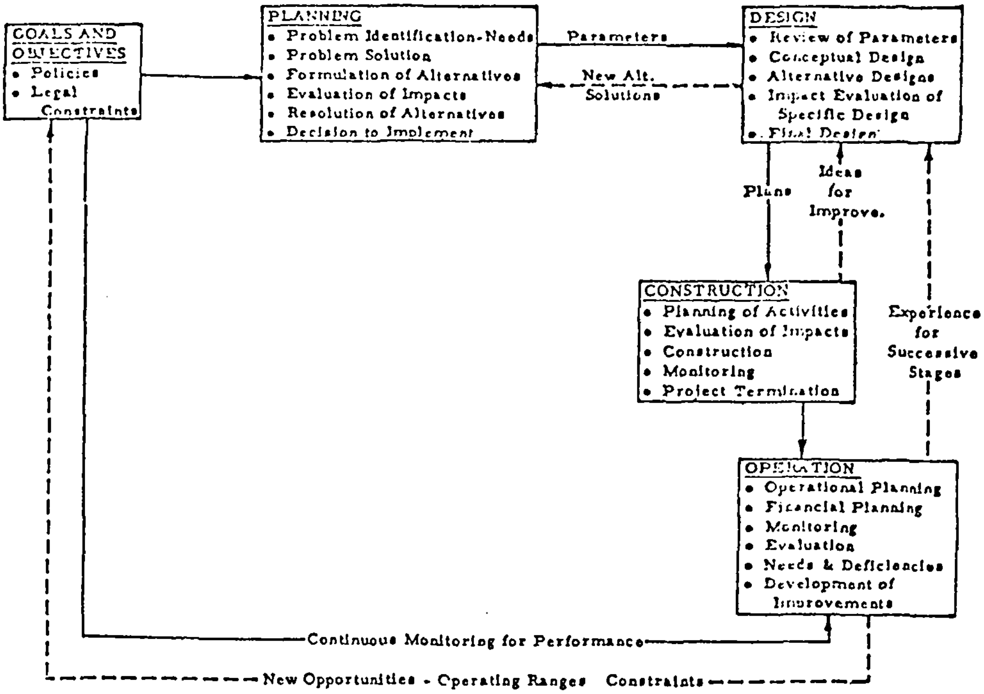
PUBLIC PROCESS :

Figure 1 : Water resources management.
Figure 2 : Water resources management with public participation.
Figure 3 : Planning.
Figure 4 : Planning with public participation.
Figure 5 : Interrelationships in design process.

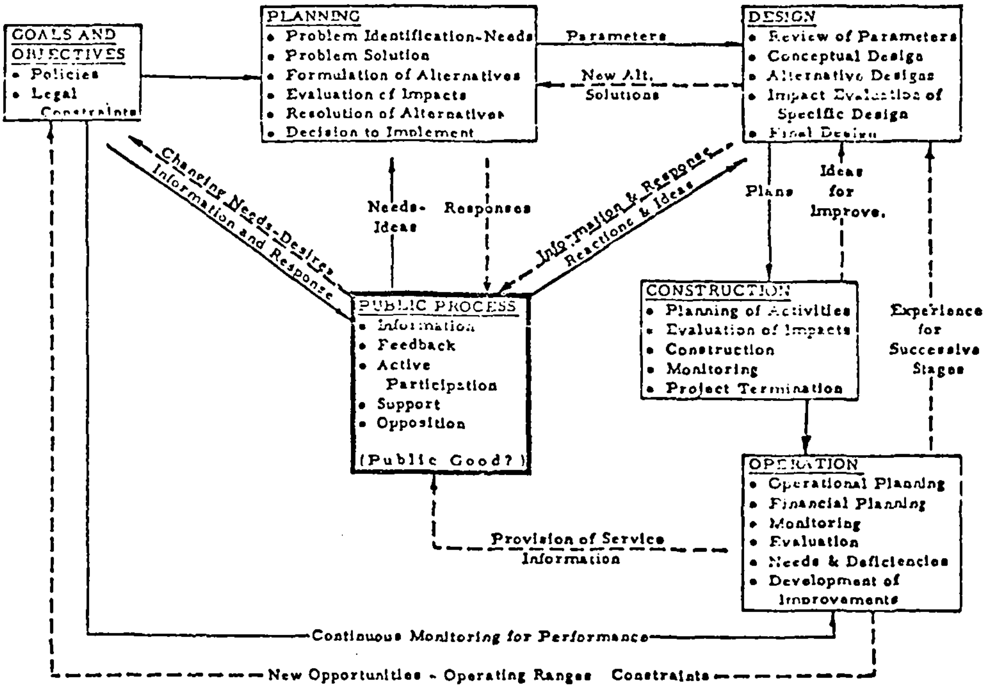
COMMUNICATION IS THE GLUE WHICH HOLDS THE PROCESS TOGETHER.

What is our task at this Seminar ?

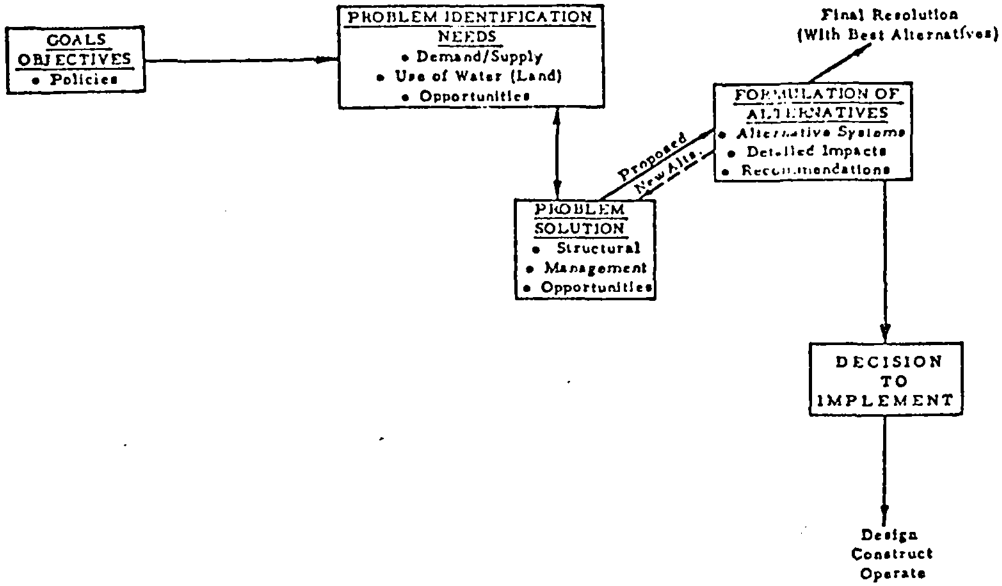
- Divides into two levels :
  1. More developed countries.
  2. Developing countries.
- Role of professional.



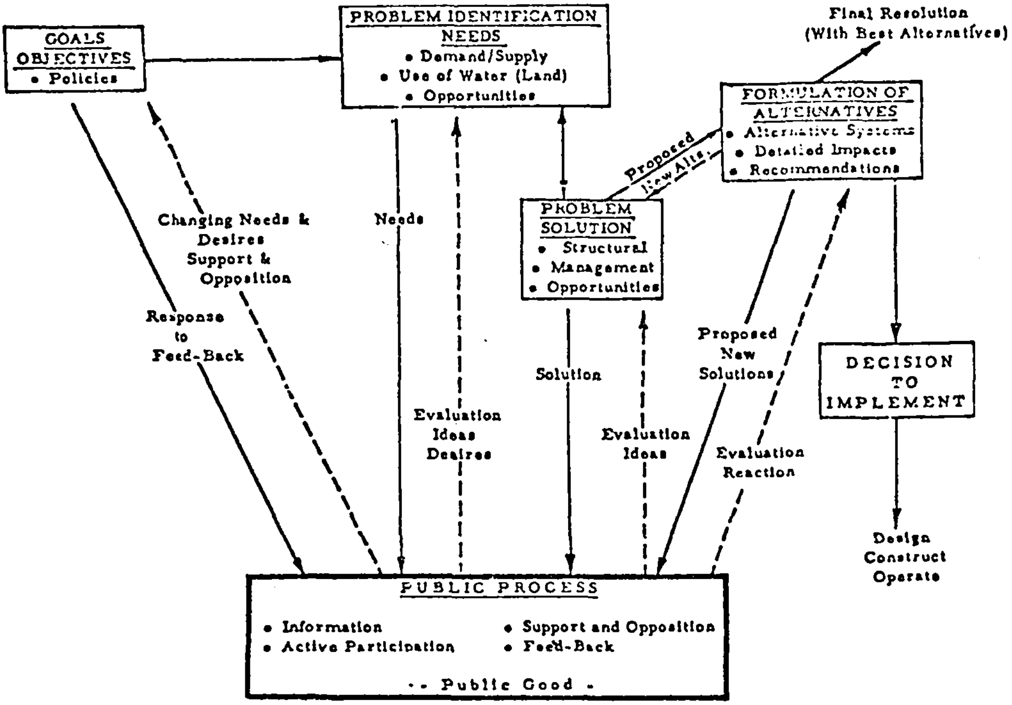
1. WATER RESOURCES MANAGEMENT PROCESS



2. WATER RESOURCES MANAGEMENT PROCESS
WITH
PUBLIC PARTICIPATION



3. PLANNING PORTION OF MANAGEMENT PROCESS



4. PLANNING PORTION OF MANAGEMENT PROCESS
WITH
PUBLIC PARTICIPATION

WORKSHOP N° 4

REGIONAL WATER PLANNING INSTITUTIONS

"ORGANIZATION AND INSTITUTIONAL ASPECTS"

Janus KINDLER

1. CENTRALIZATION/DECENTRALIZATION.

Efficient management and national unity require ordered structure of government power and authority, but at the same time responsibility for administrative activity must be shared if it is to be effectively carried out. Such sharing may take the form of constant delegation of functions to subordinate administrative branches, to local authorities, ... sharing of responsibility among civil servants and participation by citizens tend to bring out the higher loyalties and the best administrative abilities of the nation.

Centralized and decentralized administration are not necessarily antithetical, but rather complementary.

- functional structure of administration
- hierarchical structure of administration
- regional structure of administration

Assuming we have a regional water administration of some form (what are the forms ?), how it is structured, what are the functions of different hierarchy levels, do we have sometimes non-hierarchical structure, regional water administration as a part of the regional authorities concerned with overall administration of a region, if not - what are the mutual relationships (water administration vs. overall administration).

2. RELATIONSHIPS BETWEEN THE CONTROL AUTHORITY AND ITS LOCAL BRANCHES.

Local branches of the central authorities (e.g. National Water Authority) does not necessarily coincide with the regional administration.

3. MANAGEMENT OF PUBLIC AND PRIVATE ENTERPRISES AND SERVICES CONCERNED WITH WATER SUPPLY, WATER UTILIZATION AND WATER POLLUTION ABATMENT.

	SUPPLY	UTILIZATION	POL.ABATMENT
PUBLIC	V	V	V
PRIVATE		V	

3.1. MUNICIPAL, INDUSTRIAL, AGRICULTURAL SERVICES (WATER SUPPLY)

- Municipal, industrial and agricultural water uses in the region.
- Requirement vs. demand.
- Conflicts .
- Water and the natural environment.
- Organization of these services (evaluation of the present situation) - how to plan them to attain desired level of efficiency ?

3.2. SUPERVISION OF THE CONSTRUCTION OF WATER WORKS.

3.3. SUPERVISION OF THE OPERATION OF WATER WORKS.

1. CENTRALIZATION / DECENTRALIZATION.

- Functional vs. territorial.

2. REGIONAL WATER AUTHORITY (RWA)

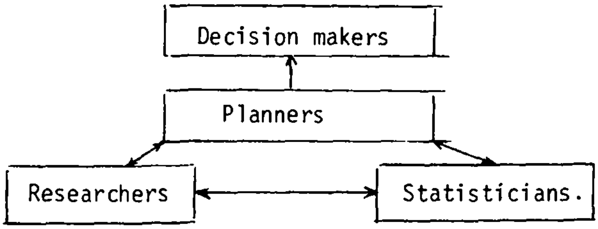
- Forms of RWA
- Relationships with central authorities
- Relationships with other regional authorities
- Organizational structure (hierarchy, etc ...)

3. FUNCTIONS OF RWA.

- Planning (developing policies)
  - participation in the long-term planning.
  - participation in passing juridical acts (licencies, charging schemes, effluent taxes, etc)
  - role in locational decisions
- Design and execution of water works.
  - supply
  - water use
  - pollution abatement
- Operation (implementing policies)
  - engineering
  - economic, and
  - juridical

mechanisms for the best (what is the best ? what is rational ?), utilization (water supply, hydropower, navigation, recreation) and control (flood control, pollution control) of regional water resources, especially in the extreme hydrologic situations (flood, drought).

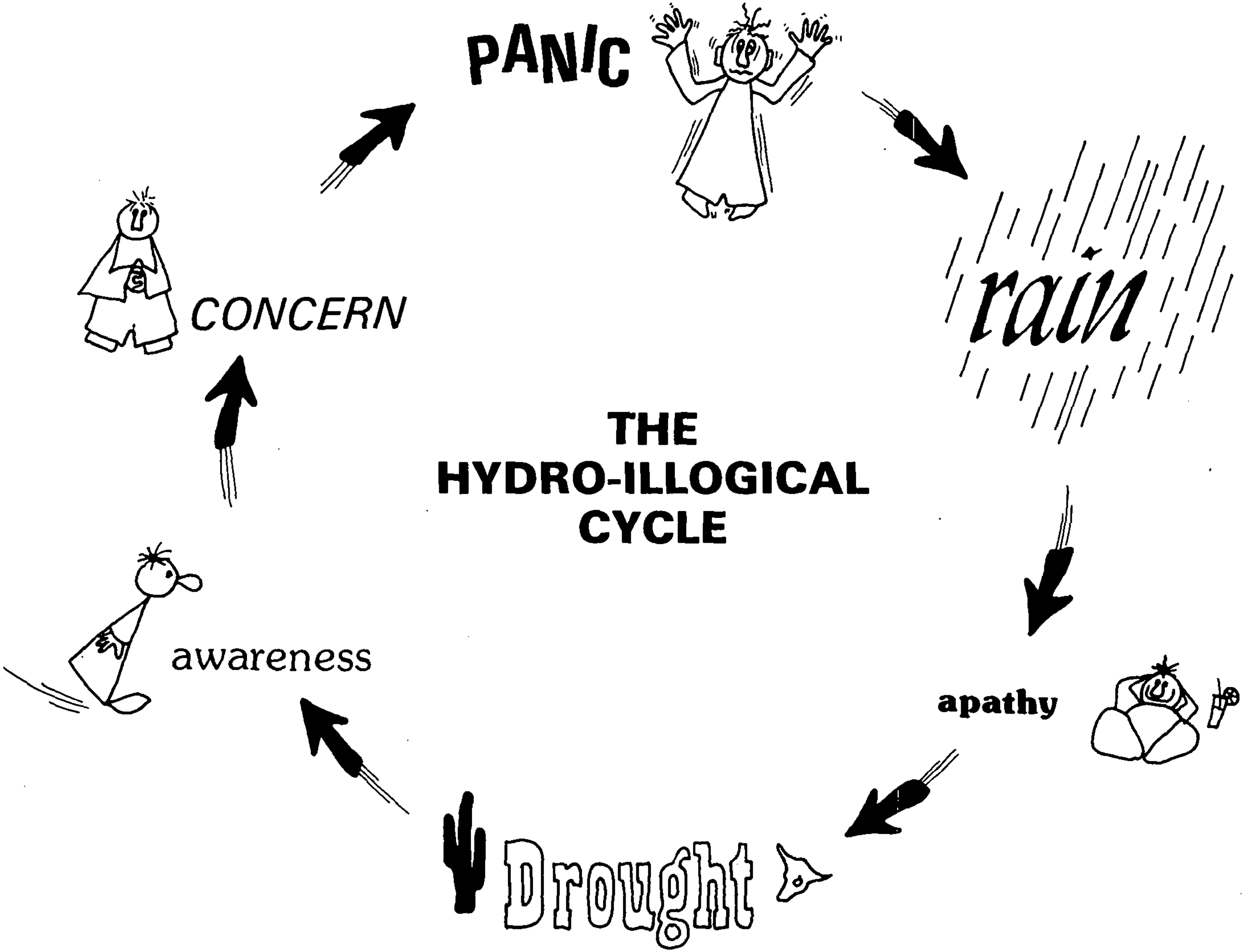
- technical assistance
- assistance to water users of regional water
- extension services ? authority.
- relationships with engineering and research organizations.
- engineering ?



acc. to C.R. BLITZER.

SUB-TOPIC 4.2. : POLICY INSTRUMENTS AND THEIR IMPLEMENTATION.

- Juridical instruments.
- Economic instruments.
- Relationship between these instruments
- Financial effectiveness of these instruments (indicators)
- Adaptation of the regional level
- Coherence with the institutional arrangements.
- Cost of implementation of economic and juridical instruments.
- Allocation of water by objectives
- Integrated water management.



THE HYDRO-ILLOGICAL CYCLE

"ADMINISTRATION DECOR AND INSTITUTIONAL ORGANIZATION"

Reuben J. JOHNSON

1. INTRODUCTION TO PROBLEM.

The problem of organization for the planning and management of water and other natural resources has been a continuing one ever since man began to consider the use of these resources in an orderly manner. Riverine drainage areas as well as the course of rivers seldom adhere to political or economic boundaries. Consequently, resource development by one national or political entity encompassing a portion of the river basin may seriously affect the economy or environment of an adjoining entity.

This problem has been growing in significance in recent years as a result of :

a) increasing populations and attendant demands for water ;

b) increasing uses of water, which accentuate competition for a dependable supply ;

c) more intensive use and development of land and other natural resources ;

d) emerging need for transbasin diversions ; and

e) deterioration of water quality with increased industrialization and more intensive use of fertilizers in farm enterprises.

The foregoing factors have precipitated reviews of and revisions to basic water laws and institutional organizations in a number of countries, to provide for a comprehensive approach to planning and development of resources, integrating all components of water use, including the impact of development on the environment as well as recognition that water management should be consistent with national planning for the whole economy.

2. EXISTING TYPES OF MANAGEMENT INSTITUTIONS.

The prevalent type of water resources administration in many countries in the past has been of a localized or decentralized form. This was favored because it was flexible and informal ; it also afforded the immediate water users direct control of planning, developing and financing of desired projects. These projects in many instances were single purpose and local in nature. In recent years pressing needs have arisen for integrating water use, establishing priorities in implementing water programs, resolving conflicts in water use, and collecting data in an orderly from to support needed decisions. To meet these needs a more centralized form of management is being given consideration in many countries.

A review of recent monographs prepared by member countries of the Water Problems Committee of the Economic Commission for Europe indicates that central management authority is generally characterized by three degrees of authority.

a) Authority limited to collection, analysis, and publication of data, and to advise on or warn against serious emerging problems. This is applicable primarily to small countries.

b) Authority includes integration of regional planning to make it compatible nationally and internationally, to provide advice in solving conflicts of use, to assist in governmental financing of water projects, and to encourage and promote water resources research and training of experts.

c) Authority assumes the main responsibility and authority for national planning, financing, and constructing of projects.

A number of the countries have developed modifications to the centralized management concept in order to emphasize the role of regional organizations. This affords inter alia a better opportunity for policy development and implementation of joint financing of water resources programs between the central government and regional agencies. These modifications generally assume the following form or a variation thereof :

a) The central authority includes representatives from the specified regions and assists in standardizing policy and problems involving several regions. The regional management institutions have the primary responsibility for planning, managing and operating water resources utilization.

b) The central authority is concerned primarily with problems involving large interbasin transfers ; coastal and international boundary waters ; general provisions for flood control and delineation of its financial responsibilities. Regional institutions have the responsibilities to plan and implement programs for utilization of their water resources.

c) The central authority decrees principles and supervises execution thereof on water use and dispositions for navigation, fisheries and protection of water quality. It also has a coordinating function when disputes arise, and makes decisions on grants and the exercise of inter regional and international water rights. All planning and construction of projects is left to regional institutions working within these limitations.

d) Responsibilities in water resources management are divided within the central authorities or between central and local authorities. The divided responsibilities are, in some instances, coordinated by a council, consisting of leaders in the separate entities of the central government. This council has responsibilities for development of principles and standards, coordination of water resource programs of agencies and preparation of national assessment of water availability and needs.

3. SUGGESTED CRITERIA FOR ADMINISTRATIVE DECOR AND INSTITUTIONAL ORGANIZATION.

In a review of institutional water resource management organizations in the United States by the Water Resources Council, a basic general observation was concluded to the effetc that :

> "There is no one "best" institution to meet all regional needs in all parts of the country. What will work "best" in a given basin depends upon its problems and characteristics. Before any commission or alternative institution is considered such elements as the physical, cultural, economic, and political characteristics of the region must be analyzed. Also noted should be such items as the water and related land resources, and relationships to adjoining regions. Above all, a careful review should be made of how water resources problems are being handled in the area at the present time, in order that new institution would accomplish specific functions not now being performed or now being inadequately performed. Existing agencies that are adequate for the task should not be duplicated or superseded."

In developing criteria for the establishment of institutional organizations some additional observations based on experiences in the United States and other Economic Commission for Europe member countries are submitted for consideration.

With reference to a centralized authority, items that require careful consideration include :

a) extent of control.

b) role of regional and local institutions.

c) specific areas of authority most applicable to centralized control such as international boundary water problems, inter-regional disputes, inter-basin transfers, establishement of principles and standards for planning and water quality, national assessment of water availability and needs, navigation and fishery regulations.

d) representation of regional and local institutions in the central authority.

e) establishment of national objectives or goals for water resource utilization and development.

f) extent and methods of assisting in financing water resources planning and development.

In regard to establishing regional institutions consideration of the following items is suggested :

a) responsibilities - establishment of goals ; prepare an integrated master plan and alternatives thereto, including plans of local agencies and urban centers ; establish priorities for implementing plan ; develop cost allocation program.

b) functions - provide a basis for national resource program integration ; provide for geographic integration within region and with adjoining regions ; serve as a source of dependable and expert information on natural resources within the region, including trends on environmental effects ; integrate the inter-relationship between water quality and other aspects of water resources development ; and reconcile the problems of water quality management, land use management, and environmental protective consideration.

The functions of a regional institution is directly related to its given authority. In the United States the centralized authority for water resources development is divided among nine Federal agencies and two general types of regional institutions are in existence. The first of these types has authority primarily for planning and coordination. Title II river basin commissions are examples of this type. Each commission is comprised of representatives from the Federal Agencies and from each State wholly or partially within the commission boundary. Funds are provided by the Federal Government and the States. The second type has responsibility not only for planning and coordination, but for construction, operation and regulation. The most notable example of this type is the Tennessee Valley Authority created in 1933 to improve navigation, provide flood control, reforestation, agriculture and hydro power development in the Tennessee River Basin. This authority is directed by three board members appointed by the President of the United States. Funds are obtained from power revenues and direct appropriation by Congress. The change that has occurred in the Tennessee Valley - from a poor, underdeveloped area in the 1930's to a highly industrialized properous area today attests to the success of this commission. However no further regional organizations of this type have been created in the United States because of problems that may arise in regard to centralized control, conflict with the other Federal Agencies, and inter regional rivalries.

"WATER RESOURCES MANAGEMENT INSTITUTIONAL FRAMEWORK"

Luis Veiga Da CUNHA

It may be said that, broadly speaking, the institutional framework for water resources management has evolved in a similar manner in different countries. As long as water is plentiful and there are no serious pollution problems, responsibility for water management is shared, usually without this causing great inconvenience, by the administrative departments that supervise its use and conservation, according to the specific responsibility of each department and the needs of the moment. But when competition for water becomes keener, the actions of the various departments concerned with water management come more and more into conflict with one another, and there is frequently overlapping and loss of efficiency. It then becomes necessary to plan and coordinate water use by setting up frameworks that can ensure an overall approach to water management.

Water resource management involves the parallel, coordinated actions of various authorities, with legislative, executive and advisory functions as regards water, and these authorities may be classified as follows :

- authorities responsible for the conservation and development of water resources ;
- authorities responsible for economic and social planning and development, and for land use planning ;
- authorities with jurisdiction over the various water-using activities.

Some of these authorities act at a national level, others at a regional or local level, coordination between their functions at the various levels being ensured by hierarchical relationships.

This multiple action can thus be analysed according to two criteria that can be superimposed, one of which corresponds to parallel interventions of the different catagories of authorities, and the other to the various levels of territorial administration that are hierarchically dependent. These two criteria were taken into consideration in the organization chart shown in annex whose central theme is an outline for a water management institutional framework, dealt with in detail later.

The organization, composition and functions of a water management institutional framework depend on a set of conditioning factors of various kinds, and this makes it hard to lay down a universally applicable framework model. The most important conditioning factors are as follows :

- aspects connected with water availabilities and demand, such as climatic and physiographic conditions, population density, urban concentration and the stage of economic and social development, insofar as they may determine the existence or relative importance of authorities or bodies needed for carrying out specific action ;
- water rights and water administration system, insofar as the scope of action of the executive authorities depends on the extent of the public water domain and on the sharing of administrative authority over that domain ;
- degree of participation given to private entities and to the public in decision-making, insofar as composition of the advisory bodies depends on this ;

- effective action of the government, which may or may not justify the setting up of management authorities with administrative and financial autonomy ;
- political and administrative organization, which may sometimes have deep traditions, with greater or lesser dependence of the regional and local authorities on the central government.

In spite of these conditioning factors, there are certain basic rules to be complied with by a water management institutional framework, if it is to be able to put efficiently into practice the management principles and carry out the action referred to. A study of the water management institutional frameworks in countries that have modern legislation, corroborates this view, even though there are differences in the organization of such frameworks and in the composition and responsibilities of some of their authorities, due to the greater or lesser weight of the conditioning factors.

One of the basic rules which can be deduced from the forefoing considerations, is that coordinated action is essential between the authorities responsible for water resources conservation and development and the authorities in the other two categories already mentioned : those responsible for economic and social planning and land use planning and those responsible for water-using activities. In fact, the various government departments normally have their own approach to water problems, and it is essential to reconcile these different attitudes by means of coordinative authorities that represent the combined interests of the different departments with jurisdiction as regards water problems and, therefore, are entrusted with formulating water management policies and planning. These authorities must, consequently, have coordinative functions, and consist of representatives of the departments most closely connected with water problems. At the top of the water management framework there must be a collegiate, interministerial committee.

For obvious reasons, it is also fundamental that responsibility for the executive functions of water management policy should be concentrated in a coordinated system of authorities.

Another basic aspect to be mentioned is participation by representatives of users and other interested sectors in laying down policies for water resources management. This means that a water management institutional framework needs authorities through which users and other sectors concerned with water can give voice to their opinions on problems that affect them.

A water management institutional framework must therefore include three types of authorities and bodies :

- decision-making and coordinate authorities, which define policies, do planning, coordinate action and take the main decisions ;
- executive authorities and bodies, which carry out action and provide support to the decision-making and coordinate authorities ;
- advisory bodies, which collaborate with the decision-making and coordinate authorities, and enable parties with interests in water matters to voice their opinions.

The set of authorities and bodies of each type is represented at national, river basin and local levels, thus ensuring coverage of the territory by decentralized management units, with hierarchical relationships within the first and second types of authorities and bodies referred to.

The authorities and bodies that make up the proposed water management institutional framework are shown in the three central columns of the organization chart shown in annex. This chart has been prepared in accordance with the basic rules defined above and, due to the conditioning factors also mentioned, is expressed in very general terms.

The water management institutional framework comes directly under the Cabinet of the Prime Minister, and incorporates decision-making, coordinative and executive authorities and advisory bodies represented at national, regional and local levels. Some details of the composition and general functions of the authorities and bodies included in the proposed framework are now analysed.

a) National level.

The water management institutional framework is headed by an interministerial commission which in the organization chart is called Interministerial Water Commission. This Commission, whose job is to lay down policy and define the guideless for carrying it out, is made up of the Ministers with responsibility in economic and social planning and in sectors connected with water matters, and presided over by a Minister responsible for water management, as delegate of the Prime Minister. Directly subordinate to this Minister is a Central Water Management Authority which carries out the executive functions of the water management institutional framework, i.e. those relating to water resources conservation and development.

Attached to the Interministerial Water Commission is an advisory council, which appears in the organization chart as the National Water Council. Its task is to provide support to the Commission, and it is made up of representatives of the Government and administrative authorities that do not belong to the Commission but are directly or indirectly concerned with water matters, local government representatives, individual or juristic persons concerned with water matters and persons of recognised competence in domains related with water management.

Also at a national level is a commission of representatives of the various Ministers, which in the organization chart is called Interministerial Delegate Commission. It is made up of the Directors of the Central Planning Authority and the central authorities with jurisdiction over water use activities, and its job is to ensure compliance with decisions of the Interministerial Water Commission and to promove studies required for briefing decisions by that Commission.

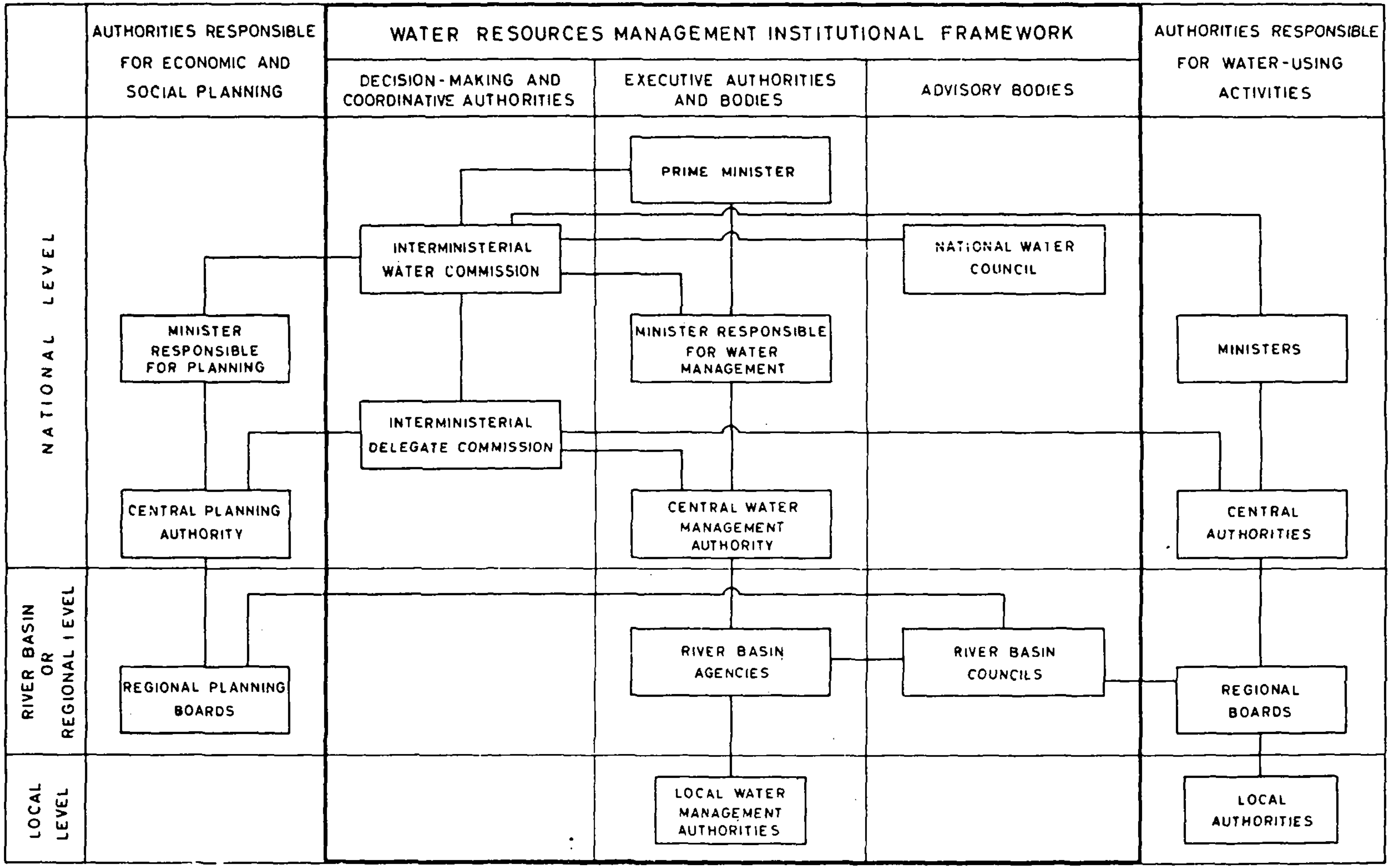
b) Regional or river basin level.

At the river basin level are the water management executive authorities, which in the organization chart are called River Basin Agencies. Attached to these Agencies are advisory bodies, which appear as River Basin Councils, whose composition is defined on the same lines as that of the National Water Council. They include representatives of the Regional Planning Boards and the Regional Boards of the departments with jurisdiction over water use activities. It should be noted that the areas of jurisdiction of River Basin Agencies may not coincide with the planning regions or with the areas of influence of the other regional boards. Moreover, on the River Basin Councils there must be representatives of all boards covered by the areas of the River Basin Councils concerned.

For working efficiency, River Basin Agencies may be given the status of public enterprises, in which case they would only be responsible for planning, technical assistance and collection and processing of information, while river basin authorities subordinate to the public administration would be entrusted with policing action.

c) Local level.

The River Basin Agencies must have authorities under them at a local level, or else delegate certain executive functions to municipalities or other local government entities. Representation of the water management framework at the local level is closely related to the degree of administrative responsibility traditionally attributed to local government authorities. Analysis at this level therefore lies outside the scope of a general outline such as the one proposed.


AUTHORITIES RESPONSIBLE FOR ECONOMIC AND SOCIAL PLANNING
WATER RESOURCES MANAGEMENT INSTITUTIONAL FRAMEWORK
DECISION-MAKING AND COORDINATIVE AUTHORITIES
EXECUTIVE AUTHORITIES AND BODIES
ADVISORY BODIES
AUTHORITIES RESPONSIBLE FOR WATER-USING ACTIVITIES
NATIONAL LEVEL
RIVER BASIN OR REGIONAL LEVEL
LOCAL LEVEL
PRIME MINISTER
INTERMINISTERIAL WATER COMMISSION
NATIONAL WATER COUNCIL
MINISTER RESPONSIBLE FOR PLANNING
MINISTER RESPONSIBLE FOR WATER MANAGEMENT
MINISTERS
INTERMINISTERIAL DELEGATE COMMISSION
CENTRAL PLANNING AUTHORITY
CENTRAL WATER MANAGEMENT AUTHORITY
CENTRAL AUTHORITIES
REGIONAL PLANNING BOARDS
RIVER BASIN AGENCIES
RIVER BASIN COUNCILS
REGIONAL BOARDS
LOCAL WATER MANAGEMENT AUTHORITIES
LOCAL AUTHORITIES

"ORGANISATION INSTITIONNELLE DE LA GESTION DES EAUX"

Luis Veiga Da CUNHA

En général, on peut dire que l'organisation institutionnelle de gestion des ressources en eau a évolué d'une façon semblable dans les différents pays. Ainsi, tant que l'eau abonde et il n'y a pas de problèmes graves de pollution, la responsabilité pour la gestion des eaux est partagée, sans des inconvénients majeurs en général, entre les autorités administratives qui sont responsables pour leur utilisation et conservation, d'accord avec les compétences particulières de chaque secteur de l'administration et d'accord avec les besoins conjoncturels.
Toutefois, au fur et à mesure que la compétition entre les activités usagères devient plus aiguë, les fonctions des différents secteurs de l'Administration concernés par la gestion des eaux ont une tendance croissante à entrer en conflit avec une correspondante diminution de l'efficacité globale. Il en résulte le besoin de planifier et coordonner l'usage de l'eau, par l'établissement d'une organisation institutionnelle qui assure la gestion intégrée des eaux.

L'application d'une politique de gestion intégrée des ressources en eau implique l'intervention simultanée et coordonnée de plusieurs organismes avec des fonctions législatives, exécutives et consultatives par égard aux problèmes de l'eau. Ces organismes peuvent se grouper selon les types suivants :

- organismes responsables pour la conservation et développement des ressources en eau ;
- organismes responsables pour la planification du développement social et économique et pour l'aménagement du territoire ;
- organismes avec juridiction sur les différentes activités usagères de l'eau.

Ces organismes interviennent à l'échelon national, régional ou local, la cohérence entre les interventions aux différents échelons étant assurée par des relations de dépendance hiérarchique.

Ainsi cette intervention multiple peut être analysée selon un double critère qui considère, d'un côté, les interventions parallèles des organismes des trois types indiqués et, d'autre part, les différents échelons d'intégration territoriale. L'organigramme en annexe a été établi d'accord avec ce double critère et représente un modèle générique de structure de gestion des eaux qui sera l'objet d'une référence plus détaillée ci-après.

L'organisation, composition et attributions d'une organisation institutionnelle de gestion des eaux dépendent d'un ensemble de conditionnements de différente nature et il n'est pas facile d'indiquer un modèle de structure à l'application universelle. Parmi les conditionnements les plus importants on peut mentionner ceux-ci :

- aspects concernant les ressources et la demande en eau, tels que les conditions climatiques et physiographiques, la densité populationnelle, la concentration urbaine et le stade de développement économique et social, dans la mesure où ils peuvent déterminer l'existance et l'importance relative d'organismes nécessaires à la réalisation de certaines actions spécifiques ;

- régime juridique de la propriété et de l'administration des eaux, dans la mesure où la portée de l'action des organismes exécutifs dépend de l'étendue du domaine public de l'eau et de la répartition de l'autorité administrative sur ce domaine ;
- degré de participation accordé aux entités privées et au public usager dans la prise de décisions, traduit surtout dans la composition des organismes consultatifs ;
- efficacité de l'appareil de l'Etat qui peut justifier ou non la création d'organismes de gestion pourvus d'autonomie administrative et financière ,
- organisation politique et administrative traditionnelle, avec une dépendance plus ou moins grande des autorités régionales et locales par égard au gouvernement central.

Malgré les conditionnements indiqués, on peut dire que l'organisation institutionnelle de gestion des eaux doit obéir à certaines règles fondamentales et développer les actions déjà mentionnées. L'étude des structures de gestion des eaux existant en des pays disposant d'une législation moderne confirme cette idée, quoiqu'il y ait des différences dans l'organisation de ces structures et dans la composition et attributions de quelques-uns de leurs organismes, par suite de l'influence plus ou moins marquée de certains facteurs spécifiques.

L'une des règles fondamentales que l'on peut déduire des considérations ci-dessus concerne l'indispensable coordination des interventions des organismes chargés de la conservation et développement des ressources en eau, avec les interventions des deux autres types d'organismes déjà mentionnés : les organismes responsables pour la planification sociale et économique et ceux responsables pour les activités usagères d'eau. En effet, les différents secteurs de l'Administration, en règle, envisagent les problèmes de l'eau selon leurs perspectives particulières qu'il faut concilier dans le cadre d'organismes représentatifs des intérêts concertés de ces différents secteurs et qui sont chargés de la définition d'une politique de gestion des eaux et en particulier de la planification. Ces organismes doivent avoir des fonctions délibératives et de coordination et être constitués par des représentants des secteurs de l'Administration plus étroitement liés aux problèmes de l'eau. Au sommet de la structure de gestion des eaux il doit exister un organe collégial et interministériel.

Pour des raisons évidentes, le besoin s'impose de concentrer la responsabilité des fonctions exécutives de la politique de gestion des eaux dans un seul système cohérent d'organismes. Quand dans un certain pays on veut établir une nouvelle structure de gestion des eaux selon les lignes ci-dessus indiquées, on pourra y intégrer les organismes qui traditionnellement s'occupaient de la conservation et développement des ressources en eau ou bien, d'une façon plus radicale, on peut remplacer complètement le système préexistant.

Un autre aspect fondamental est la participation des représentants des usagers et des secteurs intéressés à plusieurs titres aux problèmes de l'eau, dans la formulation des politiques de gestion des ressources en eau. La structure institutionnelle de gestion des eaux doit comporter des organismes au moyen desquels ces entités puissent manifester leur opinion sur les problèmes qui les concernent directement.

La structure de gestion des eaux doit donc comprendre des organismes de trois types :

- organismes délibératifs et de coordination, qui formulent les politiques, sont responsables pour la planification, coordonnent les interventions et prennent les grandes décisions.
- organismes exécutifs, responsables pour l'exécution de la politique de gestion des eaux et qui prêtent leur appui administratif et logistique aux organismes délibératifs et de coordination.
- organismes consultatifs, qui prêtent leur collaboration aux organismes délibératifs et de coordination, transmettant les avis des entités concernées par les problèmes de l'eau.

L'ensemble des organismes de chaque type est organisé aux échelons national, régional ou de bassin hydrographique, et local, assurant ainsi la couverture du territoire moyennant la division de cet ensemble en unités de gestion décentralisée, hiérarchiquement liées en ce qui concerne le premier et deuxième types d'organismes cités.

Les trois types d'organismes qui composent la structure de gestion des eaux gifurent dans les trois colonnes centrales de l'organigramme en annexe, lequel a été préparé d'accord avec les règles dondamentales déjà énoncées et, forcément, est présenté en des termes très généraux.

La structure de gestion des eaux, en raison de son caractère intersectoriel, doit dépendre du Premier Ministre. Elle comprend des organismes délibératifs, et elle se stratifie selon des échelons national, régional ou de bassin hydrographique, et local. On analysera ci-après quelques particularités relatives à la composition et attributions générales des organismes compris dans le modèle proposé.

a) Echelon national.

Au sommet de la structure de gestion des eaux se trouve une commission interministérielle désignée sur l'organigramme par Commission Interministérielle de l'Eau, à laquelle il revient de formuler la politique et de définir les orientations générales pour son exécution. Cette Commission est composée par les Minsitres responsables pour la planification économique et sociale et pour les différents secteurs d'activités usagères de l'eau, et par le Ministre responsable pour la gestion des eaux par délégation du Premier Ministre. Le secrétariat est assuré par un Département Central de Gestion des Eaux, directement dépendant du Ministre responsable pour cette gestion.

Auprès de la Commission Interministérielle de l'Eau, un organe consultatif est prévu, lequel est désigné par Conseil National de l'Eau, et dont la mission est de prêter appui à la Commission Interministérielle. Il est composé par des représentants des organes du Gouvernement et de l'Administration qui n'appartiennent pas à la Commission mais qui sont directement ou indirectement concernés par les problèmes de l'eau, par des représentants des municipalités, par des entités individuelles ou collectives concernées par l'usage de l'eau, et par des personnalités à la compétence reconnue dans les domaines liés à la gestion des eaux.

Les fonctions exécutives de la politique de gestion des eaux sont exercées par le Ministre responsable pour la gestion des eaux, à travers l'organisme central respectif.

Encore à l'échelon national, une commission de représentants des différents ministres, désignée par Commission Interministérielle Déléguée, et constituée par les directeurs-généraux du Département Central de Gestion des Eaux, du Département Central de Planification Economique et Sociale et des organismes centraux ayant juridiction sur les activités utilisant de l'eau, se charge de faire préparer les études nécessaires à la prise de décisions par la Commission Interministérielle de l'Eau.

b) Echelon régional ou du bassin hydrographique.

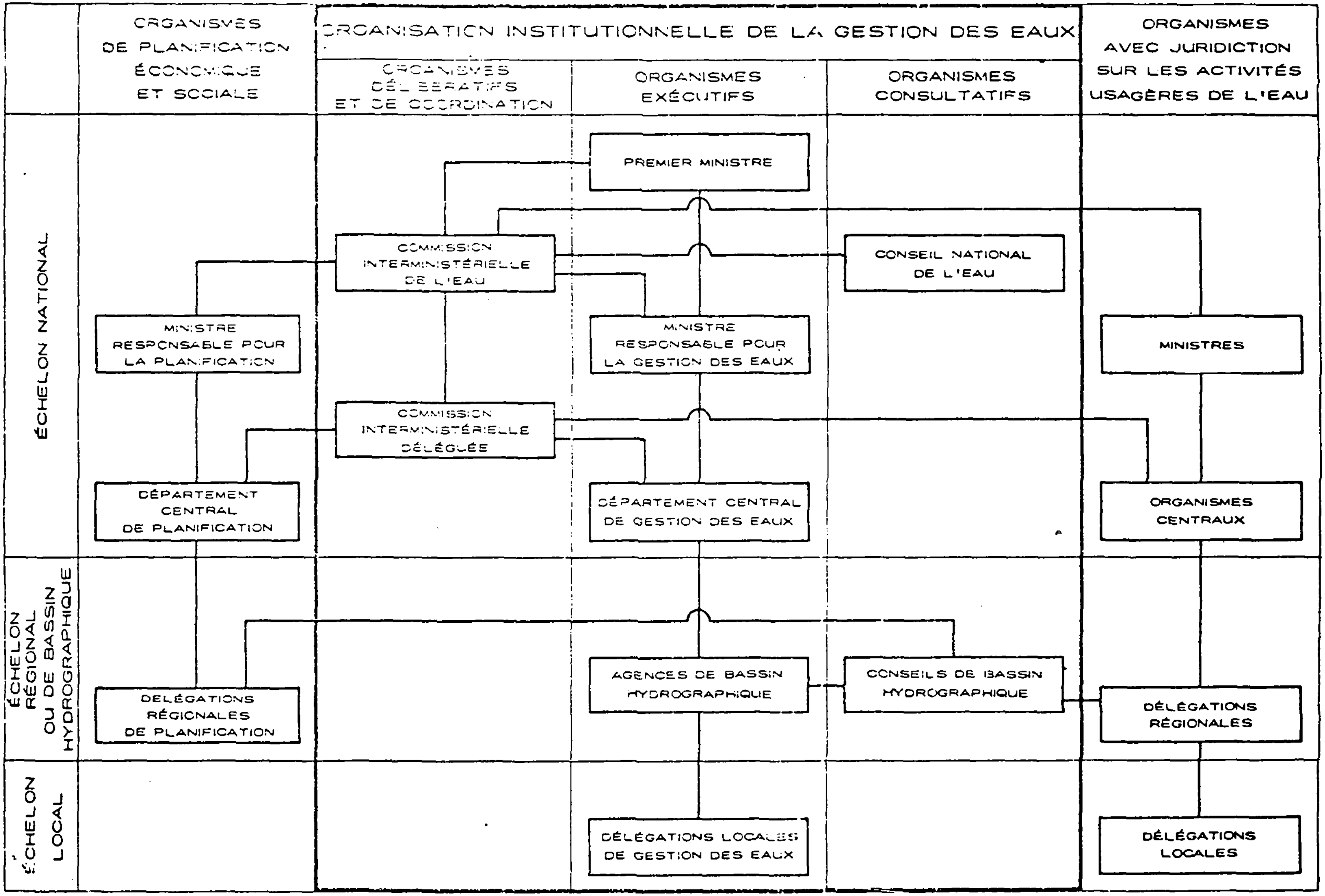
A cet échelon, il y a des organismes exécutifs de la gestion des eaux, désignés sur l'organigramme par Agences de Bassin Hydrographique. Auprès de ces Agences fonctionnent des organismes consultatifs qui sont désignés par Conseils de Bassin Hydrographique. Leur composition est semblable à celle du Conseil National de l'Eau où il y a des représentants des Délégations régionales des organismes qui exercent leur juridiction sur les activités usagères de l'eau. On doit remarquer que les zones de juridiction des Agences de Bassin Hydrographique peuvent ne pas coïncider avec les Régions-Plan ou avec les zones d'influence des autres délégations régionales. Des représentants de toutes les délégations comprises dans la zone correspondante doivent faire partie des Conseils de Bassin Hydrographique.

Pour des raisons d'efficacité, on peut admettre que le statut d'entreprise publique soit conféré aux Agences de Bassin Hydrographique. Dans ce cas, ces entités doivent seulement avoir des fonctions de planification, assistance technique, obtention et traitement de données, tandis que les actions de police administrative sont du ressort des organismes du bassin hydrographique qui dépendent directement de l'Administration.

c) Echelon local.

Les Agences de Bassin Hydrographique peuvent disposer de délégations locales, ou bien déléguer certaines fonctions exécutives aux municipalités ou autres corps administratifs locaux.

Les ramifications de la structure de gestion des eaux à l'échelon local sont très liées au degré de décentralisation et de responsabilité administrative qui traditionnellement sont attribués aux autorités locales. Pour ce motif, l'analyse à cet échelon échappe à un modèle générique comme celui qui est proposé.


ORGANISMES DE PLANIFICATION ÉCONOMIQUE ET SOCIALE
ORGANISATION INSTITUTIONNELLE DE LA GESTION DES EAUX
ORGANISMES DÉLIBÉRATIFS ET DE COORDINATION
ORGANISMES EXÉCUTIFS
ORGANISMES CONSULTATIFS
ORGANISMES AVEC JURIDICTION SUR LES ACTIVITÉS USAGÈRES DE L'EAU
ÉCHELON NATIONAL
ÉCHELON RÉGIONAL OU DE BASSIN HYDROGRAPHIQUE
ÉCHELON LOCAL
PREMIER MINISTRE
COMMISSION INTERMINISTÉRIELLE DE L'EAU
CONSEIL NATIONAL DE L'EAU
MINISTRE RESPONSABLE POUR LA PLANIFICATION
MINISTRE RESPONSABLE POUR LA GESTION DES EAUX
MINISTRES
COMMISSION INTERMINISTÉRIELLE DÉLÉGUÉE
DÉPARTEMENT CENTRAL DE PLANIFICATION
DÉPARTEMENT CENTRAL DE GESTION DES EAUX
ORGANISMES CENTRAUX
DÉLÉGATIONS RÉGIONALES DE PLANIFICATION
AGENCES DE BASSIN HYDROGRAPHIQUE
CONSEILS DE BASSIN HYDROGRAPHIQUE
DÉLÉGATIONS RÉGIONALES
DÉLÉGATIONS LOCALES DE GESTION DES EAUX
DÉLÉGATIONS LOCALES

"POLITICAL WATER MANAGEMENT INSTRUMENTS"

- A DISCUSSION PAPER -

Pier SANTEMA

1. INTRODUCTION.

This discussion-paper on sub-theme 4.2. "Water planning instruments" is based to a large extent on a report of the OECD-Water Management Group entitled "Water management policies and instruments". This report describes three main components of a water management system which are always present :

- technology and scientific knowledge relating to water, its quality and availability ;
- instruments of management, which are the physical extension of the will of the management organisations ;
- people and the organisations they set up.

Concentrating on political water planning instruments, three groups of instruments may be distinguished :

- technical, scientific and technological instruments whereby the knowledge mentioned above is applied to management. These instruments have a considerable effect on the other two types (legal and economic), (criteria, conditions and the basis for calculating taxes and financial aids), or, more important, because they bring about changes in these other instruments as a result of research or of introducing innovations.
- the legal instruments, which are based on legislation or controls, lead to sanctions being imposed on those who disregard them. They are concerned with the abstraction or discharge of water, and more recently with the environment to be protected.
- the economic instruments make use of planning and programing to strengthen their incentive effect. They may be subdivised into find-raising instruments (taxes, charges, etc...) and financing instruments (grants and financial aids).

These instruments must be used in water management since water is not only indispensible but also scarce in quantity or poor in quality and is sometimes both togather, so that it gives rise to conflicts between the various actual or potential users.

Water management consists in settling these conflicts. There are three methods of settlement. In historical order they are :

- the legal approach, which lays down constraints ;
- the economic approach, which seeks the optimum (economical) compromise under the laws of water supply and demand (in both quantity and quality) ;
- the comprehensive approach, which is more persuesive and uses joint participation machinery in programming for achieving joint objectives.

The organisations which give special prominence to the legal approach are the oldest and the most numerous and widespread.

The abondance of rules and regulations may sometimes give rise to demarcation disputes and in order to prevent this, special attention must be paid to the technical content of the rules and regulations, so that they can be enforced by reasonable checks and offenders prosecuted be and penalised.

There seems to be no purely economic organisation for water management and, when an institution adopts the economic approach, it generally proceeds by adding to earlier controls and legislation.

Typical problems encountered by organisations wishing to use this approach are how to estimate the price of compliance, how to achieve economic efficiency and minimise management costs, and how to fit an economic instrument into already existing legal system.

Supported by such arguments, "comprehensive" institutions for comprehensive management of the environment probably reflect the most marked trend in water management organisations. They possess many of the features of the two preceeding types of institutions, but give more importance to planning (fixing specific targets) and programming (indicating the means to be used and the time required).

In the following, each of the instruments mentioned will be described in turn. It would, however, be wrong to suppose that a water policy can be based on the sole use of just one of the instruments to be described and it should be borne in mind that the tools used for water management form a whole and are interdependent. It should also be remembered, when considering their field of application, that whatever the instruments (legal, economic or technical), their mode of use must be kept simple.

The scientific and technical instruments will not be discussed as such, but will often be referred to in examining the legal and economic instruments.

2. LEGAL INSTRUMENTS FOR WATER MANAGEMENT.

Two legal systems of control can be distinguished for water management :

- one applies to the quantitative and qualitative use which can be made of water ;
- the other is based on a definition of objectives to be achieved and complied with.

These two systems include or are supplemented by arrangements for legal redress and sanctions to ensure thei enforcement.

2.1. CONTROLS ON THE USE OF WATER.

The most elementary and historically the oldest, controls on water deal with the conditions for using it. The natural first step would appear to be to ensure that the conditions under which water resources are used match the quantities available and will not impair their quality.

Three types of control will be dealt with in turn :

- controls on water abstraction and consumption,
- controls on pollutions discharges,
- controls on particular uses of water.

a) Controls on water abstraction and consuption.

Water abstraction consists in pumping water out of a surface or underground supply, in making use of it and then discharging it, usually after polluting it, in a quantity about equal to the quantity originally pumped out, so that it may perhaps be used again for other purposes.

Consumption consists in pumping out water and making use of it without discharging it directly, as in the case of irrigation when the water is absorbed by plants and so cannot be used again for other purposes.

When water is scarce or net consumption is high, the latter consideration may require special measures which usually take thr form of ranking uses by priority.

When water is more plentiful, the controls usually take the form of licences or permits.

Controls on water abstraction often distinguish between underground water and surface water.

When surface water and ground water resources are interconnected, there is a tendency for the rules and regulations to become the same for both and to treat surface water and ground water as one and the same resource.

The abstraction and consumption standards are expressed in volumetric terms (e.g. flows expressed in m3 per second) and licensing (or conversely prohibitations) may be made dependent on e.g. surface variations and depth at various seasons.

b) Controls on waste water discharged.

Another form of control on the use of water consists in stipulating conditions for the discharge of waste water and follows the same procedures (licences, permits and prohibitions). These are based on emission standards which are often fixed case by case or category by category and require polluters to achieve a given result.

One of the most serious problems when licences to discharge waste water are subject to emission standards is to find a sound basis for compliance. This may be done at regional level.

Owing to the wide variety of pollutants discharged, emission standards vary greathy, but much is being done to harmonise them regionally, nationally or internationally.

The terms in which these parameters are expressed fall into two main groups, one being based on concentrations, while the other is based on flows (usually in terms of mass). The latter group has the advantage of putting a definite limit on the quantities of pollutants discharged, whereas limiting the degree of maximum concentration allows waste water to be diluted, i.e. encourages additional abstraction which results in the discharge of additional quantities of polluted water whilst keeping within the law. The current trend of controls is towards discharge standards expressed in terms of capacity. The measuring methods are intermittent or continuous, while efforts are now being made to toxic, persistent and cumulative effetcs (accumulation via the food chain).

Special standards for industries may take the form of process standards obliging industrialists to use a specified manufacturing process or waste treatment process. This kind of obligation applies e.g. to industrial discharges into public drains which must not impair the working of public waste treatment installations.

Product standards apply in many cases to deterfents, fertilisers, insecticides and pesticides. These product standards must preferably not raise non-tariff barriers to international trade, so that they assume an international effort to harmonize both the standards themselves and the conditions for testing for complance with them.

A recent trend in studying this question is to cover the whole life cycle of products (extraction of raw materials, manufacturing processes, utilisation and disposal or recovery) so as to limit as much as possible the total emissions of pollutants which product causes. This study of a product's life appears as an all embracing line of research which has the advantage of supplementing the control measures already mentioned and of taking account of the possibility of transfers of pollution between different receptor media (fresh water, the sea, the atmosphere and the soil).

For the discharge of cooling water special standards are being applied usually expressed as a maximum temperature-step or a maximum temperature of the water to be discharged.

c) Controls on special uses of water.

There are special legal regulations covering uses of water other than those already mentioned, which were connected with quantity or quality. For example, there are many regulations concerning the transport and exploitation of oil and gas.

There are special regulations on particular activities, e.g. prohibiting the dumping of rubble. Likewise the mining codes in different countries lay down for exploiting natural resources (in this context e.g. alluvial resources in river banks and beds).

In addition there are a number of regulations concerning tourism and recreation (fishing, bathing and sailing). Quite often these regulations form part of regional planning measures reflecting a desire to define the purpose for which natural resources are used.

2.2. CONTROL BY OBJECTIVES.

This control tends to abandon the view that water has to satisfy a number of requirements in favour of regarding water as a natural environment.

Three kinds of objectives may be conveniently distinguished :

- those concerned with the development of the environment and usually called environmental quality targets ;
- those which stem from regional development, planning or programming ;
- those which are based on foreseeable technological developments.

These three kinds of objectives are usually closely interconnected and are only distinguished here for the sake of clarity.

a) Quality targets.

Quality-targets establish a relationship between the natural environment's capacity to assimilate pollution, the social preferences of the inhabitants and what they can afford, resulting in a priority list of community options.

A quality target is defined with reference to two limiting factors, the first being the level of basic protection beyond which the presence of polluting products creates an unacceptable risk, while the second is a no effect level at which visible harmful effects can be detected on the various victims (flora, fauna, human beings and communities). Quality standards and targets are set in line with criteria which assess the risk to a given victim and the amount of damage caused by a known amount of pollution or dose of exposure.

These concepts of environmental quality establish a relationship between causes (polluting discharges) which can be measured (by emission, process and product standards) and their consequences (damage or disutility) which are much more difficult to assess. Here, then is a main difficulty, namely how to provide the required link in pollution control between emission standards for polluting discharges and environmental quality standards. This link is usually provided by a quality target policy with a time schedule specifying dates by which the environment must reach an increasingly strict quality standard, but it is very difficult to calculate from the time schedule what constraints to impose on discharges by water users. The relations between the two are not linear, because the environment's self cleansing which is not linear while the pollution discharged along a river is cumulative. More and more mathematical water quality models are being need to solve these questions.

Controls on discharges do not conflict with controls which fix environmental quality targets, but rather supplement them. It can be argued that the former can be compared to a "micro-economic" approach whereby each polluter is regarded as an individual behaving independently of the others as long as the controls are not in force, whereas controls by targets are distinctly "macro-economic". A quality target is an overall standardization measure to implement in which the restrictions on users can take several forms. It is the task of a water management organisation to harmonise the two approaches both technically and administratively.

An advantage of control by quality target is that it creates an awareness of the constraints which water environment quality may involve for economic development, especially industrial and urban development. Given a certain technology determining the performance of a waste treatment plant, the only way to allow expansion while ensuring the quality fixed for the environment involves technical research leading to technological innovation which increases the effectiveness of waste treatment.

b) Planning for regional development.

Another type of control by target similar to the above controls consists in laying obligations on people by making rules for regional development. Such rules will restrict the use of water and control the construction of water installations. They can be made along with general plans (for new towns, industrial areas, rural areas, etc...) or in response to a specific demand for water planning (river basin planning, establishment of protected nature parks and wild-life reserves, etc...).

The considerable expenditure connected with regional development has enabled suitable methodologies to be developed. The study and evaluation techniques used include the examination of alternatives, the construction of simulation and decision models and in particular the use of systems analysis.

Within this framework several methods have been developed ; three different types may be distinguished viz. :

- . financial methods,
- . consequence-table methods,
- . multicriteria analysis.

- The financial methods give financial values to all the consequences of alternatives for a watermanagement system. This causes difficulties in those cases where these consequences have no monetary value themselves as for instance environmental consequences. The cost-benefit analysis is without doubt the most well-known financial method.
  Another financial method is the cost-effectiveness analysis which investigates in which way a concrete goal can be realized as effective as possible (cost-minimizing) or how by given means a concrete goal can be reached to the largest extent (effect-maximizing).
- The consequence-table-methods give the possible consequences of each alternative expressed in its own dimensions without giving an optimisation. The balance-sheet-method divides those related to the consumers, each having their own goals. For each alternative the advantages and disadvantages are given for each of those two groups.
  The goals-achievement-account-method has much in common with the balance-sheet-method. In this method different aspects are being distinguished with their own values for different goals to be expressed in weighing factors. The information the account contains can be used for multi-criteria analysis.
  As a third method the score-card-method can be mentioned which consists of a matrix in which the effects of alternative plans are given in their own dimension.
- Multi-criteria analysis is a technique to optimize alternatives for a water management system using different more dimensional criteria. Using a set of weighing factors fiven by the decision-maker the alternatives can be ranked. Examples of these methods are the con- and discordance analysis, multi-criteria-matrices and permutation methods. The use of these methods in concrete cases have led to usefull results although no experience at a large scale is available.

c) Foreseeable technological progress.

Some comments were made earlier on the effects of quality targets on industrial and urban development and it is certain that, in view of the environment's limited assimilative capacity, these targets have an upper limit unless technology advances. Some controls are, therefore, based on foreseeable technological progress. Two kinds of objectives adopted, the first being short-term, namely to use the best pratical technology involving reasonable expenditure in the prevailing market conditions for waste treatment equipment. The desired level of waste treatment will then correspond to the maximum attainable with the best currently practicable technology.

The second objective, connected with the first, states the solution, when the maximum which science and technology can envisage sought by using the best available technology. In present day conditions for this technology production cost exceeds what certain groups of industries can afford.

This distinction between what is available and what is practicable has the advantage of introducing pragmatic technical considerations to graduate the controls, but one must try to avoid choosing too readily the cheapest capital project, which in the end prove inefficient.

These two objectives are sometimes accompanied by a long-term objective involving a technology which will enable "zero release" to be attained.

2.3. LEGAL REDRESS AND SANCTIONS.

The system of sanctions and legal redress which must accompany all controls of whatever kind is difficult to present in a composite picture. The possibilities range from the greatest laxity (when the amount of the fines is only a symbolic penalty) to maximum strictness (involving the immediate stoppage of the offender's activity). A repressive system will result in deplorable impunity in the first case and will usually be unenforceable and, therefore, ramain a dead letter in the second case, but when it is properly adjusted it has a strong deterrent effect. Three conditions, however, should preferably be fulfilled ; it must be possible to comply with the controls in practice ; offenders must be able to pay the fines ; and the procedure must be sufficiently rapid.

The question is often asked whether the financial or criminal penalties for the offences committed should bear a relationship to the estimated value of the damage caused, which would be a transition to the economic instruments discussed later. It seems in practice hardly possible to provide exact compensation for damage done purely by means of a system of legal sanctions, but this becomes possible by resorting to an economic instrument. Indeed the legal instruments are called for more by a sense of discipline than by a concept of continuing management and service for water users. Legal and economic instruments thus are complementary to each other.

3. ECONOMIC INSTRUMENTS FOR WATER MANAGEMENT.

Economic instruments are more flexible and easier to handle than legal controls. By putting a price on water they establish a relationship between the surplus won in the "contest for quantity and quality"and the surplus of benefits over costs which is to be shared between water users. The contest for quantity and quality relies on technology, including means of improving water resources, controlling pollution, preventing floods, etc.. The counterpart is the "give and take between people", which consists in distributing goods among water users, whose total requirements are the social demand for water.

The main difficulty in the contest for quantity and quality is to know what technical projects to undertake which do not involve irrevocable steps causing long-term damage to the environment. The risk in the give and take between people is that the water and the costs incurred in obtaining it may be badly distributed, in which case there will be undesirable favouring of people at the expense of others which may cause conflicts.

The economic instruments for watermanagement fall into two main groups :

- financial levies which both indicate how water costs are distributed and act as incentives to comply with the water policy adopted, and
- financial aids for carrying out technical projects.

We shall deal with these two aspects in turn.

3.1. FUND-RAISING INSTRUMENTS.

The fundamental questions here are where the funds are to come from and who shall bear the costs of pollution.

a) Polluter-Pays Principle.

This principle affirms that public measures are necessary to reduce pollution and to reach a better allocation of resources by ensuring that prices of goods depending on the quality and/or quantity of environmental resources reflect more closely their relative scarcity. The principle, therefore, means that the polluter should bear the expenses of carrying out the measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be relected in the cost of goods and services which cause pollution in production and/or consumption.

As an efficiency principle the aim of the Polluter-Pays Principle is thys to integrate, at minimum social cost, expenditure on environmental protection with the help of standards or charges. The revenue from charges levied for the purpose may be redistributed so as to control pollution, but only in the form of compensation for services rendered to the community and under action programmes.

Direct grants to polluters thus run counter to the principle, since these lighten the burden they are supposed to bear alone. The principle also states that generally speaking, measures decided by public authorities should not be accompanied by subsidies that would create significant distortions in international trade and investment. On the other hand the redistribution of financial charges paid by the polluters comes under the heading of planning measures which are compatible with the principle. Such charges in a sense will correspond to a purchase of services financed by all the polluters who are using the services.

b) Fund-raising instruments not directly related to water : flat-rate charges.

Flat-rate charges are based on economic activities or resource factors which are not directly related to parameters relecting water use.

Flat-rate charges have the advantage of simplicity and serve to divert to the water budget a fraction, which is usually small, of a traditional tax (on personal incomes, industrial and commercial profits, earning from real estate, the value added or trading surplus, etc...) so that use can be made of the existing assessment basis and of the administrative procedure for collecting the tax. By increasing the latter (or requiring a part of it to be paid over) one obtains a reliable revenue, but at the expense of losing touch with the technical parameters of water policy, nor is this an incentive instrument, as water, is not usually an important factor in the basis for levying traditional taxes.

Thus action which could have been taken when preparing a State or provincial or regional authority budget is instead taken when taxing the individual economic transactor. The reliability of this procedure should not be underestimated, but its rather arbitrary operation tells against it.

c) Fund-raising instruments related to water : financial charges levied specifically on water.

Taxes and charges levied specifically on water, on the other hand, are more complicated than flat-rate charges, but provide a management instrument by indicating the importance to users of water management. When they are levied, they have a two-fold economic effect ; they provide a basis for allocating the expenditure on water, and they are a direct incentive to the user to minimize his liability, i.e. his use of water as an aid to production or in removing waste.

By virtue of their assessment basis specific taxes are generally speaking a major instrument for statistical evaluation. The information given by the amount of tax or charge is a combination of technical information provided by the assessment basis and economic information conveyed by a rate which reflects the relative importance of water problems. The next point to discuss will be the problems raised in choosing an assessment basis and a rate of charge.

c1) Assessment basis of charges levied specifically on water.

The choice of a meaningful assessment basis is often difficult and must be made most carefully, because the incentive effect of the financial charges will depend on it. The way in which this choice allocates charges between polluters or users must also satisfy the concept of equity i.e. must not affect the relative rights of users to water resources while still reflecting the scarcity of the resource as recommended by the Polluter-Rays Principle.

An assessment basis which gives a value to water abstracted and consumed generally uses volumetric measurements and these may be given an hourly or seasonal weighting to take account of peak abstraction periods. For consumption (water abstracted less that which is later discharged), charges may be based on quantity in terms of mass or surface area (e.g. irrigation in agriculture). As a rule the basis for abstraction charges is not too difficult to work out when checking is easy (by means of meters, flow-meters, etc...).

An assessment basis which takes account of water quality parameters is much more difficult to work out, as many factors can still hardly be quantified (e.g., the taste and appearance of water), while the definition of others is vague or may be the result of a subjective interpretation.

When pollution is expressed in terms of disamenities, it reveals a social cost which should be avoided or compensated by means of financial charges levied for the purpose. Therefore, in choosing a basis of assessment to match the desired water quality one must try to use parameters which are not open to subjective interpretation, i.e. are easy to check. However, although forms of pollution can be isolated as factors which disturb the environment, they are difficult to evaluate. Very many parameters can be envisaged for representing the changes brought about by polluting discharges, they are unpractical as a basis of assessment because of their number and because the factors they measure are not all independent of one another. If, on the other hand one uses only a few parameters, there is the disadvantage of not representing real phenomena faithfully, so that a compromise should be sought when choosing the parameters for an assessment basis.

The compromise should include the criteria most representative of the local situation so as not to leave out too much information, but should result in a measurement instrument simple enough to be used in financial management. Five or six parameters or group-parameters would appear to be the maximum for this purpose and would usually include : suspended matter chemical and biochemical oxygen demand, temperature, pH, and toxicity, persistence and accumulation aspects in biological terms. In general it is better to use absolute parameters for assessing waste treatment requirements i.e. parameters which depend on a single yardstick, than to use relative concepts (such as concentration) expressed in terms of ratios. This ensures that the measurement instrument provided by the basis for assessing taxes on water will not be diverted from its purpose by artificial palliatives such as the dilution of polluting discharges. Another important question is how to combine the different parameters chosen so as to provide one single index. Different ways (addition, weighting, multiplication, proportions and ratios) of mixing them can be envisaged, but, as in the choice of the basic parameters the formula adopted should be accepted by the users whom it will affect and it seems essential to consult them beforehand.

In addition to these arrangements one should try to ascertain the relationship (which is often difficult) between the figures given by an assessment basis and the figures for damage produced by a polluting discharge. That is why it is more desirable to bring the assessment parameters into line with the parameters chosen for controlling the uses of water or fixing quality objectives. If this is done, it will be easier to work out a coordinated water policy in which the control will show what goals to pursue and what constraints to comply with, while the fund-raising provisions will mobilize the resources required to meet these needs in terms of the same units.

c2) <u>Unit rates of charge levied specifically on water</u>.

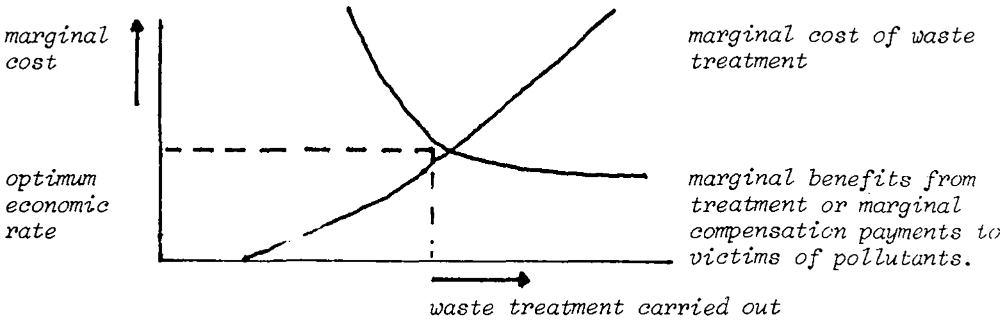
A financial charge can only exist when its component factors, the assessment basis and the rate per unit by which the latter is multiplied, are, effectively combined :

- fixing a rate of charge establishes an economic balance which should enable a water management programme to be carried out by suitably allocating the proceeds from the charges.
- another way of fixing the rate aims at influencing the behaviour of water users who pay financial charges, the object being to induce them to follow a certain policy (to be moderate in their consumption of water or to control their pollution) by levying effective charges on the water uses concerned.

  The effective incentive rate will be found by comparing it with the minimum cost at which water users can behave in the way desired. If the rate of financial charge is higher than this minimum cost, it will become a deterrent, because it will be more expensive for a user to pay the financial charges than to obey certain rules for water use and thereby escape the tax.

- Thirdly, the rate can be calculated in theory by means of a marginal cost benefit analysis, as may be illustrated by an example taken from pollution control. By plotting the marginal cost incurred as ordinate against the waste.

  treatment carried out as abscissa, one finds the optimum economic conditions where the curve for the social marginal demand or benefit (water users are prepared to pay less and less as their expenditure on the environment increases) intersects the curve for the marginal supply of technology or cost (the higher the standard of waste treatment, the more expensive is the equipment required).



> *While the graphs for the supply of technology, which correspond to the market conditions for waste treatment equipment, are known approximately, the graphs for the social demand for waste treatment are not. Estimates for the aggregate utility functions of individuals, for their preferences and for damage to be prevented or compensated are still subjects for research.*

Water management organizations may allow for these facts, which limit the application of economic theory, by trying to adopt three attitudes :

- to try to create a social demand for waste treatment by exerting a demand themselves with the aid of legislative and economic instruments ;
- to spread economic information as widely as possible on the cost of technologies and on damage functions ;
- to regard the optimum rate which the foregoing procedure will more or less achieve as both an objective and an order of magnitude. It will be an objective, because its cost is usually beyond what most water users can afford, and it will be an order of magnitude, because it will be liable to considerable inaccuracy due to the approximate nature of the basic economic data. Nevertheless, it will correspond to a reference point which one should know in order to measure the gap between actual conditions for the financial management of water resources and optimum economic conditions i.e. the conditions in which the objectives are achieved at minimum cost to the community.

It is no easy matter to determine what the main parameters for extablishing a rate actually are. Such considerations as redistribution, incentives and marginal calculation may of course be very useful when establishing financial charges, but other, more explicit considerations in the minds of water managers influences as welle the money values which these may take.

In pollution control e.g. the choice of a rate is often on the three-fold selection of a technology for treatment, a budget covering work to be done and a time table.

3.2. FINANCIAL AIDS.

Financial aids usually take the form of reducing the burden of expenditure, or else they are money payments.
Their total forms a fund which is often a factor in advance planning and will be the third point dealt with in this section.

a) Aids consisting of financial and tax reliefs.

It may be desirable to stimulate the construction of water control works (whether to improve supplies or for treatment purposes) by measures to ease the burden of the capital or operating costs falling on water users.

Tax reliefs and accelerated depreciation allowances are among the instruments used by the State for financing indirectly a part or all of a project.

Another type of relief takes the form of a temporary ceiling on pollution charges. When the burden of these charges is too heavy and threatens to crush certain polluting industries, the State may take over part of the polluter's burden by putting a ceiling on the charges he has to pay.

A futher type of relief is given by subsidising interest rates on certain government loans for investment in water control works.

In conclusion, the system of tax reliefs and exemptions has the advantage of being both more general and more specific, because it can be applied to private water users (including industrialists) and to public-sector water users (local authorities) whenever they exert a demand for water, whereas tax regulations usually affect only those users who pay State taxes. They do, however, not have the merits of an all-round instrument for water management with which one can exercise technical control of projects.

b) Money payments.

Financial aid in the form of money payments, such as subsidies, loans, advances and various kinds of grants may be made available for a number of reasons :

- general aids for regional development or reducing unemployment which may be relevant to water policy, although not specifically belonging to it ;
- aids linked directly to water policy, either because they are intended to promote development of water resources or because they concern pollution control.

b1) General aids not specifically related to water policy.

these forms of aid need not to be contradictory to the Polluter-Pays Principle, if they help towards particular socio-economic goals (such as reducing disequilibria between regions). Long before any water management policy existed as such, many water control works were given conventional government aid in the same way as other expensive community investment projects.

b2) Aids directly related to water policy.

Two kinds of distinctions may be drawn as far as these aids are concerned :

- two major types of aid concern water policy. The first type consisting of aids for improving the quantity of water resources (collection, transport and supply of water, abstraction, irrigation and navigation). These aids have no direct relationship with the Polluter-Pays-Principle, although a scarcity of water may aggravate environmental pollution. The second type of aid concerns pollution control and it is for this type that the Polluter-Pays-Principle is designed.
- In addition to the foregoing distinction there are the various terms and conditions on which aid may be provided. The funds may come either from the government or from the users themselves.

> The former arrangement is usually for local authority schemes, while the latter applies the Polluters-Pays-Principle by redistribution financial contributions and is suitable both for local authorities and for industry. Aids for developing water resources in quantity are usually provided by government.

Governments vary widely in the extent to which they support projects financially.

However, if they provide 100 % of the cost of projects, they can make certain of carrying out certain isolated schemes chosen for their utility value. If no provision is made for subsequently financing the operation of projects, aid covering all the investment costs will involve the risk of an sufficient financial capacity of the beneficiary who is ultimately responsible for operating the project assisted.

c) Advance programming of aid.

The economic justification for financial aids, and especially in the form of money payments, is to be found in the planning. Moreover, the Polluter-Pays Principle involves that such aids should be limited to well-defined transitional periods, laid down in advance and adapted to the specific socio-economic problems.

Effective use of aid granted seems to require the objectives to be matched with the resources and vice versa. Advanced planning is an essential tool without which one cannot measure the effect of financial aid, which need not necessarily be beneficial. Indeed, many countries have found some of its effects to be damaging, including subsidies paid to sponsors of projects (choice of out-of-date but subsidized techniques, discouragement of innovation, delays in carrying out projects, etc...), but by planning so as to cover all these aspects of water problems one can watch for such faults and avoid them.

Management costs due to research and comprehensive programming are usually low compared with the amount of financial aid given and seem to average 4 % for running a comprehensive management centre.

In the case of pollution control financial aid for investment is an instrument which may serve either to support a large number of low-cost and low-technology operations or to support a few costly operations using a sophisticated technology to achieve greater technical efficiency. There is likewise a choice between investing immediatly in traditional schemes which are effective in the short term or allowing time for research the effects of which will not be felt till much later. A third problem is how far to concentrate aid ; should it be scattered widely or focussed on a few localized operations ? In the case of government aid for non-public investment, the Polluter-Pays Principle involves that it must be selective and restricted to those parts of the economy where severe difficulties would otherwise occur. Many other questions of the same kind, which touch on the essence of the practical problems in water management might be added to this list, including special bonuses for certain technical operations and actions in sectors related to water management (real estate, ownership of water technologies, management of working capital, financing or regional planning operations, financing of studies leading to amendments of legislation, public information and promotion campaigns, new parameters for assessing pollution, etc...).

All the foregoing considerations regarding legal and financial instruments and their use for water management lead to the conclusion that there is no universal solution. The particular conditions in each country call for choices in favour of the one rather than the other, but the main requirements are still to charge the costs of pollution to the parties who caused it (Polluter-Pays Principle), to carry out water management projects at least social cost, and to pursue as well as possible all the general objectives of water policy.

4. EFFECTS OF INSTRUMENTS FOR WATER MANAGEMENT.

The following comments deal with the economic return on investment in water management, the economic and social repercussions which may ensue and the type of incentive which should be used. These repercussions are of great importance since the industrialized countries are facing large expenditures for water management. A reasonable estimate of the public and private expenditures for the management of water quality and quantity appears to be 1 % to 1.5 % of the GNP.

4.1. THE ECONOMIC RETURN OF WATER MANAGEMENT INVESTMENT.

This is a question which seems to be investigated by many countries but it is a difficult thing to estimate and to compare with the return on other types of investment. An interesting approach can, however, be made with the aid of the management instruments just described. This consists in comparing the value of the investment planned (to which may be added the discounted value of operating costs) with an estimate of damage caused if the investment has not been decided upon.

Another method consists in measuring the overall impact of water management investment on the economy. From the standpoint of pollution control favourable deflationary effects or unfavourable inflationary effects generated by a treatment project can thus be compared. If the damage avoided or eliminated is of greater value than the expenditure, the effect is deflationary, since such costs as the replacement of goods destroyed or degraded, compensation, protection, etc... need not be paid. But if instead money has been spent for non-quantifiable advantages (such as aesthetic improvements), it will be regarded as inflationary since the advantage cannot be measured. Economic and financial authorities will tend to brand such expenditure as "unnecessary", inproductive, or low job-creating value, generating additional money flows (administrative costs, research and capital expenditure, and the cost of operating and renewing) and having no effects which can be valued setting an appropriate value on environmental protection. Sectoral considerations can further clarify the issues. The economic return from a water management project in a sector with little economic impact will be smaller than in a strongly expanding sector.

Economic returns may also be approached from the standpoint of optimising water management. Reducing wastefulness and seeking to make maximum use of the available resource will then be the criteria for jugement. Here, for example, the use of a degressive tariff for water abstraction is bound to encourage wastefulness, since the more water is used, the lower the rate will be.

A final type of economic return is that connected with technical performance : an investment will be meaningless money needed to run the equipment is also spent. This is still too often true of treatment plants, which do not work because poorly or insufficiently maintained.

4.2. ECONOMIC AND SOCIAL EFFECTS OF WATER MANAGEMENT INSTRUMENTS.

Legal and economic instruments for water management can have restrictive effects, by changing the rules and levels of international competition, making difficulties for certain industries which use rather too much water (growth of unemployment, accelerated obsolescence of products), raising the level of prices and adding to the unflationary process (shifting added costs resulting from the control of pollution or scarce water resources on to the end-consumer).

Interference with other policies (particularly of a social kind), the fact that traditional contributions are challenged (grants by the state to local authorities), special technical requirements (pure state of the receptor medium to be respected), and the financing of important research and develoment projects, are other effects of the use of those instruments ; the provision of aid is generally the solution used. The question of internationally harmonising these arrangements and their magnitude still arises. Discriminatory effects (compensatory taxes) or non-tariff obstacles to trade must not thus be the result of aids which might be granted for certain goods produced by a country under the heading of transitional measures taken for promoting water management policy.

Water management instruments are progressively introduced in nearly all industrialized countries, particularly as regards the pricing of changes, which emerge as policy devices which can influence the development of certain sectors.

4.3. FORMS OF INCENTIVES PROVIDED BY WATER MANAGEMENT INSTRUMENTS.

The incentives provided by water management instruments do not only cause changes in economic behaviour but may also take technical or psychological forms. A form of technical incentive is encouraging the use of technical innovations when financial aids are granted, rates of tax are imposed, or controls are applied. These innovations are the result of specific research work and usually relate to recycling, recovery of waste before or after treatment, modifications to industrial production processess (to make them less polluting) and the general control of wastefulness. The main idea behind the incentive is to make the quantity and quality of water less critical so as to scale down water management programmes and reduce their cost.

Psychological incentives usually consist in shifting a water user's feeling of guilt in respect of pollution towards and awareness of his responsibility for the pollution he causes. This change of attitude means much to the success of a water management system. A pre-requisite is the search for equity.

5. SUMMARY AND CONCLUSIONS.

Integrated management of water is desirable in which the administrative, regulatory, technical and economic levels are closely coordinated and deal with underground and surface waters, quality and quantity, abstraction and discharge. Management objectives are then achieved by a choice of coordinated instruments.

Water legislation has two main functions : to provide the legal framework in which management functions, and hence to define the levels at which action is taken; and, to establish a system of regulations backed by sanction in order to achieve a measure of control over the concumption and pollution of water.

The water management units will be established by legislation? They may be based on existing administrative areas or on river basins or groups of river basins. A unit based on a river basin is ideal for applying management instruments to suit the needs of its area and for ensuring the comprehensive management of water. However, the use of river basin units may cause some difficulties in obtaining corresponding socio-economic data since governments may find it difficult to adapt administrative or political units to adjust to river basin structures.

Effective management involves the setting of a number of objectives, in terms of both quality and quantity. There must, therefore, be planning studies (long-term assessment of the community's future potential), programming (medium and short-term estimates of the facilities needed for attaining quantified objectives fixes beforehand) and simulation studies (predicting the time allowed for achieving them must take account of the technological possibilities and the research and development programme in the water industry. Planning and programming should take into account not only pollution control investment, but also provide for the effective operation and maintenance of such facilities, especially in the case of wate water treatment plants.

5.1. REGULATORY LEVEL.

Control of water consumption by regulation consists of a system of licences or permits for abstraction either from ground or surface water. The licences specify the conditions of abstraction, more stringent conditions being imposed if the water is not returned to the water course. It may be necessary to make special regulations where it is essential to reserve ground water for potable use.

Discharges of waste waters are controlled in a similar fashion. Emission standards vary according to need and practice but usually require polluters to achieve a given result. Such controls can be effective in securing quality targets. This is, however, possible only if there is effective checking of the discharges which must be supported by sanctions agains unauthorized pollution.

Control of abstraction and discharge by regulations combined with control by charges is usually found. Regulations alone may not provide a least cost solution (for the community) in achieving the management of a scarce water resource and preserving its assimilative capacity. For example, requiring all polluters to treat their effluents to the same degree would probably be less effective and more costly than applying particular pressure on a few large polluters. Charges supplement direct regulation by strengthening incentives to reduce water abstraction and to undertake more effective pollution abatement.

5.2. ECONOMIC LEVEL.

At the economic level, fund-raising instruments (charges, taxes) and financing instruments (grants and other financial aids) are available. They distribute the benefits and costs of maintaining the resource, between the users of that resource and others who enjoy its benefits.

a) Scale of charges.

Charges, when set at an appropriate level and based on quality and quantity of waters both abstract and discharged, act as an efficient incentive to limit consumption and pollution of water while promoting more rational and economical use of the resource in general. Market forces, brought into play, recognize that a price has to be paid for the use of natural resources as is the case for the use of other resources.

The scale of charges ot be based on the assessment parameters must be considered. Ideally the scale of charges is such as to induce the polluter to treat his own effluent to the prescribed level. In practice this would probably mean such a rise in the costs of particular industries that it would be unacceptable in the short term. Incentive charges can be approached gradually, beginning with low rates but working towards the incentive rate on a rising scale which is known in advance to the polluters. In this way, the polluter can make the necessary financial provision and avoid the distortions which sudden imposition would bring.

Another benefit of charges is to raise funds which can be used for pollution control purposes. This thus produces a redistribution of costs between polluters themselves or between the community and polluters. The funds would be used for the total or partial financing of pollution control.

The rates will not be the same throughout the river basin or in different basins, and will depend on the particular quality targets to be achieved. The polluters in a river basin are interdependent in that the conditions of the river downstream and hence the charges will depend on the discharges upstream. The function of management is to establish charges in an equitable manner taking into account the Polluters-Pays Principle and the socio-economic conditions prevailing in its area.

b) Abstraction charges.

Charges may be made as a flat-rate (i.e. one which is independent of the actual amount abstracted but which may be based on some arbitrary assessment of the likely abstraction), related to the volume. The former has the only advantage of simplicity but is no incentive to economical usage and would not be used other than as a provisional measure. The latter seems perhaps more costly to administer but a suitable tariff enables the income to match the cost of providing the service. A regressive tariff is not an incentive to economic use of water.

c) Effluent charges.

Ideally there should be a charge on all pollutants discharges but measurement of all pollutants would not be feasible in practice. If a system of charges is to work satisfactorily, the assessment basis must be representative, not too complicated and sufficiently adapted to the level of each polluter.

Representative means selecting those pollution parameters which are the most common cause of poor water quality. Since there are a great many pollutants, some of which are discharged in only small quantities or which are discharged by few polluters, most of these substances will not be covered by this system of charges. Such substances are best dealt with by regulation. This is why charges and controls should continue to be used in combination. Initially charges were limited to oxidisable matter (COD and BOD), but they are now being extended to other accessable parameters representative of the pollution level, because of the increasing occurence of pollutants (inorganic, toxic, etc...) with no or negligible BOD. New technologies and the use of substitution products (e.g. in detergents) create particular problems. Thermal discharges and toxic substances should be regulated and may result in charges being made for their effects. Strict regulations should be preferred on highly toxic substances such as mercury, cadmium and PCB's.

The assessment parameters are expressed in terms of quantities and not only in terms of concentration in order to prevent evasion of charges by dilution of effluents.

It will be necessary to select a limited number of parameters significant for the protection of the environment which can be understood by all the parties concerned. Direct measurement is applied to the larger pollution sources. If direct measurement is too costly for small sources then an estimated charge is made, followed by intermittent inspections.

The application will be better if the system is simple and comprehensible enough, and if the parties concerned are consulted about the nature of the assessment parameters and informed on the scale of charges which are applied.

d) Financial aids.

There are two basic financial aids which central government can give to water users and which may be used in conjunction with an effluent charge system to ameliorate the initial severe effect of the charge. The first is financial burden of an improvement in water treatment. They do not, however, provide an instrument for technical control over projects. The second is money payments whether in the form of a grant or as loans with interest below market rates. Effective use of this aid requires objectives and resources to be matched. Programming is essential to achieve technical and economic efficiency.

"PRÉSENTATION DES INSTRUMENTS D'ÉCONOMIE POLITIQUE DE L'ENVIRONNEMENT"

Pierre-Frédéric TENIERE-BUCHOT

1. RAPPEL DES OBJECTIFS DE GESTION DE L'ENVIRONNEMENT ET D'AMELIORATION DE LA QUALITE DE LA VIE : TRAITEMENT EQUITABLE DES USAGERS, EFFICACITE ECONOMIQUE, PLANIFICATION ET DEVELOPPEMENT REGIONAUX, MISE EN VALEUR DES RESSOURCES NATURELLES, COOPERATION INTER-ADMINISTRATIVE.

2. COMPOSANTS PRINCIPAUX DU SYSTEME DE GESTION DES MILIEUX NATURELS :

- . connaissances techniques et technologiques (physiques, descriptives biologiques, économiques, savoir-faire),
- . instruments juridiques réglementaires, administratifs et économiques.
- . hommes (décideurs, conseillers et professionnels, usagers)

3. LES FORMES INSTITUTIONNELLES DE GESTION.

- . voie juridique
- . voie économique
- . voie globaliste - notion de gestion intégrée de l'environnement (voir schéma ci-joint).

4. NIVEAU D'ACTION DES ORGANISATIONS.

- . niveau central national (organisation juridique et coordination administrative, statistiques, planification, études et recherches).
- . niveau régional - domaine d'intériorisation des effets économiques - extension internationale.
- . niveau de l'usager (aspects techniques et technologiques), organisations publiques (municipalités) et privées.
- . caractéristiques des organisations : tutelle hiérarchique et indépendante financière - réglements des conflits (contentieux, groupes de réflexion, programmation et planification, recherche - développement).
  information et participation publique (gestionnaires, usagers, opinion publique).

5. LES INSTRUMENTS JURIDIQUES DE GESTION.

5.1. LA REGLEMENTATION DE L'USAGE.

. usages directs ; définitions de priorités, autorisations.

. réglementation des rejets : normes d'émission (obligation de résultat), interdiction de polluer - normes spécifiques de branches. Contrôle des émissions et de l'épuration - normes de procédés (obligation de moyen).

. Notions de concentrations et de flux massiques - substances à effets cumulatifs.

. Réglementations des usages particuliers.
Normes de produits (détergents, insecticides, engrais, pesticides) - obstacles non tarifaires aux échanges. Notion de gestion globale de la vie d'un produit.
Transport, exploitations et activités particulières (hydrocarbures, carrières et mines, déchets, loisirs, pêche, chasse).

5.2. LA REGLEMENTATION PAR OBJECTIFS.

. objectif de qualité du milieu ambiant - capacité d'assimilation du milieu, préférences sociales, possibilités économiques des usagers - établissement de normes de qualité pour un risque acceptable de dommages pour une cible donnée.
correspondance entre normes de rejets et objectifs de qualité - classe d'usages.
évolution des objectifs de qualité - contraintes pour le développement industriel et urbain - croissance zéro et innovation technologique.

. planification et aménagement du territoire, contrôle de l'utilisation du sol, planification régionale. Impact des aménagements : valorisation des milieux (industrie, tourisme).

. développement technologique prévisible.
court terme : meilleure technologie réalisable (best practible)
moyen terme : meilleure technologie disponible envisageable (best available).
long terme : pollution zéro (zéro release)
rôle de la recherche-développement.

5.3. POURSUITES JUDICIAIRES ET SANCTIONS.

. répression et discussion. Dédommagement des victimes. Possibilités contributives des contrevenants. Rapidité des procédures.

6. LES INSTRUMENTS ECONOMIQUES DE GESTION.

6.1. LES MOYENS DE CONTRIBUTION FINANCIERE.

. les origines des moyens financiers : le principe pollueur-payeur et ses exceptions.

. les taxations forfaitaires
simplicité et arbitraire ; peu d'incitation

. charges financières spécifiques ; les redevances sur les usages et les redevances sur les usagers.
Moyen de connaissance statistique. Taux financier appliqué à une assiette technique.

. choix des paramètres de l'assiette, agrégation, pondération.
Evaluations forfaitaires.

. définition des taux unitaires. Taux d'équilibre de redistribution, taux efficace d'incitation, taux optimal économique. Travaux de programmation financière.

6.2. LES AIDES FINANCIERES.

. les allègements de charges et dégrèvements fiscaux
réfaction sur les coûts d'investissement ou d'exploitation.
Accélération de l'amortissement des ouvrages, bonifications d'intérêt, intérêt des circuits financiers courts.

. versements financiers monétaires
aides générales non spécifiques.
aides directement reliées à la gestion de l'environnement : subventions, prêts, avances.
Notion de bénéficiaire (maîtres d'ouvrage publics, privés).
Effort financier du bénéficiaire.

. programmes d'aide prévisionnels
coordination des interventions et possibilités de financement.

. régularité, opportunité, efficacité des aides.
Prévention des dommages et programmes d'assurances.

6.3. RELATIONS ENTRE INSTRUMENTS JURIDIQUES ET ECONOMIQUES :

. rentabilité économique des investissements de mise en valeur de l'environnement. Evaluation coût/avantage. Fonctions monétaires de dommages. Dépenses pour l'environnement et inflation.

. répercussions économiques et sociales des instruments de gestion.
chomage, obsolescence technique, élévation des prix, modification de la concurrence internationale, dus à la politique de l'environnement.
Dispositions transitoires.

. incitation des instruments de gestion. Rôle de la technique (innovations). Facteurs psychosociologiques (responsabilité, solidarité).

7. INDICATEURS DE GESTION DE L'ENVIRONNEMENT.

. indicateurs statistiques :

- statistiques descriptives à caractère général (géographie, démographie, technologie ; statistiques sur les usages, sur la pollution, sur l'épuration).
- statistiques analytiques économiques et financières, prix et coûts d'investissement et de fonctionnement, aides financières accordées, ébauche d'une comptabilité générale par milieu (recettes perçues et emploi).
- prévisions et travaux prospectifs. Planification à long terme.

. appréciations empiriques.
opposition entre urgence des solutions apportées et pertinence par rapport aux objectifs à long terme
opposition entre précision des instruments et délai d'exécution.
relations entre justice et efficacité du système de gestion.
compromis entre technicité de l'information et participation du public.

. Evaluation des politiques de l'environnement.

- résultats perçus et efforts financiers effectifs.
- faux problème de l'efficacité composée des réglementations et des redevances.
- importance des aides financières vis-à-vis du caractère socio-économique du pays (pression du secteur privé sur les subventions publiques).
- niveau d'incitation financière et demande sociale implicite.
- degré de réalisation de la programmation.
  importance de l'environnement dans le P.N.B.
  autprisations de programme, crédits de paiements engagés, crédits effectivement dépensés.

Référence : Politiques et Instruments de gestion de l'Eau
Water Management Policies and instruments
P.F. TENIERE-BUCHOT
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"METHODS AND EXPERIENCES OF WATER MANAGEMENT"

- LONG-TERM PLANNING IN HUNGARY -

Gyorgy KOVACS

1. INTRODUCTION.

The general objective of water resources development is to eliminate the differences occuring from both quantitative and qualitative aspects between the available water and the demand of the society within a given area. This task can be fulfilled by :

- regulating the run-off both in time and in space,
- controlling the water demand / applying special policy in the development of various areas, introducing technologies with economical water use, supporting the reuse and recycling of water, etc ... :
- protecting the naturel waters against pollution.

The listed activities require large hydraulic structures/reservoirs, intake works and transporting canals, treatment plants/ the construction period of which is generally long. Their full operation is achieved in most cases gradually and their design needs, therefore, the accurate forecast of the expected development for a considerably long period. These structures influence generally their environments causing changes there, which are either irreversible or any further modification needs a long time and considerable efforts.

Thus the policy applied in water resources development determines the feature of the area for a long period. These are the reasons why the long-term planning has perhaps more important role in water resources development than in any other branches of the national economy, and why a longer period has to be investigated, than the general length of medium and long term economic plans.
In areas where the difference between the water resources and the socio-economic demands is large from any aspect/water shortage, uneven territorial or seasonal distribution, strong pollution, frequent inundation caused either by the lack of run-off or by the floods of rivers/the unsufficient conditions of the water regime hinders the development of the national economy. In such areas the long term planning concerning the relevent sectors of water resources development or including the entire water oriented activities is a prerequisit for any type of economic planning.

2. HYDROLOGICAL CONDITIONS IN HUNGARY.

In the 93.000 km2 area of Hungary almost all the problems listed previously occurs in concentrated form. One quarter of the country has to be protected against the floods of the large rivers.

One half of the territory is very flat and, therefore, the water originating from precipitation has to be collected and drained from the area artificially by systems of canals. The water resources are concentrated into the three main rivers : Danube, Tisza, Drava, the water supply of large areas needs extended distribution network. The area itself is very poor in water, the available resources are carried mostly by the internationsl rivers originating from upper lying countries. The growing season is arid/potential evapotranspiration surpasses considerably the amound of precipitation and the rivers crossing the country have also low discharges in this period. Some of the rivers are severely polluted hindering the use of their waters.

Some numerical data characterizing the hydrological conditions, the rough sketch of which was given in the previous paragraph :

- the average yearly precipitation is between 500-600 mm-s. In the Tisza valley it is 500 mm-s or less, in the mountainous area/elevation between 700-1000 m above sea level/it reaches the 800 mm-s. The seasonal distribution can be characterized by the following ratios ; dormand season related to the yearly average 0,4 1; growing season 0,6 1. Generally the groups of 5-7 dry and 3-4 wet years follow each other with short transition periods between them forming a periodicity characterized by a wave of 13-14 years. In dry years the average precipitation decreases till 350-400 mm-s, while in wet periods it reaches the 700-800 mm-s. The maximum monthly precipitation occurs in May and June with an average of 70-80 mm-s.

- the yearly potential evaporation is about 900 mm-s. In winter practically there is no evapotranspiration. It increases very rapidly in spring time and reaches the monthly maximum, 200 mm-s or more, in June, July and August. This is the reason, why the crops having relatively late harvesting need supplementary irrigation especially in July, August and sometimes in September, when the precipitation may be negligible, and the potential evaporation is very high, or it is still considerable in September.

- the density of the river system is extremely low ; the average length of the water courses within a unit area is 0,3 km/km2. The regime of the rivers coming from the Alps/Danube, Drava and some of their tributaries is well balanced. The ratio between the average minimum and maximum discharges is 1.10 - 1.15. The same parameter for the Tisza River is 1.60 - 1.100, while for some of its important tributaries the ratio is as low as 1.1000. The rivers on the lowland are characterized with very gently slopes/Danube 0,ã4-0,ã8 % ; Tisza 0,ã1-0,ã3 %. This condition raises the duration of the floods in many cases above 1 month, which fact and the high flood-discharge excludes the application of reservoirs as flood protecting structures and requires the construction of longitudinal dike systems.

- Geologically the largest part of the country is composed of two interconnected large sedimentary basins, which are divided by the Transdanubian Central Mountain Range built up mostly of carbonate and eruptive rocks. Both the clastic sediments and the karstic rocks are good aquifers, providing directly consumable water for urban and rural water supply schemes. The basins are drained by more than 50000 artesian wells with an average depth of 100 m-s. In the karstic area large natural springs and artificial watering points provide the bases of water supply.

- In natural conditions the aquifers are drained by the riverd. The subsurface reservoirs ensure the most valuable surface-water resources, the low-water discharge of rivers during long dry periods. The surface and ground water cannot be regardes, therefore, to be independent resources and their interactions have to be consideres when surveying the available resources of the country and planning the utilization of the water resources.

- Owing to the geographic conditions water resources development can be realized in Hungary only by co-ordinating and harmonizing the water oriented activities with those of the other countries situated within the common drainage basin. The flood-waves arriging from the steep-sloped areas of the Carpathian Basin surrounding Hungary slow down on the low-lying plain causing a danger of inundation of the flood-plain of 2,3 million hectars. At the same time from the total available water resources measured as the yearly average surface run-off through the lower border of the country 96 % originates from the upper lying areas of the catchment and only 4 % from the territory of Hungary. Any kind of development within the neighbouring countries influences in a great extent both the quantity and the quality of water available in Hungary, especially in dry periods. Firmly based planning can be achieved only, if bilateral agreements regulate the quantity and the quality of the water expected to be available at the border, following the basic principle of the "Helsinki Rules" which states that all the reparian countries have the right to a reasonable and equitable rate of the natural water resources of the international rivers.

Generally unfavourable natural conditions listed in the foregoing required - and the centralized organization of all the water oriented activities in the country made it possible - to start with the long term planning of water resources development relatively very early. The preparation of the first co-ordinated and comprehensive water master plan commenced in 1951. Since that time a series of medium and long term plans were elaborated, a short review of which will be given in the next chapter.

3. LONG-TERM PLANNING IN WATER RESOURCES DEVELOPMENT IN HUNGARY.

In Hungary the economic planning is directed by short/yearly/medium/ 5 years/and long term/15 years/plans prepared separately for each branches of the national economy and unified afterwards in a harmonized form within the national plan.

Water resources development being accepted as an independant sector of the economy these plans are also elaborated for the subsequent planning periods to determine the objectives and means of water oriented activities. The planning is made by the National Water Authority in co-operation with the National Planning Authority, and NWA is responsible for the execution of the plans.

Before long term planning has become generally adopted for the whole national economy the need for such plans was recognized in some sectors especially in those dealing with the development of the basic infrastructure of the country and having close contact with and great influence on the other branches of the economy/e.g. housing, road construction, energy, etc ... For these sectors the National Commission of Technical Development (OMFB) in co-operation with the relevant technical Ministries or Authorities has elaborated long term 'concepts" surveying generally the needs and the available resources for a period of 25-30 years. These concepts were used as the bases of the first 15 years plans in the relevant sectors of the national economy.

Water resources development was one of the economic sectors, where the necissity of long term planning was early recognized, thereasons of this demand was already mentioned. The preparation of the fist masterplan for water resources development started, therefore, in 1951 and the plan was published in 1954. It was the first comprehensive water management plan in Hungary in the modern sense. The basis of this plan was the survey of the available resources and the forecast of the expected water demand in the various sectors of the economy. By comparing the socio-economic requirements with the existing facilities the main activities were outlined in each sector of water resources development, flood control, water control in hilly areas and in flat catchments, irrigation, water supply, canalization and sewage treatment, navigation and river training, utilization of hydro-energy.

The plan investigated two time horizons. The structures needed before 1075 were studied in more detailed form, while it was supposed that the further preducted works will become necessary around 2000. It was also explained that these time-points were not well determined deadlines, because the general economic development could not be foreseen for such a long period. Since the master plan created a logic relationship between some parameters indicating the development of the whole economy/population, industrial production, irrigated land, etc ... and the construction of the main hydraulic structures, it was supposed that water resources development could elastically follow the actual economic increase.

In the first master plan only the large multi-purpose structures having regional character were analysed in detail, weirs, dams, water transporting canals, regional networks of water distributing pipe-lines, etc ... The local activities or works serving only one sector of water management were summarized in more general form indicating in most cases only the total volume of the works expressed in both monetary units and estimated technical amounts.

Considering the large change in technology, the rapid increase of informations and the great development not only in the economy but also in economic planning the preparation of the second Master Plan became necessary. This second plan uses all the experiences gained by the preparation of the first one, but lies on a larger foundation, starting with the determination of the regional long term plans and compilingthe country-wide plan from the results of those prepared for the 13 regions. It is the reason, why in some publications the first plan is referred as the first draft of the Master Plan and only the second is called Master Plan.

Both the regional and the country-wide plans are composed of 19 chapters :

I. The role and significande of water management in national economy
II. Natural endowments, national water resources
III. Flood protection, flood control, regulation of rivers and lakes
IV. Water control of plain-land areas
V. Water control of mountainous and hilly regions
VI. Irrigation
VII. Fishery
VIII. Drinking and industrial water supply
IX. Canalisation of settlements, industrial plants and the protection of the purity of waters
X. Water power utilization
XI. Waterways, harbours
XII. Water storage and multiple-purpose utilization thereof
XIII. Mineral, medical and thermal water utilization
XIV. Recreation, bathing, water sports and nature conservancy
XV. Summary of major multiple-purpose water management installations
XVI. International relations of water management
XVII. National water balance
XVIII. Other tasks related to water management
XIX. Relation between water management and other branches of national economy.

The chapters dealing with special professional problems of water resources development, chapters III-XV, describe the situation prevailed in 31 December 1960 in the given field. Starting from these conditions the principles and the main required activities of the development are elaborated in each chapter. The text is supplemented by numerous maps. The scale of those belonging to the regional plans is 1.100000, thus these maps could represent all the planned activities in detailed form. For the country-wide plan the natural conditions and the available resources, as well as the main structures and works of the various branches of water management are summarized in maps having a scale 1.500000.

The regional plans were elaborated by the District Water Directorates, the regional offices of NWA. The borders of the regions follow the watersheds and not those of administrative units. To ensure the similarity of the plans a guide-line based on the draft program of the country-wide plan had been prepared by the same team, which summarized later on the regional plans in the national master plan.

The Master Plan contains the tasks of water management without a well defined time schedule of realization giving only the possible technical solutions of the problems. Here once again the first period of development, supposed to be reached in 1980, was investigated in a more detailed form. The objectives of the national economy and the expected progress of science and technology was duly considered.

It is worth-while to note, that the new Water Act accepted by the Parliament in 1964 stated in Section 4 : "The basis of water resources development is the master plan for water management".

The enacting clauses of the Act contain the following : Section 1, Para. 1. The National Master Plan for Water Management must be considered in the elaboration of the tasks contained in long-range and annual plans of all branches of economy touching also the field of water management and it must be used as the basis of the preparation of regional development plans.

Para.2. The systematic and continuous development of the National Master Plan has to be ensured in harmony with the demands of the national economy, with the natural conditions and with the material and cultural evolution of the society.

This further development was aimed by the preparation of new "concept"-s for water resources development in the framework of OMFB, one in 1968-1970 and the other in 1972-74. The concepts differ mainly in size from the master plans. Their basis is generally the comparison of the available water resources and the socio-economic demands forecasted for the investigated periods. The data serving to determine the available resources are taken from the more detailed studies elaborated for the master plans considering also the recent hydrological investigations. In the evaluation of these data the up to date scientific and technical development is also taken into account. The most important part of the concepts is the estimation of the future demands. Starting from the present conditions, accepting some fundamental hypotheses concerning the development of the socio-economic environment and using some models based on system analysis approch the water oriented activity required in the forthcoming 30-50 years by the society and the economic means available to meet these demands are predicted. The interactions between the developments of the national economy and water management is always investigated in great detail. Finally the expected range of the evolution of water resources development is outlined. The technical details, e.g. the main parameters of the required hydraulic structures, or those of the various services, are not studied. Only the ratios between the main branches of water management are indicated within the range of development of the whole sector.

On the basis of the "concept" finished in 1970, the 15 years plan of water resources development for the period of 1971-85 was elaborated and accepted by the Parliament as the guide line of the water oriented activities. The last Concept was just recently accepted by the plenary session of OMFB.

4. CONCLUSIONS.

In Hungary three different forms of long term planning are applied in the field of water resources development :

- 15 years plans : They give the complete list of the water oriented activities planned to be executed in the investigated period of 15 years. These plans are used as basic materials for the elaboration of the national economic plans and, therefore, they have more economic than technical character, containing only relatively short technical description of the structures to be constructed, because their general plans are usually already available, but giving the detailed economic evaluation of both the structures and other activities, cost-benefic studies.

- Master plans : They could be either regional or national plans, but both forms are basically technical documents. Their preparation starts always with the survey of the prevailing conditions, available resources, already existing demands and their possible fulfilment. It is followed by the prediction of the socio-economic development and the investigation of the activities required to meet the future demands. The main part of these plans is the detailed technical investigation of the structures, operations and other activities forming the backbone of water resources development in the next few decades. They describe generally the interrelation between the development of the national economy and the realization of the planned structures and activities. Thus the accurate time-schedule of the various works is not an essential part of the master plans. Although some estimated rate of development is indicated in most cases, at least for the first period of development, the plans have to be flexible in time to follow the actual increase of the national economy. The main purpose of the master plan is to give a framework of the future water resources development and to provide a guide line for any type of planning concerning water oriented activities.

- Concepts : These plans can be regarded to be the simplified form of the master plans, containing less technical details. They list only the most important structures, estimate the necessary financial, man-power and technical sources in a summarized form considering some main parameters of the various activities. The economic interaction between water resources development and the other branches of the national economy is generally a basic part of the concepts, thus they have a transition form, between 15 years plan and master plans. The timing is generally flexible and, therefore, the concepts are still closer to the master plans. Their main objective is to follow up the most up to date development of both water management and national economy between the preparation of two master plans. At the same time the concepts provide an important basis for the elaboration of the 15 years plan as well.

Some general remarks can be given about the preparation of the various forms of long term planning on the basis of experiences gained in Hungary :

- the first period of development investigated in long term plans, except 15 years plan, should be at least 25-30 years. The whole investigation has to be extended until the end of a period of 50 years, to check the reliability of extrapolation in this way.

- it is advisable to create an interrelation between the foreseen economic development and the requested water oriented activities instead of giving a rigide time-schedule for the realization of the various projects.

- it is worth-while to start the elaboration of the master plan with regional plans and to combine them afterwards in the national plan. In this case it is inevitable to prepare a common guidance material which can ensure the uniformity of the regional plans.

- the application of the concepts, as the simplified types of the master plans was proved to be a useful form of long-term planning which assists with keeping up to date the general planning of water resources development.

- Technical conclusions can be drawn up also from the various plans prepared in Hungary :

- investigating the available resources ground-water and surface-water cannot be separated, because they form an integerunit. If the two types of resources were calculated separately they could not be added up, but their interaction and overlapping would have to be determined.

- in areas where water shortage exists already or is expected in the near future the potential water resources, annual average run-off, have to be calculated and the technical means required for the utilization and regulation of this maximum available amount, reservoirs and distribution systems, have to be determined. In other cases some characteristic discharge available with given probability in the critical periods can be accepted as design value.

- in the economic water balance, comparison of available resources and forecasted demands, only the actually consumed water amount can be related to the available resources, not the total water demand but the difference between the latter and the amount given back as effluent water into the river system. Considering some losses and time lags in the governing system, heavy pollutions hindering the reuse and some other uncertainties a safety factor of 1,5 is applicable to multiply the estimated consumption.

- the treatment of the effluent water, considering also the self purification capacity of the recipient, has to facilitate the reuse of the water along a lower stretch of the river. The treatment plants ensuring the required purification have to be included into the plans.

- storage, higher degree of purification or other technology applied by the users can be investigated as equivalent variants. In these studies all effects, either they can be expressed in monetary units or not, have to be considered.
- when forecasting the socio-economic demands relatively higher accuracy has to be achieved in the estimation of the required and consumed water amount in the case of those branches of economy where the consumption is high, energy production, agriculture, etc ...
  Concerning the expected pollutions and required treatments similarly greater care should be given in the case of strongly pollution industries, chemical industry, oil pollution, etc ...
  The heat pollution has to be investigated separately.
- the agricultural water demand and the pollution caused by fertilizers, pesticides and herbicides need also separate investigation. In ghe case of supplementary irrigation the water demand is a random walue which can be determined only by considering its stochastic characterization as well as the simultaneous probability of the demand and the available resources. Pollutions occuring over large areas cannot be eliminated by treatment plants. In these cases, therefore, the self purification capacity of the system has to be compared with the expected pollutions.
- within international river basins the establishment of an international water law or at least some internationally accepted guide line to determine the territorial distribution of the available resources and the acceptable quality parameters of these rivers is an inevitable prerequisit for the preparation of the long term plans of water resources development in the individual countries.

ABSTRACT.

In Hungary the development of the national economy is directed by short -/1 year, medium -/5 years, and long -/15 years term plans. Water resources development is an independent branch of national economy, these plans are prepared also for the subsequent periods composing the basis of water oriented activities.

Apart from this planning of economic character, two different forms of long-term planning are used to elaborate the technical bases of water resources development :

- master plans,
- concepts.

The purpose of both types of plans is the comparison of technical possibilities and socio-economic demands for a period the optimum length of which is 25-30 years, giving also some informations for longer period. The master plans include more technical details and therefore, the elaboration of regional plans is advisable before the preparation of the national plan. The concept is a simplified form of the masterplan which ensures the follow up of the most up-to-date development of both water management and national economy between the preparation of two master plans.

The preparation of the first master plan started in 1951, thus the Hungarian experts have long experience in this field. The general and technical conclusions of the experiences are also summarised in the paper.

EXTRAIT.

Le développement de l'économie nationale en Hongrie est orienté par des plans à court terme (d'un an), de terme moyen (quinquenal) et à long terme (de 15 ans). L'économie hydraulique constitue le secteur indépendant de l'économie nationale, par conséquent on élabore de tels plans également pour le fondement de l'activité hydrologique.

Au dehors de cette planification de caractère économique, deux autres formes de planification sont encore utilisées pour établir les bases techniques de l'économie hydraulique, à voir :

- des plans-cadre
- des conceptions.

Le but de ces deux types de plans est la coordination des possibilités techniques et des besoins socio-économiques. La durée optimale de la période examinée dans ces plans est de 25 - 30 ans, mais la collecte des informations est nécessaire pour les durées plus longues. Les plans-cadre comprennent plus de détails techniques, il convient donc d'établir d'abord des plans régionaux et à la base de ceux-ci peut-on alors élaborer le plan national. La conception est la forme simplifiée du plan-cadre, ce qui permet de suivre rapidement le développement de l'économie nationale entre l'élaboration des deux plans-cadre.

L'élaboration du premier plan-cadre a été entamée en 1951, ainsi les experts hongrois ont acquis beaucoup d'expériences en ce domaine. L'étude est le résumé des expériences générales et techniques.