Water resources management system in Ceará, Brazil[1]

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Why Ceará?

Brazil is a large country, covering about 8.5 million km², with a population close to 150 million. There has been a decrease in the overall population growth from 2.5% in the 70's to 1.9% in the 80's. However, due to internal migration, urban population rose from 2/3 in 1980 to 3/4 in 1991. Now there are 92 cities with population greater than 100 000, twice as much as in 1970, which puts an enormous burden for new urban services and shelter.

There is a wide spectrum of scenarios concerning the availability of water, ranging from the Amazon rain forest, in the North, to the "drought polygon", in the Northeast. The country is politically organized in a federal system with 27 states. The Constitution of 1988 calls for the building of a National Water Resources System (NWRS), leaving the details of such system for a future specific law. This law has not yet been approved by Congress, despite the effort of several commissions and professional organizations. Therefore, for the time being, the NWRS is not effective. The passage of this federal law is delayed because the rational use of water is not yet a major political concern in most of the sates, due to its relative abundance. On the other hand local legislation has advanced in states that either: (a) have industrialized and polluted urban areas, where clean water has become relatively scarce, like the State of São Paulo; or (b) are located in the drought-stricken Northeast, where water shortages are critical, like the State of Ceará.

Ceará was the first state in the drought prone zone to pass a water law, in July 1992. This state law embodies as fundamental the following principles:

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1 Some concepts included in this paper were originally formulated by World Bank's staff and consultants that visited Ceará from April 1993 to February 1994. However, eventual misconceptions are this author's responsibility.

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- the basic water resources management unit is the watershed;
- water is a scarce resource which plays an important role in socio-economic development; as provision of water involves increasing costs - making it an economic resource of significant value - charging for water use is fundamental for its rationalization and conservation, and is a key instrument for the implementation of water resources policy;
- as water resources can be used for multiple and competing purposes, the granting of water rights is an essential instrument for their management;
- the supply of human populations should be given the highest priority in water resources use.

These principles are consistent with those set out in the Dublin and Rio de Janeiro conferences of 1992, and also with the World Bank water resources management policy paper of 1993.

This paper is focused on the relatively poor State of Ceará because in recent years the Government of Ceará has made a remarkable start in developing a water resources management system. In addition to the state law, the administration has prepared during four years (1988-1991) a very detailed water resources plan. Furthermore, Ceará has become a beacon of good government in Brazil, partially due to its administrative continuity, establishing a "can-do" track record for rapid economic and social progress. Although Ceará's per capita product remains only half of Brazil's, it increased in the 1980's at the rate of 2.4% annually, while for Brazil as a whole it decreased 0.5% over the decade.

Ceará is presently launching a vigorous Water Resources Program, worth US$ 110 million, partially supported by a loan granted by the World Bank, with the following goals: (a) implementation of the State's Water Resource Management policy, *including, inter alia*, the establishment of river basin planning and real-time management in four, out of eleven, State basins (inventory of water users and uses, detailed basin management plans), administrative strengthening and training for the recently created State Water Resource Management Company (COGERH), and the development of a bulk water tariff structure; (b) construction of about 30 medium-sized water storage reservoirs (ranging from 5 to 65 million m^3); (c) construction of about 50 water supply conveyance systems; and (d) implementation of rehabilitation works for existing reservoirs.

Water resources in Ceará

The state of Ceará covers an area of almost 150 000 km^2 (less than 2% of the Brazilian territory), with a population close to 6 million (4% of the Brazilian). Average precipitation is 775 mm,, ranging spatially from 400 mm in the dry hinterland to 2 000 mm on the hills. Distribution in time of rainfall is rather uneven: in any given year, practically all precipitation falls during half a year and roughly 70% falls during just one quarter (centered on April). Annual coefficient of variation is typically 40%, which is rather high. Roughly, it means that the precipitation will be less than 5% of the mean value, for any particular site, on the average in one out of five years. Most of the rainfall in any given year can not be stored in the ground because, in general, the soil has moderate permeability and lies on top of an impervious crystalline substrate. As Ceará is located just three degrees south of the Equator, potential evaporation is very high, typically 2 500 mm, annually. The runoff coefficient is relatively low, 13% for the State as a whole. The mean annual surface flow in Ceará is roughly 15 000 Mm^3. Most of this water would just flow to the Atlantic Ocean as flash floods, if it was not stored in reservoirs. In natural conditions, there is only one river in Ceará that would be perennial, the Jaguaribe River. All the others would be intermittent.

When a sequence of dry years occurs, a large portion of the population in the dry hinterland is left without water, even for drinking purposes. In these cases, trucks are used for carrying water for thirsty people; "emergency plans" are launched by the federal and state governments in order to provide jobs for the poor peasants that otherwise would starve to death. Large numbers of men and women are temporarily employed in the so called "working fronts", receiving in general an extremely low pay (in recent years of the order of US $ 30.00/month).

In some cases, the drought strikes even the relatively humid coastal zone, where Fortaleza, Ceará's capital city is located. This was the case in 1993 when Fortaleza had a severe shortage of water. The situation was so serious that the State Government built, in just three months, a 115 km canal linking Fortaleza to the perennial Jaguaribe River, that is capable of carrying 5 m^3/s, .

There are about 7 000 dams and reservoirs of small size in the State. Many of them have been built in the last decades by the working fronts. In general, these reservoirs are not associated with proper hydraulic conveyance structures and get dry every year, even in a normal year, because they are not deep enough to over-

come the intense evaporation rate. Nevertheless, these reservoirs serve the purpose of transferring water from the rainy season to the dry season. In general, the reservoir sites and sizes were chosen to satisfy the private interests of the local powerful land owners.

On the other hand, there are 78 properly designed reservoirs with multi-year carryover capability. For these, the storage capacity ranges from 5 to 2 000 Mm^3 (total storage is larger than 9 000 Mm^3, which corresponds to 60% of the mean annual streamflow of Ceará). Although these 78 reservoirs were properly built by DNOCS, a federal agency founded in 1909, they were designed mainly for supporting public irrigation districts, generally located in the downstream reaches of river basins, close to the sea. This leaves large portions of the State's hinterland unserved by any water regulation system.

The new reservoirs to be built with the loan granted by the World Bank will have multi-year carryover capability, proper hydraulic conveyance structures and will be located in these water stressed regions. Also, several of the existing reservoirs will be recovered and enhanced on their present capability for providing water to the nearby small urban communities. Although the selection of the reservoir sites has been driven from the point of supplying water for human consumption, the sizing of the reservoirs and the planning of their operation has followed a multiple uses approach, which allocates most of the water for irrigation in lands located at the edges of the new lakes and at the river reaches, located just downstream of the dams. Naturally, one assumes water to be available for irrigation only when the water level in the reservoir is above a threshold level. Bellow this critical level, water is reserved for human consumption.

Institutional capacity

Historically, water resources have been managed in Ceará not differently from most parts of the rest of the world: (a) water resources were provided virtually free to users; (b) almost all resources were raised by government through general tax revenues and borrowing; (c) management was centralized in a command and control system, in which government decided. This is called the "old" paradigm, as defined by the Dublin statement. Like elsewhere, this system has resulted in waste and unfair allocation of scarce water resources. The lobbying for the construction of new reservoirs with federal money and the operation of those already

built in order to meet the interests of few powerful ones has been one of the more important sources of political power in Ceará and elsewhere in the Brazilian Northeast. This perverse system is known as the "drought industry".

The revival of democracy in Brazil, starting in 1986, fired an overall discussion about institutional re-organization of the country. In particular, for matters related to water, the Brazilian Association of Water Resources, an association of professional engineers that is affiliated to IWRA, issued two relevant documents, the "letter" of Iguaçu (1989) and the "letter" of Rio de Janeiro (1991). These two documents embody the general principles that were latter confirmed by the Dublin statement, namely: a) that water should be treated in an integrated manner; (b) that water should be considered an economic resource; and (c) that all stakeholders should be involved in defining policies and in managing the water system, with management responsibility for specific functions assumed at the lowest appropriate level. In Ceará, these principles were incorporated in the State's Water Law of 1992.

According to the Water Law the State Water Resources Council was formed with 14 members. Half of them represent agencies of the state administration. The other half represent some NGO's and other branches of government. This Council has the highest authority in the state for the implementation of the water resources policy and plan. It is presided by the head of the Secretary of Water Resources (SRH), that reports directly to the Governor.

One of the most persistent problems in Brazil is the lack of administrative flexibility of governmental agencies that operate within the so called "direct administration", like SRH. They are constrained by a complex legal apparatus that unfortunately has not changed much from the time Brazil was a colony of Portugal, in the last century. For example, it is virtually impossible to hire or to fire staff without going through an "authorization procedure" that takes several months (sometimes years) and several approval steps. In November of 1993, the Government of Ceará decided to overcome this difficulty through the creation of COGERH, the bulk water company, which is almost as administratively flexible as a private company.

COGERH was staffed in the first semester of 1994 through a national competition that resulted in the hiring of 21 professionals, 9 of them with a M.Sc. degree in a field related to water resources. Other 30 non-specialized people, needed for the administrative and support activities, were temporarily requested from the direct administration.

Water as an economic good

A bulk water tariff study is underway to enable COGERH to establish an appropriate tariff structure, initial tariff level, and a timetable for increased tariffs to gradually achieve reasonable cost recovery of investments in new water storage and conveyance infrastructure. The key parameter is the unit price of bulk water that can not surpass the users' ability to pay. A preliminary study was performed in order to provide a crude idea of COGERH's financial health in the years to come, adopting US$ 18/1000 m^3 as the unit price of bulk water. This value was chosen because it would mean an increase of expenditure for a poor family living in a urban center of approximately 1% of the family's income, neglecting the effect of subsidies. The other adopted assumptions are: (a) COGERH will pay to the Federal Government US$ 1/1 000m^3 for water released from federal reservoirs; (b) loss of water "in transit", including the river reaches, will be equal to 30% of the water volume yielded from the reservoirs; (b) 30% of the bulk water will be delivered to very poor peasants that are unable to pay anything; (c) COGERH's ability to charge those that are supposed to pay will be 30% in the first year, growing steadily until the fifth year, when it will reach 70%, staying at this level in the following years; (d) for those that will pay, the unit price will increase from 60%, in the first year, to 100%, in the fifth year, of the nominal unit price of US$ 18/1000 m^3.

Under these assumptions, COGERH's revenues would grow from zero in the first year to US$ 17.7 million in the tenth year, while the O&M costs would grow from US$ 1.8 million in the first year to US$ 6.5 million in the tenth year. After the tenth year there would be a steady financial flow. Its present value (rate of return of 8%) is very close to the present value of the US$ 110 million Water Resources Program being launched in 1994, assuming that the investments would be uniformly spread over a 10 year period. This attractive result is only possible because COGERH will not have to pay for the past investments made by the Federal Government in its own reservoirs. In other words, although the Water Resources Program is feasible under a national perspective – otherwise it should not be adopted – it would not pass an economical evaluation based on full cost recovery from the users of all investments, including the federal ones. However, in which country are the full costs for major works, such as dams and pipelines, fully recovered from the users?