

The Brazilian Northeast Region and the Rio São Francisco

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ABSTRACT *The drought-stricken Northeast of Brazil has for centuries been an economic and social problem-area for the country. The lack of reliable water supplies for both potable use and irrigation, coupled with poor soils and weak institutional systems for the development and management of water supplies has, historically, caused great suffering for the population of this region. It has also created an economic drain on the resources of the country as cyclical mitigation efforts have been necessary to alleviate these problems. In recent years, the Federal Government and the state governments of the Northeast have begun a broad-based effort to develop the institutional and legal structure to support efficient management of the scarce water resources of the region. This follows many years of attempting to solve the problem solely through the use of infrastructure development. Some of this infrastructure effort has been extremely successful, but many of the systems have been poorly managed and maintained with resulting inefficiencies and waste. Recent Federal and State water laws along with strengthening of the agencies responsible for the management of the resource have improved this situation and show great promise for the future. The Rio São Francisco which crosses through the Northeast represents the single most valuable water resource of the region. It has been extensively developed for the purpose of hydro-power production, frequently at the expense of other multi-purpose uses. The resource has been partially developed for irrigation of high-value fruit crops and has the potential of further more intensive development if conflicts between governmental jurisdictions and competing sectoral users can be resolved. The river basin is also faced with problems of water pollution from municipal/industrial point sources in the upper reaches of the basin and non-point source pollution from agricultural and land management practices within the entire basin. Possible strategies for the future development of an integrated management system for the São Francisco Basin include the development of a reliable and credible database to provide all stakeholders with full information regarding the resource. In addition, practical decision-support models for the basin are needed to give decision makers the capability of evaluating alternative strategies to optimize the management of the basin. To develop support for this process among the stakeholders and general population, an extensive education and public information programme is needed to reach the media, the public leaders, politicians and stakeholders within the basin. Ultimately, the decisions with regard to the development and management of the resources of the basin will be made in the public and political arena in response to the demands of the stakeholders. Provided that these decisions are based upon a fully informed public and supported by state-of-the-art technology, the evolution of a sound and sustainable management system within the basin holds great promise for the alleviation of poverty and the minimization of the vulnerability of the region to cyclical drought.*

The Northeast

Since the late 1800s, northeast Brazil has been officially viewed as one of the country's foremost 'problem areas'. It had been the nation's wealthiest region during the sugar boom of the colonial period, but subsequently lagged behind as industrial, agricultural and commercial activity shifted to the south. Inter-regional income and socioeconomic disparities have persisted over many decades. Today, with nearly 30% of the nation's population, the Northeast accounts for only 12% of GDP. Over 72% of the region's families are poor, and the majority of these poor families reside in the rural areas.

Northeast Brazil includes nine states: Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia. The northern portion of the state of Minas Gerais is also considered part of what is called the *Polígono da Seca* (Drought Polygon). Their combined area is about 1.5 million km² or 18.6% of the country's total area. The region is heterogenous in terms of climate, topography and vegetation. The *Zona da Mata* (forest zone) stretches along the coast from Rio Grande do Norte to southern Bahia in a narrow strip. Although the total area of this subregion does not exceed 128 000 km², it contains approximately one-third of the regional population, six of the nine capitals, and a major portion of the industry and plantation agriculture (largely sugar-cane and cocoa). The *Agreste* is a transitional zone between the humid *Zona da Mata* and the semiarid *Sertão*. Its area is about 260 000 km². Annual precipitation, concentrated between March and June, is less than 1000 mm; soil fertility is medium to low, and its economy is dominated by mixed farming for domestic markets, as well as cattle raising. The *Sertão*, totalling some 750 000 km², is the largest subregion and the most vulnerable to periodic droughts. It encompasses the greater part of Ceará, Rio Grande do Norte, Paraíba, Pernambuco and Bahia. Its total population is only slightly less than that of the *Zona da Mata*. Annual rainfall averages 700 mm for the *Sertão* as a whole, but ranges from 250 mm in the driest areas to over 1000 mm in the humid uplands. Soils suitable for cultivation exist but lithosols and rigosols, unsuited to agriculture, are widespread. The variation in climate and soils permits a diverse rural economy, with extensive cattle raising as the predominant activity. The middle north, constituting Maranhão and most of Piauí, accounts for one-quarter of the Northeast's lands; climatically it represents a transition between the semiarid zone and the humid Amazon region. Most of its area has been settled since colonial days, but large undeveloped frontier areas remain.

The Rio São Francisco

The Rio São Francisco is the most important river system in the Northeast. It is the main reliable water source, with a mean base flow of 2100 m³/s at its mouth, excellent water quality, and an annual discharge averaging 100 billion m³. Its basin occupies some 640 000 km². Major dams at Três Marias in the upper São Francisco Valley and at Sobradinho in the middle valley have regulated the river flow, as well as facilitated the use of large areas of the inland river basin for fishery development, domestic and industrial use, and irrigation. The lower part of the river has been extensively developed for the production of hydroelectric energy with the construction of dams and power plants such as Itaparica and Xingo. In the northern part of the region (from Bahia to Ceará), most other rivers have highly variable flows and remain dry during a significant part of the year.

The Drought

Recurrent drought cycles are a dominant factor in the Northeast's development. The first recorded drought occurred in 1587, and 76 subsequent droughts are on record, with 20 in the twentieth century thus far. During the two most recent droughts (1978 to 1983 and 1991 to 1993) over 80% of the Northeast was seriously affected and over 1.3 million families have been assisted by emergency relief programmes. Rainfed crop losses, particularly in the *Sertão*, averaged between 80 and 100% in 1983 and 1993. In addition to the severe drain on public funds, the savings of many smallholder families (usually in the form of live-stock) were depleted. Hunger has been widespread, and rural food prices have risen to record levels; there have also been numerous lootings of food markets and storage facilities. Water for human consumption is scarce in most rural areas; many rural communities have no source of water other than government tank trucks, which deliver water infrequently. Even large cities such as Fortaleza and Recife have resorted to expensive emergency solutions to meet basic human and industrial water demands.

Federal government involvement in the Northeast began in the late nineteenth century with the development of emergency drought contingency programmes. The severe droughts periodically affecting the region, coupled with persistent widespread poverty, prompted the creation of numerous programmes, approaches and strategies. Until 1950, most federal interventions were limited to drought relief works, short-term drought emergency programmes and crop-specific policies. In 1959, the *Superintendência para o Desenvolvimento do Nordeste* (SUDENE) was created and given a wide range of responsibilities, including coordination of all ongoing activities and investments in the region, and responsibility for drought emergency measures. These efforts culminated in the mid-1970s in the creation of several new programmes and financial mechanisms aimed primarily at settlement, land distribution and agroindustrial modernization. This trend continued through the 1980s as the federal government created several additional programmes for the rural Northeast. The devastating impact of the last two severe drought periods on the rural population demonstrate, however, that little has changed despite the assistance programmes of the past decade.

Over the last 80 years, in an attempt to conserve rainfall and reduce the risk of floods, the government has built 270 major public reservoirs in the Northeast. These reservoirs have a total storage capacity of more than 12 billion m³. In addition, there are 600 major private reservoirs and several thousand smaller ones. Because of the pervasive climatic conditions (long drought periods), the operation of reservoirs is a very complex activity. In the *Sertão* area, a large part of the stored water is lost to evaporation and safe water yields average only 15% of the potential yields.

The Plan

The Master Plan for the Development of the São Francisco River Valley (PLAN-VASF) was completed in 1989, with the assistance of the OAS, and was designed to provide incentives to the public and private sectors for the development of the basin. This plan included proposals for the development of natural and water resources, increased food production through irrigated agriculture, increased

power generation supplying the National Network, increased water and sanitation services, improved river navigation and enhanced environmental protection. This plan was adopted as a part of Federal Law 8851/94, as the Plan of Economic and Social Development of Northeastern Brazil. Subsequently, the Federal Government passed Law 9433/97, creating the National Policy on Water Resources and establishing public institutions such as the basin committees for the issuance of water rights and implementation of water-use payment systems. With the approval of the National Policy Committee on Water Resources, as established by the National Constitution, the Federal Government is promulgating criteria and guidelines to be followed by states in implementing federal law 9433/97. Presently the states of Bahia, Pernambuco and Sergipe, within the Rio São Francisco Basin, have passed legislation consistent with these objectives, principles and guidelines and are creating institutions to implement the new law at the state level. The states of Minas Gerais and Alagoas are presently modifying or creating water legislation in order to comply with federal regulations. Within the Northeast, the states of Ceará and Rio Grande do Norte have also been leaders in the formulation of strong legal and institutional frameworks compatible with the new Federal Law. Activities in the Brazilian Coastal zone are regulated by Federal Law No 7661/88, the National Environment Program, that establishes the National Coastal Management Plan, the principle objectives of which are the sustainable use of natural resources in the Coastal Zone, and preservation, conservation and rehabilitation of ecosystems in the Coastal Zone to promote sustainable development. A coastal zone inventory and macro-diagnostic, including the Rio São Francisco estuary, was completed in 1996 by the Government of Brazil with support from the World Bank.

Through the last three drought periods, the Brazilian Government has made extensive payments (in excess of \$4 billion) in drought relief programmes and loan guarantees. With the hope of finding an important part of a permanent solution to the problem of the North-east, the Government of Brazil launched the *Programa Semi-Árido* (Semiarid Program, PSA), which includes actions in the agriculture, water resources, health, and education sectors. To implement the Program, the Government has also created a Executive Committee, coordinated by the Ministry of Regional Integration, and composed of representatives of the Ministries of Agriculture, Mines and Energy, Health, Education, and the Secretaries of Planning and Strategic Affairs.

The Transposição

One of the components of PSA is the São Francisco Trans-Basin Project (*Projeto de Transposição das Águas do Rio São Francisco*), based on a plan to divert water from the São Francisco River to the *Sertão*, located in the states of Ceará, Rio Grande do Norte, Paraíba and Pernambuco. Initial studies, which included detailed field investigations, were started in 1981 by DNOS (National Department of Reclamation Works). In 1984, at the government's request, the World Bank financed the preparation of an Action Plan for the São Francisco Trans-Basin Project, by an international joint venture of consulting firms. The main recommendations of the plan included: (1) full development of local water resources prior to the construction of the São Francisco diversion works; (2) establishment of irrigation pilot areas in the plateau of Jaguaribe in Ceará and Apodi in Rio Grande do Norte; (3) creation of a multisectoral entity to prepare

detailed plans and implement the project; and (4) the requirement that institutional constraints to efficient water use be resolved prior to project implementation.

Progress to Date

During the past decade, the government with the support of the state governments has undertaken the construction of the most important hydraulic infrastructure required to exploit local water resources. This includes the completion of the Armando Ribeiro Gonçalves dam in the Piranhas-Açu river in Rio Grande do Norte and the planning, design and commencement of construction of the Castanhão dam and reservoir located in the Jaguaribe river in Ceará. Two pilot irrigation schemes, recommended in the Action Plan noted above, have been built by the federal government and an Executive Intersectoral Committee has also been established. The region-wide effort to provide a solid framework (including comprehensive legislation) to promote the rational use of water for irrigation and other purposes has begun to lay the base for consideration of the many options available to the Northeast to assist in the resolution of the historical drought problem. This includes a regulatory framework that promotes the registry, allocation and use of water-use rights. This framework, combined with the development and increased need for coordinated use of the resources of the river basin, has begun the evolutionary process for the development of an integrated plan for the comprehensive and multipurpose management of the river basin. This could include the use of surplus waters from the river within the other drought-stricken areas of the Northeast. Such an integrated plan presents many challenges in the areas of statesmanship, engineering and institutional development. The process will generate a multitude of controversies and will be the topic of many election campaigns. However, if the interests of the citizens of the Northeast are kept to the forefront, the conflicts can be amicably and equitably resolved.

The Process

The negotiation process to resolve the conflicts created by an integrated management scheme for the Rio São Francisco will require a great deal of consensus building and a strong participatory approach at all levels. This will have to be coupled with a well-planned public information and education programme that includes the citizens of the basin, private sector business, the media, the political and governmental leaders within the basin and the bureaucrats who influence the basin and have vested interests in the status quo. Some of the necessary steps in the negotiation process are outlined below.

The consensus building that will be necessary can only be accomplished if full and transparent information is available to both the decision makers and the stakeholders within the basin. This will require the establishment of a comprehensive and accessible database for the basin that reflects the hydrology, meteorology, geomorphology, ecology, sociology and economic parameters of the basin. Unless such a database is developed in a manner that gains the trust of all stakeholders, controversies over data and the impact analyses that will depend on this data will overshadow the compromises needed to reach consensus. One of the first steps must be to examine all available data and to determine

where gaps in either sufficiency of data or credibility of data exist. Efforts must then be made to provide the most comprehensive database possible and to obtain the agreement of all involved in the planning and negotiation process as to the credibility of the database for the purposes of the planning and management of the basin.

In order to adequately assess the impacts of operational decisions within the basin, a credible decision support model, operations model and decision mechanism will need to be developed. This will have to be supported by historic and stochastic hydrologic and meteorologic models and databases that are acceptable to all players. From these tools, the decision makers can then evaluate the impacts of different scenarios of operation and development on the different sectors and upon the different future alternatives for the basin.

The watershed management issues such as erosion control, revegetation, recuperation of the ecological system of the basin and the minimization of pollution through point and non-point source controls, education, modification of irrigation practices, herbicide and pesticide use, industrial waste discharge control and sewage collection and treatment must all form part of the basic strategy for the basin. Each of these pieces is a link in the chain that will hold the sustainable management plan for the basin together.

In order for such a programme to be developed and to be sustainable over the long term, sustainable mechanisms for funding the management and administration of the programme must be found that will assure that the programme does not become crippled by political indecision, changes in government or influence by special interests. This challenge alone is formidable.

In the final instance, the development of an integrated management plan will be carried out in the political and legal arena. A representative committee of the leaders of the affected states and communities, the Federal Government and the stakeholders within the basin must sit together and negotiate the resolution of sometimes conflicting interests. These representatives must be provided with the information and decision support tools to allow them to examine alternative solutions carefully and in a transparent manner so that they can assure their constituents' interests are protected. In the end, a great deal of statesmanship will be needed to arrive at the compromises necessary to resolve the various parochial and vested interests.

The endeavour to develop a sustainable integrated resource management plan for the Rio São Francisco Basin will not be easy and will be evolutionary. It is imperative that such planning be accompanied by realistic expectations as to the timing and practicality of results. It will take a great deal of time, money and strength of purpose. However, the rewards to the economy, culture and ecology of the basin will be enormous. The creation of a sustainable development and management plan and programme for the natural and social resources of the basin provides an opportunity to improve the well-being of the entire Northeast of Brazil as well as that of the entire nation.

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