La Grande Sécheresse: Strategic Considerations

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September 28, 1995

Prepared for the U.S. Agency for International Development, Morocco. These notes were prepared on the basis of a visit to Morocco from September 8-18, 1995. The author wishes to express his thanks to the many Government of Morocco officials who shared their impressions with him and the many USAID officials who organized and facilitated the visit and the meetings, and helped focus the impressions reported herein. Special thanks are due Alan Hurdus of USAID and to my graduate student, Mlle. Hynd Bouhia, who served as research assistant, guide, interpreter, and translator of this paper.

EXECUTIVE SUMMARY

Morocco is confronting a critical problem in its economic and social development. A severe drought is ravaging the country, devastating the economy and necessitating over a half a billion dollars of emergency expenditure to remediate some of the drought's worst impacts. The disaster has, however, led to some major institutional changes that may enhance Morocco's ability to cope with future droughts of this magnitude. The drought has led to the passage of a new law on water, which, if fully exploited, can make the country much more resilient in the future. A terrible drought can also be a great teacher: it has shown the strengths and the weaknesses of the present institutions, technological approaches, and planning capabilities. The impressions garnered during a recent visit have led to the following recommendations.

1. The Government should seize the opportunity presented by the drought and the new water law to create a new and flexible structure to oversee national water policy, planning, and implementation. Specifically it should strengthen the role of the Conseil Supérieur de l' Eau et du Climat, making it an apex body, reporting not to a specific minister but to the Prime Minister. The Conseil should be supported by its own secretariat, which would engage in broad-based policy analysis, freed of dependency on any particular ministry.

2. To take advantage of a wider body of expertise from a variety of disciplines, the Government should create an Autonomous Water Planning Group (AWPG), charged with formulating the National Water Plan called for by the new water law. The AWPG would work with the Conseil's secretariat in formulating the plan and would report directly to the Cabinet Royal. The AWPG should have a prescribed life of only 5 years.

3. Given the exhaustion of inexpensive dam sites and the general lack of supply augmentation options, major efforts should be placed upon demand management studies. It is now more important to focus on improving the use of current supplies rather than on future supplies. In particular, progressive pricing policies and tariff setting should be fully explored.

4. Given the need to protect the lives and the livelihoods of the rural populations, work should be inaugurated on studies to assess the feasibility of different types of financial drought insurance.

5. Given the importance of drought on food security and food self sufficiency, an integrated study on the role of irrigated agriculture in agricultural policy should be given high priority.

6. An experiment should be carried out to test the feasibility of adapting to Morocco elements of the Drought Preparedness Support System developed in the United States. The Agadir region would be suitable for such a trial.

7. Given the need to harvest every drop of water, more attention should be paid to active groundwater storage. A variety of new low-cost technical approaches could be considered.

8. There are many technical initiatives currently underway in Morocco as pilot programs, such as wastewater re-use, the use of non-conventional water, reduction of unaccounted-for-losses in urban water supply systems, improvement of irrigation water use efficiencies, and the promotion of conservation by users in both rural and urban settings. These research and development efforts should be encouraged and implemented.

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1. Introduction

At the request of the Government, the author was invited by USAID/Morocco to visit Morocco in an effort to broaden discussion about the current drought and to stimulate strategic thinking about drought mitigation in the context of the overall management of the economy and the water sector in Morocco. This paper is based upon discussions with many relevant government and USAID experts and officials, and on impressions gained on visits to Agadir, Marrakech, Settat, and Tangier during a short trip to Morocco in September 1995. (See appendix for list of meetings.) This paper gives a brief background to the current situation, reviews the lessons learned during the visit, and concludes with some recommendations for both strategic and tactical actions. The recommendations are not meant to be exhaustive, but rather to bring forward options the Moroccan Government could consider adding to its current drought policies.

2. Background

Morocco has a high variability in rainfall from year to year and from season-to-season. Over hundreds of years Moroccans have devised an agricultural system which copes very well with the seasonal variations in rainfall, but less well with inter-year variations. Rainfall records from recent times, and those extended back for several centuries using tree ring records, indicate that the Moroccan territory has always suffered from cycles of drought followed by good rainfall years. From these 1000 years of data it can be inferred that a drought is likely to occur once every 8 years and a drought like the 6-year drought of 1979 to 1984 can be expected once in 500 years. While the probability of drought in a given year in at least one of the country's major regions is quite high -- in the range of 30-40% -- the probability of drought nationwide is much lower, in the range of 10-15%.

As Figure 1 demonstrates, recent times, however, have been different. Since the mid-1970s a sequence of nationwide droughts of varying severity have occurred. For example, the drought of 1991/92 was followed by a drought in 1992/93. 1993/94 was a good rainfall year followed by a particularly severe drought in 1994/95. This most recent drought is perhaps the worst single-year drought in the last century. Since agriculture accounts for a significant part of Morocco's economy, almost 50% when agri-business is included, the economy is severely impacted by shortages of rainfall. Approximately 65% of agriculture (mainly the cereal crops) is dependent directly on rainfall; drought can have a major impact upon food production. Figure 1 shows the impact of drought on the total production of major cereals (wheat, barley, and maize) from 1975 until 1995. Cereal production, which accounts for 80% of cultivated land, dropped from 8.6 million metric tons (MMT) in 1991 to 2.9 MMT in 1992. Production stayed at 2.8 MMT in 1993 and rose dramatically to 9.6 MMT in 1994 only to fall to 1.7 MMT in 1995. Because of the shortage of over-year storage, a drought can severely affect irrigated agriculture, as well as cause such disastrous effects on rain-fed agriculture.

Drought impacts have been strongly felt throughout the entire agricultural system, including the livestock sector. Households and industries, as well as farming, have suffered from water shortages with the biggest impacts being felt in the rural areas and those cities and regions without fully developed water storage and supply systems. Employment, particularly in the rural areas, has been badly affected. All of these impacts on different sectors, taken together, are reflected in the growth rate of the economy which showed a 4.1% decline in GDP in 1992 and a decline of 1.1% in 1993. These two years were followed by a 12% increase in 1994 and an estimated 4% decline in 1995.

Faced with these large swings in the economy, the Government of Morocco has instituted a series of emergency measures, including importing large quantities of food and feed, expanding well drilling programs, transporting water by truck and ship, and creating jobs in the rural areas. These emergency measures, costing more than $565 million in the present case, are absolutely essential to protect the population from the consequences of the drought, but they do not, of themselves, provide the basis of a long-term strategic plan for managing future droughts.

Issues in Drought Management

Nature, with its natural fluctuations in the weather, is not the only cause of droughts. Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of shortfalls in precipitation or streamflow. This definition of drought emphasizes the role of human demands upon the water regime. In other words, a physical water shortage of the same magnitude might not have been considered a drought in the past, but as human demands upon the water resource are increasing, the same shortfall may be considered a major drought. For example, from Figure 1 it can be seen that the cereal production level in 1981 was similar to that of 1995, but the human and social impact of the 1995 drought could have been much more serious, because by 1995 the population and the demand for food grains have become much higher than in 1981. However, the social situation was much worse in 1981 because other aspects of the economy were less able to cope with the drought then. Today, the liberalization of the economy, more private sector activity and much higher foreign exchange reserves has improved its response capability. Also, there was a record crop in 1994 which led to larger food and animal feed reserves. All of these factors have played an important part in coping with the 1995 drought and underline the difficulty in defining drought as a purely natural phenomenon, and the importance of strategic management.

Role of Conjunctive Use

Given the large inter-annual variation of rainfall and streamflow in Morocco, one approach to reduce the variability is to establish over-year storage capacity for water. This strategy, which is widely applied in Morocco by surface storages, reduces the inherent risk of a severe imbalance in a particular year between the supply and consumption of the water. Indeed, the huge program of dam construction started during the 1960s and continuing to this

day is a striking example of this approach. Forty dams have already been constructed and another 49 are scheduled for construction between now and the year 2025. However, the planned new surface storages may no longer be appropriate, since the best and cheapest storage reservoir sites have already been exploited. In many countries, where the geologic conditions are favorable, potential groundwater storage is typically of much larger capacity than surface storage sites, and groundwater is becoming the over-year storage method of choice. Not only are groundwater storages cheaper in capital investment terms, but they also reduce the annual evaporation losses of stored water from 20-30% to close to zero. It remains to be seen if the geological conditions in Morocco will allow substantial developments of this kind.

Time Frame for Planning

There are three time frames to be considered for successful drought response planning. Emergency measures are implemented as *ad hoc* responses to conditions that are too specific or rare to warrant standing plans and major investments in countermeasures. Tactical measures, like water rationing, are developed in advance to respond to expected short-term water deficits. Finally, strategic measures are long-term physical and institutional responses such as building water supply and storage structures, changing water law, and developing plumbing codes. Restructuring the plumbing codes for new construction, for example, is extremely important to ensure the success of residential water conservation measures. In Morocco, almost all attention is devoted to the emergency and tactical measures, and very little to the strategic measures.

Integrated Nature of Problems

In Morocco, as in many countries, the problems associated with drought are integrated; but solutions are typically not. In other words, drought affects the entire economic system, but the responses typically deal with individual symptoms in a fragmented way. The many disciplines required to analyze drought problems and to develop and implement solutions are typically poorly coordinated. There is a need for integrated planning, which would cover the wide disciplinary inputs required and which would plan for both the strategic and tactical time frames. Hence, drought management is effectively a subset of water resources management. Water resources management deals with the best ways of managing the resource for human and environmental use given the natural variability of the weather and climate. Drought management cannot be successfully effective independent of the management of other aspects of water. In many countries, including Morocco, drought management has been assigned to agencies which have little coordination with agencies managing other aspects of water use. This has led to confusion of goals and a fragmentation of the effort to carry out a coherent integrated strategy.

Catalysts for Change

A severe drought can act as a catalyst for change. The social crises arising during severe droughts often stimulate governments to reorganize their institutions and procedures to ensure that the next drought will not catch them unprepared. Government and private sector actions that would be unthinkable during normal times can get widespread support during and shortly after a major drought. For instance, progressive pricing policies may be introduced, permanent reallocation from agriculture to urban and industrial uses may be carried out, household and industrial sectors may embrace conservation methods long ignored in normal times, and agriculture may be induced to change cropping patterns or irrigation technologies to conserve water. The Government of Morocco should be quick to take advantage of the willingness of the political and social elements in society to accept change under the current drought conditions.

Risk Reduction

The most important issue in drought management is how to reduce the risk to society from the water shortages while at the same time encouraging the best possible economic use of the water resource. One way of reducing risk is by being very conservative and planning on using only a small percentage of the average annually available water. For example, a discussion of water availability in Morocco using only the mean flows is misleading and would be dangerous as a guide to future policy. In arid countries the inter-annual variability is as of much interest as the mean availability. In other words, how much water is available 90% of the years is much more relevant than how much is available 50% of the time.

Conceptually, it should be possible to plan to use larger percentages of the average available water by use of clever insurance schemes. In several countries various types of crop insurance schemes are in place to reduce the climatic risk to the farmers. These typically work best in large countries like the U.S., where the probability of drought occurring over the entire country in any one year is very small. In Morocco, where nation-wide droughts are more frequent, some form of inter-annual insurance scheme which creates a financial fund for carryover from years of surplus to years of deficit may be more appropriate.

Drought in the Context of Water Resources Management

The goal of water resources management, and thus drought management, is to maximize the economic benefits of water use and still be sustainable in the long-run. This means that environmental quality must be improved and maintained under present and future uses. The inherent variability of rainfall and streamflows are fundamental parameters in the management of water. High flows cause floods and low flows bring droughts, creating the incentive to even out the variability of the hydrology so that human uses can be met satisfactorily all the time. This evening-out can be achieved by storage, either in surface reservoirs or in the ground. Surface reservoirs are man-made, but underground storage can

be either natural or man-made. Much of the work of water resource planners goes into deciding on the best size of such storages to meet the human and environmental demands placed upon the resource. The wider the fluctuations in rainfall and stream flow the larger the storages have to be to meet the demands most of the time, since the goal is to catch the excess water from periods of high flow and save it for periods of drought. Hence, floods and droughts are two sides of the same coin, and as such have to be managed together. In well-managed water systems, little water is lost to non-beneficial uses, remembering that the maintenance of in-stream flows for fish and stream biota are beneficial uses. Of course, effective water resources management deals with the institutions and the administrative "software", as well as the structural "hardware" of water systems. The institutions for water management must be capable of dealing with both flood and drought conditions.

Current Drought Program

In response to the drought of 1994/95 the Government of Morocco borrowed a $100 million emergency drought relief loan from the World Bank allocating $44 million (DH371 million) for rural drinking water, $30 million (DH250 million) for small and medium irrigation systems, $12 million (DH100 million) for livestock watering and pastures, and $15 million (DH132 million) for urban drinking water. This does not include a separate item of $14 million (DH120 million) to cover the $6 million spent for emergency pipeline and pumping stations in Tangier and the $125,000 per day operating costs for water tankers. In addition to the protection of employment provided by livestock watering and irrigation programs, the rural and urban potable water programs will generate 500,000 days of employment each.

The drought program costs given above do not include the importation of additional food and feed grains: additional imports of up to 1.5 million tons of wheat, 150,000 tons of maize, and 400,000 tons of animal feedstuffs costing $450 million beyond normal imports are planned, with some variations depending upon the nature of the concessional loans or purchases. A large part of Morocco's foreign exchange reserves were used for these imports.

In the worst affected regions, Comités de Vigilance have been established to assess needs and carry out programs, such as digging and deepening wells, sensitizing the population about the scarcity of water, regulating groundwater pumping, creating hygiene committees to make the population aware of the health aspects of water shortages, controlling water losses in both production and distribution networks, encouraging agriculture to use its own wells, reducing irrigated areas, cutting water use in public offices during holidays and weekends, bringing down the consumption of large water users, imposing restrictions on lawn watering, car washing and private swimming pools, monitoring public standpipes, providing water for livestock, and disinfecting the water sources. The details of the emergency program seem to be well conceived and carried out. The broader conceptual framework, however, of what to do about future droughts, has been largely ignored.

3. Lessons Learned

Nature of the Problem

There are many lessons to be learned from a drought and a society's response to it. The conventional view of drought is often far from the actual concerns of people exposed to the dryness, although the response differs depending upon whose concerns one solicits. Certainly from the government's point of view, drought is a major social problem. First, and foremost, food security and food prices are of grave concern. Then follow the impacts upon employment, particularly in rural areas where drought emergency measures are hard to implement. With reduced incomes and food prices raised by the drought, the rural poor are particularly hard hit and migrate to the large cities seeking employment. In the past this has led to urban unrest, as in the 1981 Casablanca riots and the "bread riots" of 1983. For the government, the stabilization of food supply and employment in the rural areas is the major drought problem, followed by concerns with the growth rate of the economy, and with the consequences of financing the short-term $565 million dollar drought emergency program.

Spatial and Temporal Distribution

Another important lesson is that the spatial and temporal distribution of the rainfall makes a large difference in the impact of the drought. For instance, cereal production during the 1982/83 drought, which appears to be almost as dry as the current 1994/95 drought, was 3.5 MMT compared to the current production of 1.7 MMT. This demonstrates the effect of intra- seasonal precipitation and its geographic distribution. The implication of this is that even improved forecasting of the drought conditions may not be very helpful unless it is able to capture the temporal and spatial distribution of the rainfall. The Direction Nationale de la Météorologie has an extensive research program addressing this problem. Nevertheless, given the difficulties in forecasting rainfall over periods of a few days or more, the expectation that local seasonal forecasts will soon be available should be tempered with caution. However, information based on historical and field trial data on delayed or advanced planting, fertilizer applications, etc., such as that derived from the cropping calendar research at INRA in Settat and the Institut Agronomique in Agadir, can be directly used to inform within-season decisions by the farmers.

Drought Versus Over-exploitation

Different regions of the country struggling with drought issues are faced with different sets of problems. For example, there is a paradox between the extreme drought problems in Tangier and the situation in Agadir. Intuitively, one would expect that the massive shortages of municipal water in Tangier, which have necessitated draconian water use restrictions and the importation of water by tanker at a cost of over $6 per cubic meter, would be much more serious than the situation in Agadir, which is currently without major

water use restrictions. The situation in Tangier is, however, much more easily resolved than that of Agadir. The surface storages needed to stabilize the supply to Tangier were only completed after the current dry period began so that they were never filled by normal rains. However, after a few years of normal precipitation Tangier could have as much as a 10-year supply in storage against future droughts like the present one. Agadir, on the other hand, will see its groundwater aquifers completely depleted within 20 years with or without subsequent droughts. Under current operation, the water situation in Agadir is not sustainable. A return to normal rainfall will solve the Tangier problem, but not that of Agadir. Agadir, therefore, requires a major shift in all aspects of water policy for its resolution: nature will not solve this problem, and in the absence of integrated water management policies, neither will man! The Tangier and Agadir problems are representative of the variety of regional problems in Morocco; they demonstrate the need for detailed examination of each case in an integrated comprehensive framework.

Subsidization of Water

Another major lesson learned on this visit was that while water is quite expensive to provide, most users pay little for it. For example, the capital costs for surface water irrigation systems are met by the government, leaving the farmers only operation and maintenance costs of about $0.02 per cubic meter of water, and in many cases the farmers are not even paying these amounts. Similarly, municipal users supplied by the Organisation National de l'Eau Potable (ONEP) still receive a subsidy on the capital cost of dam construction although they are expected to pay the full costs of the system's operation and maintenance and to cover the capital costs of the remaining components of the water supply and sewerage systems. Underpricing a resource is one of the main causes for inefficient use.

Depending upon how one calculates the costs of water mobilized from the dams proposed for construction between 1995 and 2025, the long run marginal costs lie between $0.05 and $0.58 per cubic meter, and for groundwater between $0.29 and $0.76 per cubic meter. The costs of transportation and distribution can add another $0.35 to $0.70 per cubic meter to the total marginal costs of urban supply and $0.05 to $0.08 per cubic meter to agricultural supplies. Since the transportation costs of groundwater are typically lower than for surface water developments, the total marginal costs for new groundwater will on average be lower than those of new surface water.

In all but a few cases, the water tariffs charged in Morocco are substantially below these marginal costs. For agriculture, the total marginal cost of supply far exceeds the estimated value of water in crop production for all crops. Great concern about tariff reform is expressed by the agricultural and urban water suppliers in Morocco, but one wonders if the political fortitude to pursue radical reform exists under the current institutional framework for water management. Much additional research needs to be done on assessing the marginal benefits of water use in agriculture, but if the preliminary work is to be

believed, it casts serious doubts on the economic and social wisdom of pursuing the current plan to double the area irrigated over the next 30 years.

Institutional Arrangements

In Morocco the responsibilities for water are mainly split between two major institutions: the Ministry of Public Works and the Ministry of Agriculture. These ministries have their own specialized branches to deal with different aspects of water management; Public Works has the Direction Generale de l' Hydraulique (DGH) for resource mobilization and planning and ONEP for urban water supply, and Agriculture has Offices Regionaux de Mise en Valeur Agricole (ORMVA) to deal with irrigation. While there appears to be good cooperation between these two ministries, other important players, such as the Ministry of the Environment, are largely shut out of the present arrangement. Even between Public Works and Agriculture, the collaboration seems to sometimes work out more in support of institutional interests than the long range national interest. The national interest is reflected in principle in the apex water policy body; the Conseil Supérieur de l'Eau et du Climat. Unfortunately, this body meets only once a year and its secretariat is staffed by the Ministry of Public Works. In essence, this means that inadequate attention is devoted to the intersectoral issues associated with water uses other than irrigation, municipal water supply, and hydropower.

In addition to the exclusion of significant ministerial interests by the present system, the resources of an increasingly well-qualified research community are not fully utilized. For example, it is not clear that there is an integration of the concerns of the Meteorological Department for drought monitoring and forecasting with the work of either the Institute for Teledetection which shows great competence in the handling of remote sensing information, or the planning and research activities of the DGH. Similarly, university research on flood wave routing that could have been very important in predicting recent flash floods in Marrakech, was not utilized because there was no appropriate framework into which it could have been integrated. The institutional responsibility for water resources management in Morocco is uncoordinated and fractured among the various ministries.

Role of Agriculture

The major lesson to be learned in Morocco concerning water is the overwhelming role of agriculture in the use of the resource. About 90% of the total water used goes to agriculture, and the remaining 10% is split between all the other users in industry, households, and commerce. This fact has immediate implications for future water policies in Morocco. Clearly, a small percentage improvement in agricultural water use efficiency would provide large amounts of water for use by the other sectors. A 10% improvement in agricultural water use efficiency would almost double the water available to the other sectors. All the research on irrigation in Morocco, including that supported by USAID in Tadla, indicates that efficiency improvements of this magnitude could be easily attainable. These

efficiency improvements have, however, not been implemented because of the underpricing of agricultural water.

Even if these efficiency gains were not available, a small reallocation from the agricultural sector would provide all the water needed by the other sectors. However, the future would look quite different depending upon how current plans for expanding irrigation from 650,000 ha. in 1990 to more than 1,300,000 ha. in 2020 are modified by rational water sector planning. Complete understanding of the future of water resources in Morocco awaits the creation of a truly interdisciplinary planning institution which can analyze and weigh all the disparate aspects of water use in the overall national economy.

4. Future Steps

Three Components of a Strategic Management Plan

Any plan to deal with drought management in the context of overall water resources management must have at least three major components: Supply Augmentation, Demand Management, and Institutional Development.

Supply Augmentation

Supply augmentation is the most conventional and well understood of the three components. It deals with the technical methods to ensure a greater supply of water to users. Building storage dams, canals, pipelines, well fields, recycling and reuse plants, cloud seeding, and desalination are among the approaches taken. Supply augmentation is typically the domain of the engineer. In Morocco all of these approaches have been explored and many implemented. Indeed, the huge program of dam construction started during the 1960s and continuing to this day is a striking example of the supply augmentation approach. However, in all countries, including Morocco, over time the availability of inexpensive supply augmentation projects becomes smaller and smaller as the best options are built first. It finally becomes apparent that the demand for water cannot be satisfied by continuing to build more and more expensive surface water facilities. Some other approach is needed. This typically leads to the examination of groundwater storage options and to the implementation of demand management.

Demand Management

Demand management is the policy component most preferred by economists and other social scientists. In essence, they claim that, as the cost of supply augmentation increases, the most efficient approach to meeting water demands is to bring demand into balance with supply rather than increasing supply to meet the demand. In its strictest interpretation, demand management requires a progressive price policy. This is to say that, by increasing prices the demand can always be made to match the supply. Broader interpretations allow for government regulation and conservation as so-called "demand management" strategies.

In both cases, the demand will be equilibrated with supply by a mixture of government restriction and pricing, and by active conservation by the consumer. Not only do price increases reduce the demand for water, they also expand the supply, since sources that were too expensive to develop in the past now become economically feasible due to the increased price of water. An increased price also makes the conservation options much more economically attractive. Pricing policy can, therefore, lead to the introduction of new technologies and practices on both the supply and the demand sides of the water availability equation.

Institutional Development

In order to plan and manage water resources a set of appropriate institutions must be in place; these are the indispensable third component of water resource management. There is no one set of best institutional arrangements; there are many options reflecting the structure of different societies and the technologies for water control. Important functions of water institutions are research, planning, management, public education, and implementation. In many countries all of these functions are located in one institution, an arrangement which has both advantages and disadvantages. The major advantages are the consolidation of technical expertise, information, and data within one body. The major disadvantages are the danger that the specific institution will ultimately mistake its own institutional goals for national goals, and it may also limit the disciplinary perspectives applied to the problem. Water management is usually considered a technical issue and is, hence, usually left to engineers to implement. Investments in water control and delivery infrastructure also often end up consuming a large percentage of the government's investment budget. This ultimately leads to large, well-funded, elitist engineering organizations, with their own agendas for development. One can observe in the U.S. the influence of the U.S. Army's Corps of Engineers and the Department of Interior's Bureau of Reclamation over national water policy. Many other countries have assigned similar powers to centralized agencies with similar results. Under these types of institutional arrangements environmental considerations are often ignored in the drive to develop water resources for economic purposes.

Morocco is in great need of improved institutions to deal with water issues and the following section describes how such an institutional framework could be developed.

The Conseil Supérieur de l'Eau et du Climat

The new Loi d'Eau assigns a major role to the Conseil in overseeing all water developments. Since the detailed regulations associated with the Loi d'Eau have still to be worked out, an excellent opportunity presents itself to the Moroccan Government. The structure and responsibility of the Conseil can be designed so that all the policy-setting decisions are located there. This means that, in order to maintain its independence and neutrality, the Conseil must have its own secretariat, rather than staff on deputation from the ministries. It should be invested with both research and planning responsibilities, and it should report directly to the Prime Minister's Office, without passing through one of the

ministries. One model for this could be the now defunct U.S. Water Resources Council. The Council was abolished in 1983 precisely because it was becoming an effective advocate for integrated national water policy and found itself in conflict with powerful political forces which exploited inter-ministerial rivalries. Since 1983 U.S. water policies have become *ad hoc*, and fluctuate wildly from administration to administration. By providing the appropriate structure and political support to the Conseil now, Morocco could avoid these distortions later.

The members of the Conseil should be the ministers of Agriculture, Public Works, Public Health, Environment, Interior, Energy, Forestry, and Finance. The chairmanship should rotate among the members with the chairman reporting to the Prime Minister. The Conseil should be provided with a small technically trained secretariat with competence in water resources planning. The disciplines represented should include hydraulics, hydrology, economics, ecology, environmental science, agricultural economics, law, and political science. An Executive Director, preferably recruited from outside government, should be appointed to oversee the work of the Conseil secretariat. Such a structure would ensure a reasonable amount of independence for the staff while assuring that the work would be meaningful and of use to the Prime Minister's Office, the Cabinet Royal, and to the individual ministries. The Conseil as envisaged, still entirely within the hands of the government, would be strengthened by allowing non-government membership with observer status. It is important, however, to ensure that the Conseil be viewed as the apex government body on water resources and not as an "enlightened debating society." The important role of non-governmental input is reserved for the Water Basin Agencies described below and shown schematically in Figure 2.

In Figure 2, the Conseil is placed directly under the Prime Minister's Office. The Conseil would have two major tasks: to set national policy and to oversee the formulation and implementation of the National Water Plan called for in the new water law. It would be equipped with an Executive Director and a permanent secretariat, which together would carry out policy analysis and formulation, help formulate the National Water Plan in collaboration with a water think tank described below under the name Autonomous Water Planning Group (AWPG), and devise water pricing and tariff structures to be used by the water sector. The secretariat would then be the interface between the Conseil and the Agences de Bassin called for in the new water law, and the various specialized arms of the ministries which would be in charge of implementing the policies and the National Water Plan. Figure 2 is meant to be schematic and not the final word on actual agency configurations. For example, it shows a "Water Quality Branch", a proposed component of the Environment Ministry which apparently does not yet exist. An important feature of Figure 2 is the role of the AWPG.

A "Think Tank" or Autonomous Water Planning Group

Given the current disarray and lack of coordination among the various governmental and non-governmental actors in the field of water, consideration should be given to setting up an Autonomous Water Planning Group (AWPG) with a limited life span, perhaps of five

years. Such a group, which should be considered external to the government, but provided with government funding and guaranteed access to governmental data, would be unfettered by the usual restrictions on government officers that tend to limit the speculation about the solution to water problems. The AWPG would be charged to produce, in collaboration with the Secretariat of the Conseil, a strategic plan for all water resources in Morocco within two years, and a detailed implementation schedule for the plan within the 5-year life of the institution. This would be the National Water Plan called for in the new water law. The AWPG should be staffed by academics, researchers, government officers on deputation, and representatives of all the major water users in the country. Their strategic plan, which should embrace each of the three components, supply augmentation, demand management, and institutional development, should be subjected to the widest public scrutiny through public hearings, focus groups, television and print media, and parliamentary debate. With the acceptance of the National Water Plan by the Conseil, the life of the AWPG would end. By that time the lessons and the culture of interdisciplinary work will have been absorbed into the fabric of the Secretariat and also of the ministries.

Food Security, Food Self Sufficiency, and Agricultural Policy

An important underpinning of a nation's water allocation to agriculture is the country's attitude toward food security and food self sufficiency. A commitment to either side of this debate will have major implications for water use in agriculture, and hence, for the rest of the economy. This issue cannot, however, be addressed in the absence of a general study of future agricultural policy. This is a major concern in Morocco given the developments in the European agricultural policies and the slow implementation of GATT. Such critical studies should be organized by the Ministry of Agriculture, but with major input from the AWPG.

Tactical Planning Actions

Drought Insurance

There is a need for a detailed study of drought insurance for agriculture and rural populations in Morocco. This study should consider the range of possibilities from conventional financial crop insurance schemes to the selling of "drought futures" on international financial markets, or crop trading among various Arab or other countries. This could be one of the studies assigned to the AWPG or to the Conseil's secretariat.

Pricing and Tariff Setting

There is a great need in Morocco for guidance on the setting of appropriate water tariffs in all sectors of water use. Such guidance would have to be based upon first-rate econometric research and also on extensive outreach to convince the government agencies implementing the policies and the users who will have to pay the new prices of the practical wisdom of the policies. All too often, economists divorced from the practical realities of

actual agency procedure specify tariff structures that are unimplementable by the agencies concerned. This can be avoided by giving the responsibility for these studies to the Conseil secretariat.

Experiment with the Drought Preparedness Support System

Based upon a multi-million dollar study of drought management in the United States done for the U.S. Congress, the U.S. Army Corps of Engineers devised a computer-aided support system for drought preparedness studies (DPS). This system is based upon a series of workshops held jointly between central, regional, and local government officials and representatives of local water users groups. The goal is to achieve collaborative planning of all water resources in a region subject to drought before the drought situation occurs. The philosophy behind the system is that, if a shared vision can be reached and specific contingency plans can be worked out in advance of a drought, then there is a much better chance of being able to enforce rational actions once a drought has begun. The first workshop in the series is basically to get all the stakeholders to agree to a definition of what the drought problem is in that region. For the second workshop, computer experts are brought in to help the participants make a simplified model of the resource endowment of the region and to agree upon the current water use pattern. The third workshop is devoted to having the participants, who working from their agreed-upon definition of the problem from Workshop 1 and using the models developed in Workshop 2, work out consensus solutions. Several such studies/workshop series have been done in the U.S., and the Corps of Engineers claim that they are remarkably successful in creating effective local drought preparedness plans which have a high degree of acceptance among the stakeholders. The Agadir region would be a promising place to try out such an approach in Morocco. Already the central and local governments have established good rapport with the local water users through the Comités de Vigilance. The water problem in Agadir is a particularly difficult one which will require the cooperation of all the players if it is to be resolved.

Technology Options

Active Groundwater Storage

Groundwater storage is already widely used in Morocco to stabilize inter-year and inter-seasonal fluctuations in precipitation and streamflow and needs to be extended. Much of the current groundwater storage is by natural recharge of the aquifers from rainfall and from river bed seepage, which together can be called "passive" groundwater storage. With passive storage, however, large amounts of water run off to the ocean during flood periods. Interventions in the hydrologic cycle can be made to achieve active storage of groundwater. To date, however, the technologies used, such as the building of surface impoundments to serve as recharge basins and tubewells for the injection of water into storage aquifers, are expensive and limited in scope. There is a need to explore much cheaper technologies which have less permanent structures but rely on the annual, or seasonal, creation of low earthen

dams in the streambeds and the use of bulldozers to scrape the beds of the non-perennial rivers to maintain high infiltration rates into the ground. These technologies are in use in Southern California which has many hydrological similarities to parts of Morocco. Care should be taken when carrying out these experiments to consider serious ecological consequences to stream biota and fisheries.

Inter-Basin Transfers

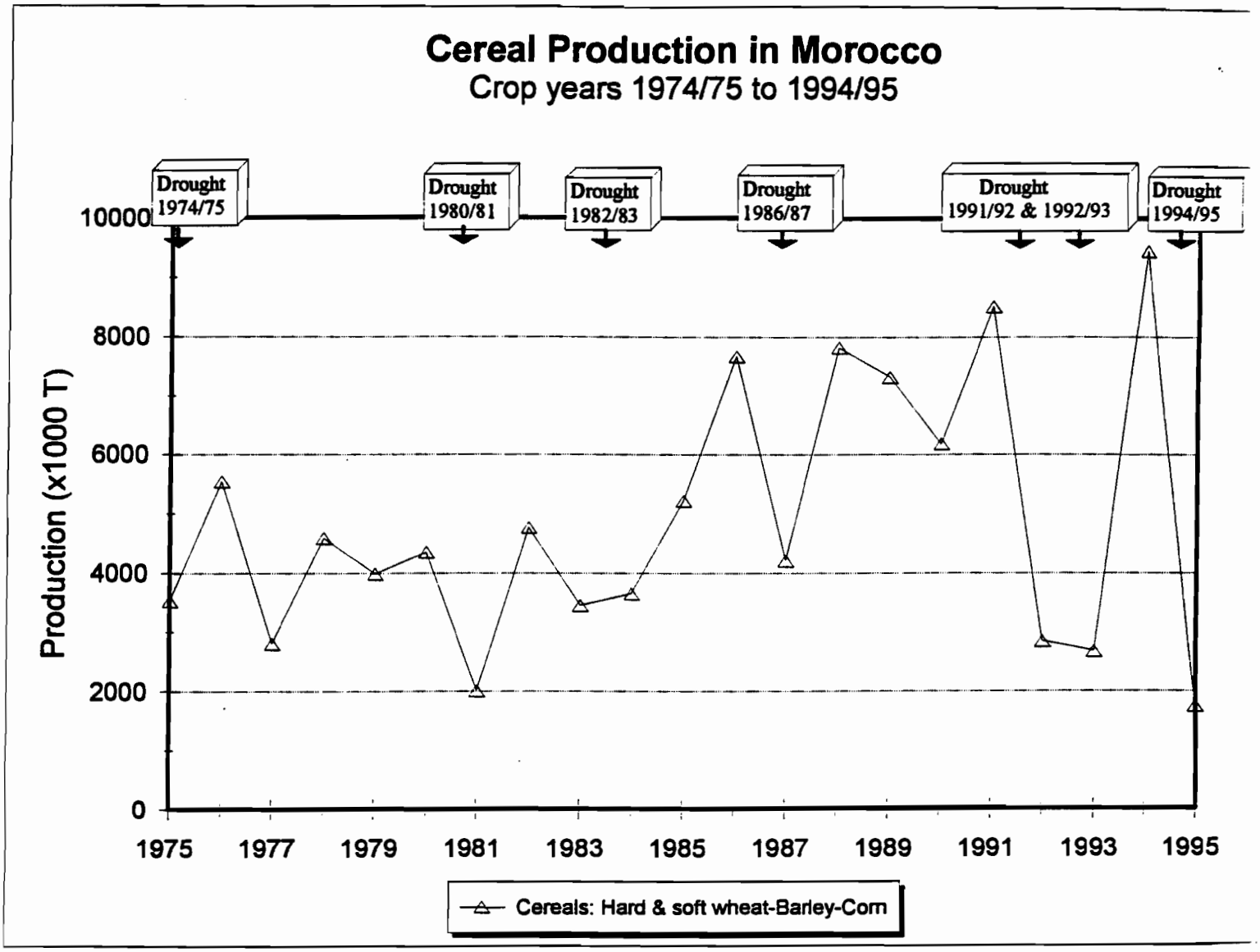
One good way of reducing the uncertainty in water supply systems is to build as many inter-ties as economically feasible. The reason that California was able to withstand a catastrophic 6-year drought was that it was almost fully interlinked by canal and pipe systems, making it relatively easy to transfer water between distant users. Studies should be made of the feasibility of intensifying the present limited interconnectedness of the Moroccan water system. For example, it might have been more efficient to build a small diameter pipeline from the Tetouan irrigation project to Tangier for use only in extreme drought situations like this year's than the actual option chosen.

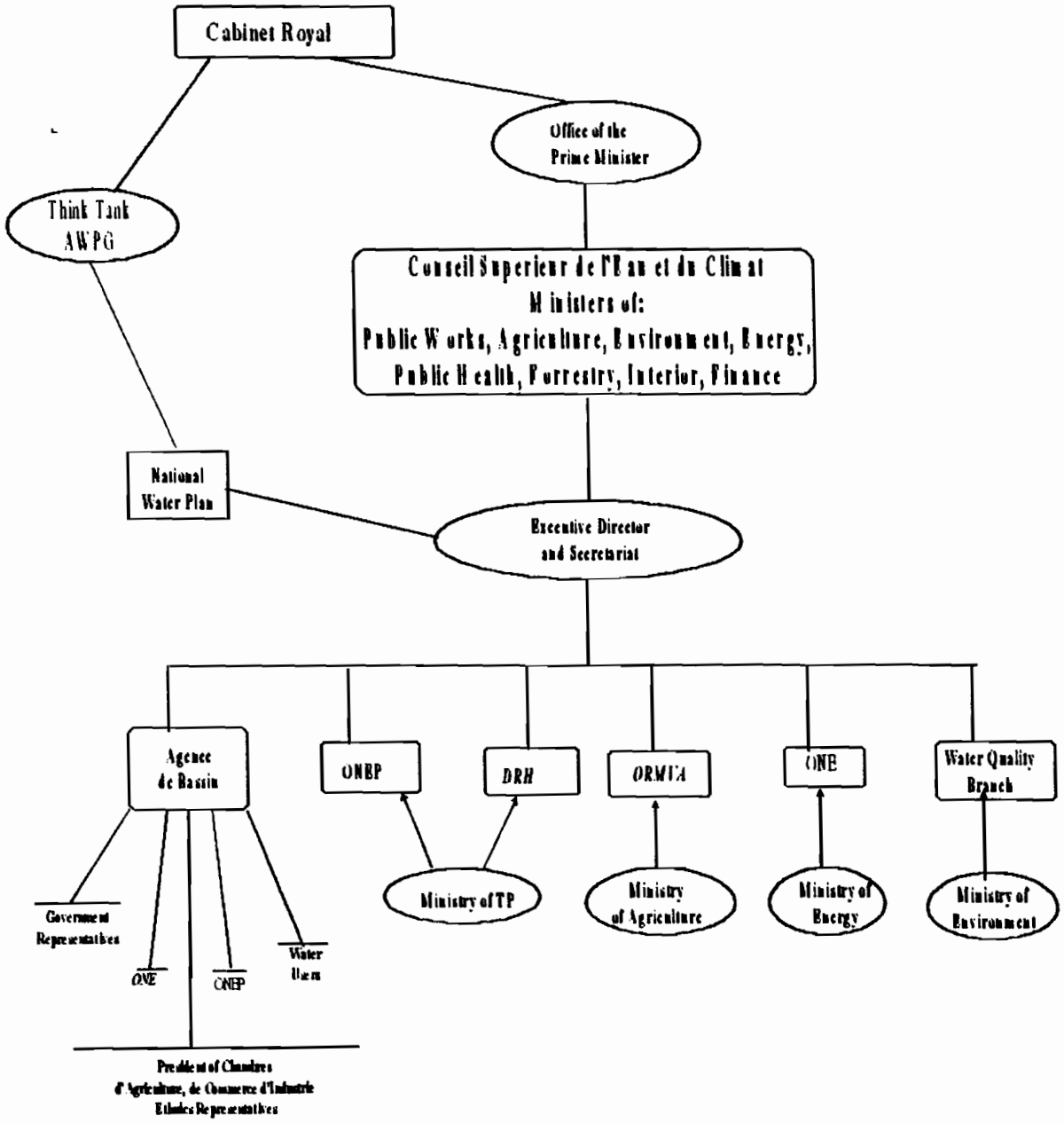
Other Technologies and Research

There are several other technological options already under limited implementation and consideration in Morocco which are very promising for drought management and should be further pursued. These include the research on alternative crops and cropping calendars underway at INRA in Settat, wastewater re-use research at the Institut Agronomique in Agadir, the reduction of unaccounted-for-losses in the urban distribution systems, and the promotion of conservation by all users in both the rural and urban areas. Technology is not only hardware, but it is the software such as research, program development, and training in all of these areas and is a good path to follow.

A research issue which has potentially fundamental consequences for the hydrological future of Morocco is that posed by global warming and climate change. A small shift in global weather patterns could be very beneficial or catastrophic for Morocco. Unfortunately, the research is still not refined enough to be able to predict regional consequences at the scale of Morocco. This issue is, however, well worth the investments made by the Métérologie Nationale and the Centre Royal de Télédétection Spatial in staff and equipment to monitor research developments in Europe and North America and carry out their own research. These efforts are important and should be vigorously pursued.

Figure 1


Cereal Production in Morocco
Crop years 1974/75 to 1994/95
Drought 1974/75
Drought 1980/81
Drought 1982/83
Drought 1986/87
Drought 1991/92 & 1992/93
Drought 1994/95
Production (x1000 T)
10000
8000
6000
4000
2000
0
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
Cereals: Hard & soft wheat-Barley-Corn



AGENCY TASKS

Policy

Policy Analysis & Formulation
Planning
Water Pricing & Tariffs

Implementation

Figure 2

ANNEX
List of Meetings

Friday September 8. Arrive in Casablanca

Meeting with USAID, Rabat.
Mike Farbman
Alan Hurdus
M'Hamed Hanafi

Saturday 9. Trip to Settat and Marrakech.

Dr. Mohammed El Mourid
Head of the Regional Center of the Agronomic Research
Institute National de la Recherche Agronomique (INRA)

Sunday 10. Visit Agadir

Dr Hafidi
Institut Agronomique et Vétérinaire Hassan II
Dr Redouane Choukr-Allah
Institut Agronomique et Vétérinaire Hassan II
Brahim Azrou
Chief of Water Management and Planification
Direction Régionale de l'Hydraulique du Souss

Monday 11. Rabat

9:00 am	Mr Jellali Directeur Général Direction Générale de l'Hydraulique
11:00 am	Marc Charles Ginsberg US Ambassador
12:30 pm	Lunch with Mr Jellali and Mr Ahmed Merzouk, Direction Générale de l'Hydraulique
3:30 pm	Dr Mostapha Terrab Charge de Mission (Science and Technology) Cabinet Royal

Tuesday 12.

8:30 am	Dr Driss Ouazzar Ecole Mohammedia des Ingénieurs
10:30 am	Ait El Kadi Directeur de l'administration Du Génie Rural Ministry of Agriculture
12:30 pm	Paul Preckel Purdue University Consultant to the Ministry of Agriculture
2:30 pm	Travel to Tangier

Wednesday 13. Tangier

Ahmed Fouad Belkeziz
Directeur Provincial des Travaux Publics de Tanger
Ministry of Public Works
Mohammed Ahmamad
Directeur Provincial de Tanger
ONEP

Thursday 14. Rabat

9:00 am	Driss Khalil Minister of Higher Education and Research with the US Ambassador & USAID (Alan Hurdus & Mohammed Hanafi)
10:30 am	Ahmed Bensari Directeur Direction de la Métérologie Nationale
3:00 pm	Abou Ayoub Minister of Agriculture
4:30 pm	Noudine Benomar Alami Minister of the Environment Mme. Layachi Directeur, Direction del'Environnement Ministry of Environment

Friday 15.

7:00 am	Wallace Tyner Purdue University Consultant to the Ministry of Agriculture
8:30 am	Mouslim Kabbaj Directeur du Centre Royal de Télédétection Spatial

10:00 am	Ahmed Hajji Chief Engineer Direction de la Planification ONEP
11:30 am	Press Conference
2:00 pm	Briefing USAID staff
4:00 pm	Andre Azoulai Chief Advisor Cabinet Royal
6:30 pm	Reception at Hurdus residence

Saturday 16.

12:00 noon	USAID debriefing Mike Farbman James Hradrsky Alan Hurdus

Sunday 17. Depart from Casablanca