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Water Resource Perspectives with Regard to USAID/DAP  
Visit to Senegal and Mali

October 21 to November 9, 1974

by  
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The following comments and observations are made as a result of the writer's participation as a member of an AID sponsored mission organized to consider medium and long term assistance programs for the Sahel region of Africa. Approximately 10 days each were spent in the countries of Senegal and Mali, ending with a charter flight following the course of the Niger River through Mali and into Niamey, Niger. During this brief time, many government officials were visited to get an appreciation of national plans and objectives and to determine what role water resources development was expected to play in achieving those goals. Although time was limited and visits were brief, the writer attempted to glean as much information as possible about the location and characteristics of water supplies as well as the nature and extent of current uses and potential or planned utilization.

Practically all government contacts (regardless of branch or level) emphasized the need and desire to increase food production. All long term priorities in planning seemed to give high priority to the agricultural sector and to achievement of self-sufficiency in food production. This automatically leads to considerable emphasis on water resources development because of the critical relationship of water to crop and

livestock production. Governments know that unless they master their water they will have difficulty in increasing, diversifying, and stabilizing food production, both for internal and external markets. They believe that a healthy agricultural sector will be a requisite to catalyzing or underpinning other important industrial and commercial sectors.

The governments realize that big development schemes involving large dams need to be considered if rather massive and permanent increases in productive potential are to come about. Not only is regulation and storage essential to maximum utilization of water in food production, but there is a tremendous need to increase the energy base and the hydro-electric potential offers some hope in this regard. However, much can be done in terms of water management before the large dams and the regulation of principal rivers is accomplished and can be achieved in ways that are not counter-productive to patterns that emerge optimal under full development.

It is difficult to imagine any single intervention in the Sahelian region that would promise a more major and sustained impact on food production (including the considerations of nutritional balance) than irrigation could stimulate. With irrigation, farmers can plant seed varieties and populations for maximum yield; manage and fertilize accordingly. Deficiencies in natural rainfall can be made up by supplemental irrigation, thus minimizing periodic crop failures or near failures. Year round production, made possible through irrigation,

would greatly increase production per unit of land by multiple cropping. If food production is to stay ahead of expected population increases, and in fact develop a surplus for export markets, there will have to be substantial development of water resources and expansion of irrigation. Much of the Sahel region at present is essentially a one-crop per year (or rainy season) agriculture. Along the major water courses considerable flood-recession agriculture is being expanded. Additional lands and improved production is being realized in many areas along major rivers through the construction of physical works to better control the depth and extent of flooding onto farm lands during the period of high runoff. Pumping from the river for short periods before and after the peak flows offers opportunity to extend the growing period beyond the rainfall season somewhat. The ultimate in effective utilization of water is when surface or underground storage can be utilized so that water could be made available on a year round basis. Climate is certainly conducive to year round agriculture in the Sahel. There is very substantial opportunity for expansion of irrigation in many parts of Senegal and Mali. Some of these which appear appropriate for consideration within the policies and programs of USAID are discussed in later sections.

While increased agricultural production is a high priority goal and although the physical mix of resources can be managed to meet that objective, the realization will be highly dependent on governmental policies affecting the incentives to produce. Technical assistance,

management inputs, credit, rural information and development services, and all other aids are ineffective unless the producer sees a payoff from their incorporation. Pricing policies for agricultural commodities could very well stifle the payoff from technical assistance. Although this is a subject outside the scope of this report, the suggestions and comments included herein must be ultimately considered in that context before commitments are made.

One other general comment regarding comprehensive and integrated national development may be in order. If central governments had all of the capital needed to develop master plans and implement them, the principles of multi-objective basinwide development could be successfully applied. The fact is that Sahelian countries have practically no development capital. Consequently their programs are highly donor oriented. A multiplicity of donors, each with their own policy guidelines and preferences, exercise their own prerogatives about programs they will support and at what funding levels. In the face of this reality, governments have little alternative but to compromise classical integrated approaches and proceed with a pattern of development which may ultimately prove to be less than optimal. Nevertheless, the countries are starting at such a low development base, and the urgency to get on with meeting some of the basic needs of their people is so great that programs oriented toward meeting those needs (although seemingly piecemeal) cannot be greatly criticized. Any well-conceived master plan having all its elements properly prioritized and programmed in

optimal sequence can be quickly upset if donor financing fails to materialize or projects to support are selective in some single-minded fashion. Actually, the governments seem to have their priorities pretty well thought out and are doing reasonably well in getting donor support allocated in ways and for purposes which will fit into long term development schemes. This is not to say that assistance and encouragement should not be given toward the achievement of better coordination among programs and more comprehensiveness in approaches to planning and development. It is just to point out that there are some real barriers to the application of these concepts. Multi-donor cooperation holds the key to improvement of greater effectiveness in comprehensive river basin planning and development. Some consideration to achieving better cooperation and communication among donors may be useful. If master plans were available and donor groups could merely find their place by supporting components according to prescribed times and levels it would be ideal.

There are two basic approaches to achieving desired increases in food production. Factors of capital available to host governments and donor countries, time constraints, available technical and managerial experience, etc., dictate which might be appropriate. Perhaps governments would benefit from some of both.

The Bud-Senegal concept is conducive to maximizing early production, but with limited opportunity for technology transfer and social impact. If certain guarantees are provided, private capital can be

encouraged to introduce large scale projects that are highly mechanized and use the very latest in science and technology. This kind of development might lead to more rapid reduction of capital outlay for food imports. Such enterprises would have to be permitted to organize factors of production and marketing in their own way (largely) with a minimum of government restrictions.

The other approach, which is much more attractive in the long run, is to build on traditional patterns of agriculture and upgrade in a more step-by-step manner. Under this approach, training of large numbers of people becomes important. This is a slower process but in the end could result in much greater social progress and in a non-disruptive way. Where populations are expanding and people are starving, a mixture of these development philosophies lead to the best overall result.

It would seem most appropriate for AID to give much greater focus to assistance in the development of water resources and irrigation. Certainly, the U.S. is unexcelled in river basin development and irrigation principles and practices. Particularly important would be the U.S. know-how regarding on-farm water management which in the end determines the success or failure of an irrigated enterprise. The general concern for assisting the people most seriously hurt by the drought may have led to a heavy assistance program dealing with range and livestock problems in the more drought sensitive areas to the north. Also, in these fragile areas, there has been considerable emphasis on rainwater harvesting, runoff agriculture (water spreading, micro-

catchment farming, and desert strip or contour catchment farming), as well as well drilling, etc. These measures to conserve and better utilize water occurring as runoff from rainfall are important in stabilizing the subsistence agriculture and providing additional insurance against the effect of drought. However, the region which provides both the better shock absorber to periods of precipitation insufficiency as well as holding the key to producing food for export lies further south in the regions where rainfall deficiencies are far less frequent and there are perennial streams. Here the magnitude of the manageable water supply is much greater. Hence, the opportunity for multiple cropping throughout the year is greater. Consequently, the productive capacity per unit of investment may be substantially higher. However, one should keep in mind that the advantage of greater productivity might be off-set by the added transportation costs of moving the excess production to regions of need.



### Educational Needs in Water Management

If water resources development is to proceed efficiently and effectively and if the fruits of irrigation are to be realized in Senegal and Mali (and probably other Sahelian countries), there is a tremendous educational need that must be met. While the top people in governmental agencies are generally well trained for their positions, their ranks are thin and there seems to be a big void in middle level technicians. Mostly, personnel in water agencies are young and short on experience. At the present time there is practically no knowledge or experience with irrigation per se (except for flood recession adaptations). There is hardly anyone with training or experience in irrigated agriculture as practiced in the western United States and many other arid and semi-arid areas of the world. A way must be found to introduce this technology if food production potentials are to be realized. In Senegal, many French technicians are still employed in key positions within the mission agencies. In Mali this is much less common. In either case, however, there is a notable lack of background in irrigation. An infusion of American know-how would be most valuable.

Government officials in both Mali and Senegal expressed a desire for technical assistance to their agency personnel in matters of water resources management, hydrologic design, irrigation, and river basin planning. Much of the work falling in these categories is now accomplished under contract with outside consulting groups or under

sponsorship of such organizations as UNDP, World Bank, etc. For example, UNDP is presently conducting a comprehensive study of a section of the Niger River between the Selengue Dam site and the Macala Dam, looking at possible use patterns resulting from the storage and regulation of the river with the construction of the Selengue Dam. The ability to conduct such studies in-house is rather limited. Special studies and investigations are commonly done by consulting firms under contract or by specialist organizations such as ORSTOM or BRGM.

There are many places and ways to consider this education infusion:

1. Technical experts could be provided to work in staff positions with those government agencies responsible for planning, development, and extension. Such technicians could work side by side with local counterparts functioning in a kind of tutorial setting. Actual problems could be addressed and the U.S. expert could actually contribute to the planning and execution of projects with his African counterparts. Facility with the French language would be necessary in this kind of arrangement. This learning by association in doing could be augmented by periodic seminars or skull sessions led by the visiting expert where concepts and principles could be presented in a more concentrated way by topic.

2. Bring specially qualified individuals to the United States for study. This, of course, would require a reading and speaking capability in the English language. Such study programs could include those

that are tailored to a specific need. They might study at a selected institution or spend time with different federal or state organizations with involvement in programs and problems that have pertinence to situations at home. For example, certain individuals involved in river basin development and management (such as OMVS) might benefit from spending time with organizations such as TVA or other more recently created river basin commissions. The Colorado River Basin has many parallels to Sahelian River Basin management where there is multiple state interest in a common water supply, and problems of water allocation and quality degradation are critical. Top echelon people would benefit from this kind of training experience and could return to encourage incorporation of certain concepts or practices in their own situations as appropriate.

The more traditional forms of training could be considered as components of a training package which brings qualified individuals to the U.S. Enrollment in regular university programs to receive in-depth training and perhaps an advanced degree in the process could be considered in special instances. Particularly, U.S. institutions would have much to offer in river basin planning methodology, water management, and irrigation principles and practices.

3. As a corollary or compliment to Item 2, the U.S. might provide individuals to instruct in some of the technical schools or universities in the Sahelian countries where they could bring the water emphasis or introduce special courses into existing programs.

4. Use of Peace Corps volunteers for disseminating information and demonstrating on-farm irrigation practices might be one of the most viable educational approaches that could be adopted. Such a program would involve special training of the PCV's before arriving at the host country. Their assignments could emphasize water management in local or individual settings. They could be advised and assisted periodically by knowledgeable people and would receive much growth experience themselves in the practical arts and practices of irrigation, well development, pumping, etc. Increased capitalization of the experience of PCV's both in terms of their own career objectives as well as in the assistance program might be brought about by a post PCV tour providing educational opportunity at an appropriate U.S. educational institution. The opportunity for carefully selected PCV's completing tours of duty to build on their experience with more formal training would provide a manpower resource well-suited to the needs of regular technical assistance programs. It would seem that the Peace Corps might offer one of the most effective and least costly ways of handling a part of the educational process and information transfer.

5. There would be an important place for bringing teams of experts to host countries or as adjuncts to the interstate training center (such as CIEH) to conduct workshops, seminars, or symposia on special topics. These might be most effective if carried to individual countries or regions where local situations could provide the basis

for the training experience. A myriad of topics could be treated effectively in this way ranging from integrated regional planning down to special topics such as on-farm water management. Kinds of training that might be appropriate would be design, operation, and maintenance of small pumping plants for surface stream and deep well applications with various prime movers, small watershed hydrology and storage ponds, water spreading, and runoff conservation.

## Specific Programs for AID Consideration

### OMVS Support

Certainly the OMVS needs to be supported as a strengthened river basin organization with authority to plan, contract, implement, and operate projects in an integrated regional framework. It appears that a UNDP has provided the major continuing technical support needed by OMVS to this point in time. A variety of studies have been conducted under contract. The Bayrard report constituted one of the most recent and comprehensive reports summarizing past work and providing a blueprint for future development. Construction of the two reservoirs which are central to the proposed development, Manantali in the upper reaches and the Diama Dam at the delta near the coast, appears to be imminent. Financing for the delta dam is reportedly secure. The Manantali Dam has been under investigation by the Red Chinese and their report was to have been completed by the end of October. President Singhor was said to be optimistic about the Chinese willingness to finance the dam construction. He was also reported to be confident that if the Chinese did not take on the project, there were other sure sources of support standing by. Much remains to be done in terms of developing more definitive plans for the various major elements included in the basin scheme, and in strengthening OMVS as a planning and management organization.

While it appears that UNDP will continue a rather high level of technical assistance to OMVS, AID may also wish to provide expertise to shore up particular areas. AID may choose to support certain special studies which are critical to the overall planning and decision-making process. For example, the water quality dimension of the Senegal River development does not appear to have been given sufficient attention to this point in time. AID could provide expertise to develop a water quality management plan. This may require the establishment of additional water quality monitoring stations and perhaps the locating, staffing, and equipping of a water quality analysis laboratory. The physical, chemical, and biological water quality background could be incorporated with other hydraulic and hydrologic information to permit the development of a predictive model which could be used to assess the impacts on the aquatic environment of the river system and associated project lands resulting from particular development configurations. The United States has a good deal of experience and expertise in hydro-quality modeling and assessment of environmental impacts. Such a predictive tool would be valuable for assessing the consequences of various patterns of water use. AID might profitably support this kind of modeling activity for the Senegal River Basin. The development of such models should be done in close collaboration with OMVS technicians so that they will be fully aware of limitations, assumptions, and the applications of such a model. Selected individuals might be supported for special training in the development and use of models in river basin planning at U.S. locations.

There are a number of preinvestment studies completed or being completed for various perimeter developments along the Senegal River. Each country is subsequently making contacts with donors on a unilateral basis to initiate these. Countries welcome financial support and technical assistance in planning and designing the irrigation developments as well as for the actual construction and placing in operation these projects. To the extent that such development seems to fit an overall basin plan and does not foster an imbalance in development between countries that could lead to disharmony, AID may wish to choose some of these perimeter developments to support.

UNDP plans to make contracts with consulting firms to provide various kinds of technical help to work on the overall OMVS program. They have already obtained prequalification information from several firms (notably absent were any American firms). Project documents will be provided to perspective firms to give an understanding of the kind of expertise needed. They feel they would need about five people for two to three years along with many short-term consultants. These people would work continually with OMVS to advise and counsel on priorities, to examine plans as they are developed, and to generally control the entire implementation program. AID may wish to contribute to this kind of effort also.

#### Water Allocation Considerations

To this point in time Senegal, Mali, and Mauritania are unified in support of a plan for Senegal River development which includes the



Manantali and Diama Dams for river regulation and storage with power generation, irrigation, and navigation features important in the general scheme. There has been no allocation of water as between riparian countries. While agreement has been reached about the general basis of common development, the question of individual country entitlement or allocation has not been seriously negotiated. One OMVS official stated that while they have not agreed to any allocation formula as yet, the allocation question would be considered as each new phase of development is initiated. In other words, the present plan of OMVS seems to be to negotiate and conciliate the partitioning of water and determine its availability at each stage of development. However, there is considerable activity in planning and development of individual perimeters along the Senegal River on an individual country basis. Donors are being invited to provide the financial support to move forward with the development. Since governments all depend on donor financing and are now looking for any donor to support these individual parcels, the extent and sequence of development will be determined by what donors elect to do. The way things now stand if one of the OMVS countries could obtain financing, there would be nothing to prohibit that country from making whatever diversions and depletions it wished without regard to limits or consideration of other countries.

OMVS, itself, is sending out requests for help in random fashion inviting donor groups to assist with various components of the Senegal

River development. Bilateral arrangements will be the rule and it is unclear how these would be coordinated by or with the OMVS Secretariat.

Under these circumstances, it would appear that it is only a matter of time until allocation problems are encountered. There was some comment that already Mauritania is complaining about Senegal pre-empting too much water for use in its planned developments. If this unilateral development continues prior to and concurrent with the dam construction without regard to any overall plan and programmed pattern of development, there will be steadily increasing potential for disagreement and conflict about "who's getting their share" of the water.

It may be well to begin facing up to the question of a river compact right now. U.S. experience could be quite valuable in working out an acceptable agreement about entitlements and conditions of use. Once allocations are agreed upon by the riparian countries, unilateral developments can proceed according to national plans and available donor support up to the limit of each country's entitlement. Under the terms of the compact each country would be assured that water would be available for its intended uses when they come on line. Allowable stream depletion should be the primary basis for such allocation, but with proper consideration for water quality degradation and the necessity to take water quality into account in establishing "equivalents" in terms of quantity allocation.

Any allocation scheme would also have to consider the inter-connection of the groundwater basins to the river itself. There have

been some studies made regarding the groundwater/river interconnections and any depletions arising from the groundwater part of the river basin system would have to be taken into account.

#### Irrigation and Drainage Evaluation

While much emphasis has been given to this point in time to the design and construction of major works, such as dams and reservoirs, the ultimate success of the Senegal River Basin development in so far as agriculture is concerned is the management of the water on individual farms. Much work is already underway in the design of the hydraulic works to convey and distribute water to several large perimeters that have been identified along the river. Pilot projects within these major development perimeters are being initiated as rapidly as financing can be secured. However, some of the important considerations connected with on-farm management of irrigation water are not visible. Similarly, there is little evidence to indicate that factors of drainage, which must be considered concurrently with irrigation, have been adequately assessed. AID might provide a small team of irrigation experts to review plans in progress and evaluate the physical, economic, and social factors that would be critical to the successful implementation and sustenance of these irrigation perimeters. There have been many comments pro and con about specific methods of irrigation best suited to the developments along the Senegal River. An on-site investigation by some irrigation and drainage experts could do much to dispel the uncertainties related to irrigation design and several important management aspects.

### Energy Analysis

The development of the Senegal River Basin will entail hydro-electric energy production at the Manantali Dam and will generate energy requirements for many of the enterprises contemplated. Consequently, it would be well to have a comprehensive energy analysis and evaluation to relate the energy needs, their location, magnitude, and seasonal variation with potential sources of supply and the problems of transportation and distribution inherent in the utilization of supplies to meet projected needs. Most of the irrigation development along the river will require energy for pumping from the river to lands adjacent. For the ultimate acreage of development being talked about, tremendous amounts of energy would be required. Add to this the associated energy requirements for agricultural processing industries, transportation, villages and other mining and mineral industries, and it becomes evident that careful consideration needs to be given to the general subject of energy uses and availability. AID may wish to initiate some comprehensive analyses about the energy question in the Senegal River Basin as an OMVS background study.

### Data Collection and Processing

A good data base of hydrologic and climatologic data is essential to planning, design, and management of water resources. It appears that there has been a deterioration in quality and quantity of records since independence. Other donor countries and organizations have analyzed the data needs and given some support to regular and special data

collection programs. Included in consideration of streamflow data should be a skeleton network of water quality measuring stations. Information on water quality is extremely limited and will become an important factor in the common use of international streams. AID may wish to support an activity of upgrading hydrologic and climatologic data collection networks. Governments do not presently have the funding or expertise to operate and maintain these networks. Training of local technicians could be an integral part of such an assistance program with the idea that networks would ultimately be operated by their own personnel.

AID might also support the establishment of a central hydrologic-climatologic data bank. A central repository would aid all donor organizations as well as the Sahelian country governments. Many international, national, and private donor organizations now make the same rounds to ascertain the whereabouts and kinds of water and climate data and information. Such a data bank, housing copies of all records and reports relating to water and climate of the Sahelian countries might be operated in conjunction with regional centers such as CIEH in Ouagadougou.

### The Casamance Region

The Casamance Region of Senegal seems to afford substantial potential for increased production through adoption of irrigation and improved water management practices. Research results on varieties of rice are impressive and suggest that upland rice with shorter growing season might be grown in areas where the rain season is normally considered a bit short for growing the common varieties of paddy rice. These

areas, now considered marginal, could be extended further with the addition of irrigation to supplement rainfall deficiencies. In fact, not only would irrigation provide a way of making up the rainfall deficit, but could extend the growing season to year around and thus greatly expand productivity.

Transportation would have to be considered concurrently with increased production but the opportunity and potential for greatly increased food production through water management appears substantial in the Casamance Region. Certainly, the Casamance and the Gambia River Basins should be studied and hydrologic inventories prepared. Opportunity for diversified production, including fruits and vegetables, appear to be unlimited.

The major water development focus of the Senegalese government seems to be on the Senegal River. While this is understandable and desirable, there are many factors which would suggest that the Casamance Region might offer the greatest productive return per unit of investment of any region in Senegal. We were unable to learn of any plans for major irrigation development in the Casamance Region other than the rice projects which, again, are largely flood recession in character. No one we visited knew of any river basin investigations being undertaken to identify potential power, irrigation, or navigation projects. It was learned that Bud-Senegal had obtained land in the region and was making plans for another intensified agricultural enterprise somewhat in the pattern of the one near Dakar.

## The Peanut Basin - Senegal

The so-called Peanut Basin to the east and south of Dakar is one of the most important agricultural regions of Senegal. The Senegalese are emphasizing "intensified farming" in this area and are providing substantial extension services to assist farmers in increasing production. Mixed farming and the utilization of animal traction is being promoted. Demonstration farms and model farmers are being used to demonstrate new tillage practices, crop varieties, fertilizer usage, grain storage, etc.

There are some physical characteristics along with the availability of a rather well-staffed and organized extension service which may make this region a favorable one for introducing irrigated agriculture. The likely source of water supply would be from underground aquifers. It is reported that this area is underlain by one aquifer located 20 to 40 meters from the ground surface with another deep aquifer 250 to 500 meters below ground surface but also having a static level in the neighborhood of 40 meters. With AID support, irrigation might be initiated at the Special Activities Center and Demonstration Farm near Mbodiene. This would be a good location to demonstrate multiple cropping and irrigation techniques and practices. It is anticipated that a good vegetable market will develop in this region as the tourist facilities along the coast are constructed and put into operation. Using the organizational structure of SODEVA, model farmers could be selected for participation in irrigation farming. Although the full extent and

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characteristics of the underground water may not be fully known, some well activity could be implemented with little risk of making a mistake. It was suggested that some studies on groundwater in this region were being conducted by BRGM at the request of the Senegalese government. Any information developed to this point in time could be evaluated before initiating any projects. However, the contemplated wells would only serve one to four farmers and a certain amount of this kind of development and demonstration could be encouraged as more complete understanding of the groundwater resource is being obtained.

The combination of irrigation practices and year 'round cropping, coupled with the integrated livestock farming, should provide some rather dramatic increases in productivity for farms in this region. Experimental results at the Bambey Experiment Station shows that yields of tomatoes up to 109 tons per hectare are possible. Experience at that station indicates that a well can be provided at a cost of \$1200 to \$2000 and would normally produce somewhere between 200 and 800 gallons per minute which could serve from 15 to 60 hectares. The elements of location, availability of water, adequate extension structure and the availability of good farmers would make this a good location for the introduction of irrigated farming.

The area between Thies and St. Louis and between the highway to the north and the coast is another region which is said to be rather productive. It was reported that there were a number of wells drilled in this region under AID financing a few years ago, but the Senegalese govern-



ment did not have the resources to equip these wells with pumps so they were never put into operation. If this is true, there should be locations which could be exploited rather easily and irrigation farming demonstrated in this region also. Again, working with SODEVA, AID might supply the expertise needed to advise on well drilling, pump selection, pumping, irrigation system design, irrigation practice, etc. In other words, the expertise to assist and train in matters of water management and irrigation could be attached or incorporated into the existing organizational pattern of SODEVA. The objective would be to diffuse this knowledge about irrigation and water management through the SODEVA organization in their own cascade system where each level is responsible for training the next level down.

## Potentials in Mali

Mali has extensive areas of cultivatable land and occupies a most favored location within the Niger River basin. Mali has great opportunity for expanding rice cultivation in the region of the Niger Delta and along its major rivers. The use of dikes with regulating gates, land leveling, and better conveyance and distribution systems makes possible the utilization of improved management practices and expanded and improved production. There is still much opportunity for increasing rice production by using this kind of management mechanism. Yet diversions to provide water for such operations can only be made when the river flows are sufficiently high to permit direct diversions. However, without storage to reduce flood peaks and augment the dry season flows, diversions to these developed areas cannot be sustained throughout the year. In some cases, pumping can be employed to continue to supply water but even this cannot be accomplished year round. To realize the long term development potentials will require storage and river regulation. The Selengue Dam would provide a substantial degree of storage and regulation which could then foster substantial enlargements or increases in productivity. With irrigation a great variety of crops can be grown including vegetables of all kinds, dates, tea, citrus, cotton, rice, cereals, peanuts, etc. Investments in some of the works presently being constructed for rice production is not high. Costs are reportedly in the neighborhood of \$250 per hectare. Total costs including materials and equipment for cultivation along with the extension cadre are said to be running about \$400 to \$500 per hectare.

Mali is placing heavy stress on eliminating the need for cereal imports. They are stressing increased production in all regions, both north and south. Although the southern regions and those areas along major river flood plains offer the greatest potential for major increases in food production, programs to conserve and manage rainfall in the drier areas to the north is still an important need. Many small scale measures to retard, capture, conserve, and utilize runoff from rainfall will be worthwhile. Were it not for the transportation factor, however, the locations of greatest productivity per unit of investment is along the Niger and Bani Rivers and around the Niger delta.

Malians encourage and seem to prefer bilateral arrangements for financing development. As opportunities and needs are developed, they publicize these and let donors select those they will support. As mentioned earlier, with no capital of its own with which to force the development pattern, the government must compromise some of the ideal approaches to comprehensive and integrated river basin planning in order to get the financial backing to move quickly forward with projects they know to be effective in relieving vulnerability to drought and which free heavy dependency on food imports. Introduction of more sophisticated planning processes must be achieved as situations permit. General guides and blueprints are important but until substantial progress has been made in meeting the basic needs of people, we may have to accept what appears to be piece meal development for the moment and concentrate on optimizing within projects rather than among and between them.

### Baguineda Project

The Baguineda Project across and down river from Bamako offers a most interesting potential for AID input. This is an old project started in 1928 by diverting water from the Niger River into a 44 kilometer canal which was designed to serve more than 33,000 hectares on the right<sup>1</sup>/<sub>2</sub> bank of the river. Some 3,000 hectares more were planned for irrigation on the other bank.

At the present time there is production on only about 3300 hectares. The main canal and distribution system has deteriorated over the years and substantial repair and maintenance would be needed if full development of the property were to be realized. Tomatoes have been successfully grown at this location. It is said that a new tomato processing plant will be built here in the near future.

FAC is continuing limited technical and financial support to this project under a five-year commitment. Any program of USAID would need to be correlated with the FAC program so that no conflict would occur in the use of the main canal and conveyance works. While more thorough examination and study would be necessary before committing U. S. funds to this project, there are several features which make it an attractive project to consider.

While the main canal and some of the physical works are in need of rehabilitation, there is plenty of capacity to begin a modest sized irrigation development immediately. Thus, no early expense in major facilities would be necessary. Tracts could be selected which have been levelled, contain good soils, and have the basic distribution channels in place. Thus, the start-up costs could be very low. The size of the project could be

scaled to whatever size best suited the purposes. There would be good opportunity for expansion. Quite likely a desirable direction would be to start out quite small and expand as appropriate. This would be especially true if training and establishing farmers on the land is an objective. The project could serve as a demonstration area where different methods of irrigation could be shown, Crop varieties could be demonstrated, etc. It could be expanded to contribute in a very significant way to the needed food production of Mali. Being close to the capital city of Bamako, there should be a ready market for the products grown. The project would offer good opportunity for <sup>improving economic welfare</sup> ~~upgrading the situation~~ of the farmers presently living in the area. This would not constitute a major resettlement <sup>operation</sup> but ~~consists~~ <sup>only</sup> of an excellent opportunity for improving the economic and social situation for those already in the vicinity. The project could serve as an excellent laboratory to experiment and prove out training techniques and social programs of various kinds. The area is ideally suited for livestock raising, also, and mixed farming and animal traction could be made a part of the program. Being located near Bamako, the capital city, would minimize the logistics of transportation and communication. The project could become an easily accessible show piece of U. S. assistance.

#### Office Du Niger

The Malians are inviting donor support to rehabilitate and expand the large Office Du Niger project with headquarters at Segou. Again, this is a very old project with original plans to place a million hectares under

irrigation. At the present time they are cropping less than 50,000 hectares.

Many reasons can be cited for the lack of productivity of this operation.

Yields have never reached expectations. The major problems voiced during the visit at ODN were that the canals and conveyance works were in urgent need of repair and rehabilitation. Substantial canal lining was an expressed need. ~~Rather substantial~~ Equipment needs ~~were expressed~~ for land levelling, dredging and cleaning canals, <sup>very also given high priority,</sup> etc. The problem of fluctuating river flows makes it impossible to divert needed water during the low flow period.

It would appear that the heavy investments in canals, land preparation, diversion dams, etc. did not really provide that much advantage over rainfed agriculture in this particular region. With the advent of the Salengue Dam and subsequent river regulation, this project could likely begin to flourish with good management and multiple cropping. Under the present situation from both a physical and political aspect, this would not be a highly attractive project for U. S. assistance. Later on, as circumstances change, it might very well prove to be an attractive venture.

#### Serpent Valley

The Malian government expressed an interest in support of studies leading to a project in Serpent Valley. Such a project would conceive of taking water from the vicinity of the lands now being served by Office Du Niger and taking this over a low divide to initiate a new project many miles away. The ODN canals would likely have to increase their capacity to get the quantities of water needed to <sup>transport</sup> ~~move~~ into Serpent Valley. If ~~we understand~~ the plans <sup>are</sup> ~~correctly~~ <sup>understood</sup>, there are also questions <sup>concerning the</sup> of quality of the land for <sup>irrigated</sup> agriculture. There would seem to be little justification for conveying

plentiful much closer to the source of water supply. It would be much more simple to expand the programs around Mopti and Segou.

*Valley*  
High Valley Project

The so-called High ~~Valley~~ *Valley* area represents another good potential for U.S. assistance with a high probability of immediate and long term benefit. This is a broad valley interspersed with many small ponds and lagoons which are filled during the rainy season. Under the direction and assistance of one of the government agencies, programs of using small pumps to deliver water from these ponds and lagoons to near by farms has been initiated. In addition to the small ponds and lagoons, there is also some opportunity of utilizing groundwater through the drilling of small wells. Although the groundwater potential has not been evaluated, there is obviously reasonably good recharge. The water table is quite close and quite likely a significant use of water from this source would be possible. The situation here would offer opportunity to build on the traditional subsistence agricultural base and demonstrate the advantages of irrigation. A few of the farmers have already had experience in irrigating specialty crops and have proven to their own satisfaction that this can be very profitable. There appears to be excellent rapport between the extension people and the farmers and a good working pattern of providing credit, seeds, fertilizers, etc. to encourage irrigated farming. Capitalizing on the peculiar physical situation conducive to irrigation schemes emphasizing small farms, together with the good attitude and background of the extension workers a program of AID in this area would ~~also~~ have a high probability

of success. Assistance could be in the form of pumps and power units, well drilling, irrigation equipment, assistance in irrigation design and operation, technical assistance and training to extension cadre, training and assistance in the operation and maintenance of small pumping plants and power units and perhaps a whole host of other ways.