AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

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3. COUNTRY ENTITY: CHAD

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8. ESTIMATED FY OF PROJECT COMPLETION: FY 82

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 77; B. QUARTER 4; C. FINAL FY 80 (Enter 1, 2, 3, or 4)

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 –)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	720	1060	1780	2515	4405	6920
(GRANT)	(720)	(1060)	(1780)	(2515)	(4405)	(6920)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1. P.C.	20		20	920		920
OTHER U.S. 2.						
HOST COUNTRY		140	140		650	650
OTHER DONOR(S)	500	2000	2500	10000	2000	12000
TOTALS	1240	3200	4440	13435	7055	20490

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 77 F. GRANT	E. 1ST FY 77 G. LOAN	H. 2ND FY 78 I. GRANT	H. 2ND FY 78 J. LOAN	K. 3RD FY 79 L. GRANT	K. 3RD FY 79 M. LOAN
(1) B	100	230		1780		1500		2390	
(2)									
(3)									
(4)									
TOTALS				1780		1500		2390	

A. APPROPRIATION	N. 4TH FY 80 O. GRANT	N. 4TH FY 80 P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1)	1250				6920	
(2)						
(3)						
(4)						
TOTALS	1250				6920*	

12. IN-DEPTH EVALUATION SCHEDULED: MM 09 YY 78

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

* rounded - off

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14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: John A. Lundgren JRMorris for

TITLE: Country Development Officer

DATE SIGNED: MM 05 DD 27 YY 77

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Project Paper - Lake Chad Irrigated Agriculture
Project No. 677-0001

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PART I. Lake Chad Irrigated Agriculture

677-0001

I. B. Recommendation for phase one of the project

- Grant — $6,920,000
  For contract services, commodities, participant training and other costs associated with irrigation projects, agricultural research, water use and control research including irrigation with low-lift pumps, regional infrastructure and supplies, and health activities

  For a study of the reorganization of SODELAC

- Grant (Program Support Funds) — $ 220,000
  Soil and Topographic and other agricultural investigation.

- Waiver for source and origin for equipment, and supplies

- Waiver for 25% contribution per FAA Sec 110(a). Chad is on the UNCTAD's list of relatively least-developed countries.

LIST OF ACRONYMS USED IN THIS PROJECT PAPER AND THEIR DEFINITIONS

CDO	Country Development Office/Country Development Officer
CFA	Communaute Financiere d'Afrique
CIMMYT	Centro Internacional de Mejoramiento del Mais y del Trigo
FAC	Fonds d'Aide et de Cooperation
FED	Fonds Europeen de Developpement
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IITA	International Institute of Tropical Agriculture
IRCT	Institut de Recherches du Coton et des Textiles
PCV	Peace Corps Volunteer
REDSO	Regional Economic Development Services Office
SCET	Societe Centrale d'Equipement du Territoire
BADEA	Banque Arabe de Developpement Economique de l'Afrique
USAID	United States Agency for International Development
GOC	Government of Chad
ORSTOM	L'Office de la Reserche Scientifique et Technique Outre Mer
CMPA	Cooperative for Dairy Production
SONASUT	Sugar Cane Production Organization
META	Firm Specializing in Engineering
SEMABLE	Organization for Developing Wheat Production
PVC	Polychlorine de Vinyle

Part I. C. Description of the Project:

Introduction:

The eastern shores of Lake Chad are characterized by a series of sand dunes which create elongated islands or fingers of sand reaching into the lake. Many of the long, narrow lake inlets can be dammed by small sand dikes (polders). When the shallow water evaporates or is pumped out the newly exposed lake bottom (empoldered area) exhibits rich soils, which so far have produced sustained high yields with little fertilization. a/

Farming of the polders has been carried on in one form or another since the early 1900's. By 1950 23 crude dams had been constructed and the dried surface represented about 1,500 hectares. After 1950 the largest city in the area (Bol) undertook the construction of nine more larger dikes, and in 1961 the central government set up an institution (SEMABLE) to encourage the development of the area. (This institution has since been replaced by SODELAC. See Annex C). With modest amounts of United Nations and French assistance the total area recovered from the lake reached 15,000 hectares in 1966. Unfortunately, due to irrigation practices unsuited to the conditions (mostly the use of saline sub-surface water) many polders had to be abandoned as salt and alkaline levels rendered the soil unsuitable for cultivation.

About 10 years ago the FAC began funding the development of irrigated agriculture along the shores of the lake, and in 1975, the IBRD approved a $5 million loan for the gravity flow irrigation project on two empoldered area (Guini and Berim) near the town of Bol which SODELAC (the GOC agency charged with the development of the area), is now supervising and executing.

At the time the IBRD loan was signed it was agreed that USAID and other donors would participate in the project. Specifically, the USAID agreed to provide $1.0 million for agricultural research for cereals at the Matafo Agricultural Research Station. b/ This station is operated by SODELAC and located on one of the polders being developed by the World Bank (Guini). USAID also agreed to undertake a limited epidemiological study of the area to determine the extent to which schistosomiasis

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a/ In what the term polder and empoldered areas are used interchangeably.
b/ See the World Bank's report #828a-CD dated October 16, 1975.

and other diseases affect the population and what steps could be taken to control them. The agricultural research will be a component of the present project, the epidemiological study began in March 1977 and the first part will be available by mid 1977 but it will require a full year to complete. It is anticipated that this report will highlight potential follow-on development activities.

As a result of GOC requests as articulated by SODELAC, surveys, site inspections, meetings with other donors, and prior A.I.D. commitments, the components of an irrigation project as presented have taken shape. While rainfed projects will continue to be allotted the highest priority, we believe that in time it will be necessary to develop the irrigation potential of Lake Chad and the rivers of the Lake Chad basin. The rationale for this is that given Chad's arid climate and the susceptibility of most of the country to drought of one degree of intensity or another, irrigation alone can solve the critical problems faced by the economy as a whole and the rural sector in particular. Some of the benefits that would accrue from the development of an irrigated sector are listed below. The list is not exclusive, but it is sufficient to indicate why we believe it justified to make a start in developing such a sector albeit on a small scale. Benefits of developing irrigation in Chad would include, inter alia:

(a) greater diversity of crop production: Chad is now dependent on the importation of farm-originating produce that it could produce domestically with irrigation. Important are such basics as cereals, sugar, and a wide range of vegetables and fruit. Chad is so located that imports of these and similar commodities are very expensive, and supply, subject to disruptions beyond the country's control.

(b) better utilization of the country's livestock resources: Chad's Sahelian pastures are good breeding areas, but finishing stock for sale now requires long distance migration in the dry season, often south into Cameroon and Nigeria. An irrigated sector would generate substantial amounts of crop by-products and residues in the dry season that could help to stabilize the livestock sub-sector and improve its contribution to the economy. Irrigation alone could permit the ultimate development of a dairy industry;

(c) evolution of a high technology agriculture: The rainfed system has clear limitations when it comes to yield potential and the efficiency of fertilizer and improved seed. Water, in this case rainfall, is the limiting factor. Irrigation would allow the utilization of modern technology to a much greater degree than now possible and permit Chadian personnel to learn, employ and further develop modern agricultural techniques. Finally such a system would assure its participants higher and more secure incomes than under the rainfed system;

(d) insurance against the disruptive effects of drought: The impact of drought is not only to lessen the supply of food staples such as grains; among other effects, livestock are irretrievably lost through death, and agriculturally based industries are disrupted because of the lack of raw materials. These effects may be felt for many years -- until livestock herds are replenished and farmers have replenished their own food resources through de-emphasizing cash crops. Cereal reserves can be stored as an insurance against drought-induced famine, but irrigation alone can cushion the other disruptive effects of drought.

(e) development of the rural sector: The type of irrigation most appropriate in Chad involves small plots cultivated by family labor. As productive resources are placed in the hands of small farmers, their incomes will rise and greater income equality will result. Thus, irrigated agriculture can be a powerful tool in the quest for greater equity, and the involvement of the small farmer in the development process.

In summary, with this project, A.I.D. is addressing Chad's most immediate need to feed its people while developing a partial solution to the serious problems of rural poverty.

Project Description:

The proposed A.I.D. funded project will comprise four major activities and a series of sub-activites. In outline form, these activities are:

1. Polder Development:

2. Strengthening of SODELAC as a regional development institution:

   (a) Management study

(b) Equipping and operating a mobil maintenance brigade
(c) Participant training

3. Research:

(a) Agronomic research at Matafo Research Station
(b) Land and water use in the polders
(c) Low lift pump research
(d) Socio-economic research and the definition of small scale local activities which complement the development of polders themselves.

4. Health Activities

(a) Epidemiological survey
(b) Health services support

A. Development of a Polder:

The purpose of this project is to assist Chad in developing its ability to feed itself and to provide the small farmers of the Sahel with an alternative to traditional low-yield agriculture. The Chadian Government created SODELAC to do this, using thewaters of Lake Chad and the adjacent fertile soils as the basic resource. In order for SODELAC to be able to carry out its functions economically it must process and transport enought agricultural output to offset its cost of overhead and operation. Given the yields anticipated on the polders it is necessary that 3,000 or more hectares be under modern irrigated agriculture. In order to reach that amount of land under cultivation Tandal Polder must be built as soon as possible. Tandal, a polder of 800 irrigatable hectares can be developed new Bol. The current level of experience within SODELAD, plus the planning previously done, the existence of trained technical crews, and suitable equipment in place, make the construction of a polder feasible and desirable. When the project is completed Chad will have a visible production unit which will increase food production and the incomes of small farmers in the Sahel.

The Tandal polder has been chosen for development since it is immediately adjacent to the project areas now under development and well within the communications net that presently exists. Basic technical studies and unit designs have been previously completed and the unit cost factors, when adjusted for inflation and experience, are applicable. SODELAC will

use its staff to: (a) build the polder, (2) drain the empoldered area, (3) design and construct the area's irrigation and drainage system, (4) choose and settle volunteer farmers, and (5) train and aid small farmers on economic production units. The individual farms would be one hectare in size and worked by individual farm families. The total number of farms will be 800.

B. Development of SODELAC (the implementing agency):

In Chad, the few successful development stories one can relate revolve around quasi-governmental institutions involved in commercial operations which have strong leadership (leaning heavily on expatriates) and rather lengthy terms of external financing. For example COTTON-Chad's present production program has vitalized the cotton industry. To cite another example, CMPA has organized the local dairy-poultry industry, and SONASUT is managing the development of a sugar production industry. In view of the GOC's institutional weakness, development via specialized quasi-governmental agencies is now accpeted as the preferred strategy in Chad. Unfortunately, SODELAC has not yet been able to realize its full potential as a development institution due in great part to lack of financial support and dispersed development activities. In order to improve SODELAC efficiency, three sub-activities are contemplated:

(a) A management study which will recommend modifications of its structure in order to carry out its functions efficiently. A USAID funded preliminary study of SODELAC management and structure was undertaken as a pre-project activity. (See Part 2-3) The preliminary study confirmed the requirement for further analysis to determine the optimum organization to manage the activities of SODELAC as they are expected to evolve.

(b) The equipping and operating of a mobil maintenance brigade to rebuild and maintain the infrastructure around Bol. Restoration and maintenance of roads and polders is the responsibility of SODELAC as part of the GOC assignment to the development of this unique water resource in the in the Chadian Sahel. At present SODELAC's lacks this maintenance capability which is essential to the accomplishment of its developmental objectives.

It is feasible and economically sound to improve the existing infrastructure net work. Basically, this consists of the simple roads and dikes which will permit the improvement of 28 existing polders now protecting 12,500 hectares of under-utilized land.

The maintenance activity has a very low relative cost. It will be operated by Chadians with the assistance of two Peace Corps volunteers. Expatriate engineers from CDO/REDSO/SCET have done requisite 611A certification and monitoring. The support will cover the purchase of machinery and all costs for personnel and operations for the first 5 years of this project by which time it is anticipated SODELAC will progressively be able to take over fiscal responsibility for these maintenance functions in the final phase of the project.

(c) Participant Training: In order to strengthen SODELAC's human resource base funds for participant training are included in the project. Short-term training in specialized areas of administration and accounting are contemplated. Also training for Metafo research station personnel will be arranged at the IITAT in Ibadan, and at the LCBC agricultural school in northern Nigeria.

C. Research:

Since 1970, SODELAC has engaged in agricultural research at Matafo, six kilometers from Bol. It has been mostly concerned with the choice of appropriate wheat and cotton varieties for the empoldered areas. This station is to be developed further under the project by staff selection and training, and a building program. A.I.D. would finance all research with the exception of the cotton components which will be done by FAC and IDA. The following activities are planned:

(a) Testing wheat varieties from international sources such as CIMMYT, Mexico.

(b) Testing corn, sorghum, forage, millet and food crops from IITA, Ibadan, Nigeria.

(c) Water use and control, including low-lift pumps, spray irrigation drainage, etc. with particular emphasis to be given to experimentation concerning low-cost irrigation methodologies, such as utilization of low-lift pumps as

applicable to soil and water conditions conducive to favorable growing conditions.

(d) Socio-economic research related to SODELAC's operations, farmers operations, and the development of the area.

(e) Soil reclamation and salinity/alkalinity control

(f) Continuous ecological monitoring and control measures to avoid unforseeable damage to the ecology of the area.

D. Health Activities:

The World Bank foresaw the increase in the health needs of the polders area and USAID agreed to make this a component of its program. Two sub-activities are countemplated:

(a) an expidemiological survey to determine health hazards and the potential spread of malaria and schistosomiasis. In April 1977 a preliminary survey was conducted by a team from the America Public Health Association. The addtional visits will be made in 1977 and recommendations will be made to mitigate the negative effects of the development of the polder region.

(b) Health services suport. Four kinds of activities will be supported as a part of this project:

- Epidemiological monitoring of the polders will continue throught the life of the project.

- Local medical facilities will be repaired and re-equipped.

- A low-cost paramedical system will be instituted in the polder area.

- A limited amount of endemic disease control measures will be initiated.

These activities have been requested by the GOC and are in line with the USAID health strategies in the DAP.

Part I. D. Conclusion from Project Analysis:

The directly measurable economic benefits from the project produce an internal rate of return of 6%. There are, however, substantial secondary benefits which increase the return to 12%. Finally, in view of the dual need to produce food and to provide an alternative to those living in the Chadian Sahel, cost effectiveness considerations tip the balance in favor of moving ahead with the project. This project is viable from the farmers' point of view, and after paying all associated expenses the farm family will be able to realize a net income from three to four times higher than under traditional agriculture. Getting started in irrigated agriculture, however, is an expensive proposition and a substantial subsidy will be required. In the A.I.D. project this subsidy is provided in the form of a grant rather than loan-funded activity.

Based on experience with other irrigation projects (see REDSO's irrigation paper dated March 21, 1977) this project contains, as the following points indicate, certain ingredients which augur well for its success.

- Based on hard analysis and realistic data, it will produce an acceptable rate of return (12%). It would not be feasible for loan financing, but is acceptable for a grant project.

- The land is of proven fertility.

- The resultant products have ready markets. Wheat and flour are now imported at the rate of 12,000 tons per year. We estimate that this project will produce 2,000 tons annually and that the World Bank's polder will produce another 3,000 tons. There will still be a substantial demand which will have to be met through continued imports.

- There is sufficient population in the area of influence to satisfy the labor requirements for the projects.

- Traditional farming by means of irrigation agriculture has been practiced in the area for years. Hence, while the techniques to be employed will be different in degree, they will not be of a nature which will upset the existing social order. They will, however, require a greater amount of discipline than under the traditional system.

- There are relatively good transportation links between Bol and the capital. The canal linking Bol and the lake was opened during the 1977 dry season, and SODELAC intends to keep it open. If it is ever closed during the dry season, there is a land route which is more expensive. The cost by water is estimated by SODELAC to be one fourth of the land route cost.

To balance the analysis, one should also summarize the factors which increase the risk of project failure:

- The per-hectare cost is high. Consequently, sustained high yields will have to be realized if the farmers are to pay their fair share of the costs.

- To continue to provide development services, SODELAC will need continuing GOC financial contributions.

- Running a regional development program of this nature will continually challenge SODELAC's management capability.

- In a project of this nature, bottlenecks can occur which, if not quickly removed, can preclude the realization of the project purpose e.g., malaria epidemics, no social service facilities, prolonged closing of the canal, settlement problems, etc.

Where possible, this project has been designed to address these risk factors. Agronomic Research on improving crop yields together with studies on how to reduce the high building and operating costs of irrigated polders will be undertaken. The management study of SODELAC and an annual budget review will address the question of institutional weaknesses. Finally, by providing resources for complementary activities and a resident technician to administer them, the external threats to project success can be addressed as they arise.

Part I. E. Summary Findings

In view of the need to increase food production in Chad and provide an alternative to the population of the Sahel, CDO and the Government of Chad have designed this project and recommends that it be undertaken. The existence of Lake Chad, an enormous reservoir of scarce water in the midst of a parched Sahelian landscape, has long been recognized by the Government of Chad and by potential donors as an obvious developmental resource which should be developed to alleviate persistant food shortages in the Sahel. This project has been designed to exploit that resource and so in a systematic phased manner with due regard for the absorptive capacity of local institutions, the long range interests of the GOC, the ecology of the area and the individual interest of small rural growers who will be the first direct participants and beneficiaries. The arguments supporting this conclusion are:

(1) The project is judged to be appropriate for the time and place, is economically feasible and cost effective. It will increase food output and improve the economic and social conditions of small farmers in the Bol area while adding to the food reserves of a much wider area.

(2) SODELAC will be competent to supervise the project as the sole host country governmental implementing agency because it will have the financial resources, and expatriate staff, advice and assistance, a sufficient number of qualified Chadians, in addition to Peace Corps volunteers, and A.I.D. technical support as indicated.

(3) An epidemiological survey, to be completed early on in the projects implementation, will supply data on current and potential health problems being faced by the polders population. Based on the finding of the epidemiological survey the proposed health services support activities will be directed toward reduction and/or eliminations of the identified health problems affecting the beneficiary population.

(4) Participant and counterpart training is sufficiently funded, and has enough time within this project design to strengthen Chadian personnel.

(5) The project meets all applicable statutory criteria. The statutory check list is submitted herewith in Annex F.

(6) The country has the future capability to maintain and utilize the project effectively. The Mission Director's certification as per FAA 611(E) is submitted herewith in Annex G.

Part I. F. Project Issues

The issues we now perceive are grouped into two broad categories:

- Those issues which revolve around SODELAC as the project's executing agency and its effectiveness as a problem solving institution.

- Those issues having to do with the innovative nature of this project.

1. SODELAC as a Development Institution: As discussed in greater detail in Appendix C , SODELAC is a financially fragile development institution, which reflects the financial situation of the Government of Chad. The importance the Government attaches to SODELAC as an instrument for development is evidenced by its continued support of this agency despite many competing internal demands for its limited resources. For example, in the last two years for which data is available the GOC subsidy was CFA 20 million ($80,000); an amount equivalent to about one-third of regular revenues. However, SODELAC remains administratively dispersed and needs reorganization. In view of the task ahead, is it prudent to depend on this institution to implement the project, and how can SODELAC be expected successfully to address the many problems that will surface in the process of polder construction and settlement?

   As discussed in Appendix C , with a management reorganization, and a set of operational tasks organized in an aggressive work plan supported with the financial wherewithal, equipment and personnel, including expatriate assistance needed for the job, SODELAC can be transformed into a viable development institution.

   Probably for most troublesome issue which SODELAC will face is the whole question of polder settlement. SODELAC will have to make arrangements for leasing the land to settlers under conditions which will insure permanence and continued land utilization. This will involve negotiations with local leaders and the drawing up of the rules concerning occupancy which are compatible with local customs and common law (or its equivalent). To assist SODELAC in this process a socioeconomist will be attached to the research station. This person will also be instrumental in negotiations with the local population and in settlement counselling.

A related issue is the "control" of production on the polders. The project seeks to avoid the possibility of converting the polders into communes or gaint share-cropper plots. In the present case SODELAC will provide subsidies for some crops, but, prices can change. Will they eventually require forced marketing at prices below the prevailing market price? Will they (literally) cut off the water to those farmers who do not "cooperate"? These are issues which can determine the success or seal the fate of this project. As SODELAC gains experience in this area, and with expatriate technical advice, the CDO feels these issues can be resolved.

A related issue revolves around SODELAC's ability to act in both a commercial and developmental capacity. When an organization wears both these hats, there is a tendency for its goals to become confused. For example, a policy of providing low cost wheat to the capital conflicts with a policy to optimize the income of the small farmer. Also, the use of SODELAC's vehicles and facilities for purely development activities such as social services or health care will put pressure on SODELAC's limited resources. In order to avoid these kinds of problems an important component of the management reorganization study will include a cost accounting system which will define the costs of its commercial activities and those of its purely developmental activities. The GOC subsidy is designed to cover the costs of the latter.

2. Experimental Nature of the Project:

While people have been farming the polder area for some time, there is relatively little experience in the type of intensive irrigated agriculture contemplated in this project. The World Bank Project is moving along well, and SODELAC is gaining valuable experience, but there are certain unknowns. While these cannot be predicted, we feel that the following issues may arise:

(a) Appropriate technology: This is a question for which there is no simple solution in Chad. It may be helpful to discuss the problem from two points of view: the technology to be employed in farming the plots, and the technology to be used in the construction of the polders themselves.

In general, once the family plots are settled, labor intensivity will be the rule. The exception is at harvest time when small mobile thrashers will be used for wheat. This is the busiest time of the year since the wheat must be harvested quickly and the land rapidly prepared for planting cotton. The SODELAC's limited experience is that the mobile thrasher makes sense under these circumstances.

With respect to the construction itself, the system adopted by the World Bank involves mechanization and a high degree of capital intensivity. For example, on the first two polders, the ground contouring is done by heavy machinery (with the assistance of a computer). Slope angles and run off rates are crucial, and a highly mechanized approach is appropriate. While large amounts of local labor will be utilized in the construction of the dikes and canals, the amounts of machinery, steel and cement involved render this a capital intensive project. Since this is not a labor surplus area, and in view of the need for precise construction tolerances, the REDSO engineers have concluded that capital intensive construction techniques are the cheapest way to construct the polder.

However, this in itself does not mean the project runs contrary to the intent of Congress. A.I.D. does not rule out projects calling for infrastructure investment in the agricultural sector. Removing transportation obstacles which inhibit rural production of food crops is an essential element of our strategy. We also remain interested in assistance schemes which provide a local infrastructure base so that small producers can increase their output -- even when these schemes call for heavy initial capital investments.

Part 2. Project Background and Detailed Description

A. Background

The Lake Prefecture Polders

A) Prior to 1950

The Tilho mission that drew the first map of Lake Chad between 1904 and 1908 does not mention in its reports any dikes built by the lakeshore inhabitants. On the other hand, a map of the southeasterly end of the lake, done in 1913 by Lieutenant Andreys, mentions the Bilidon dam. This is the earliest mention found of works specifically executed to manage the polders.

Between the years 1908 and 1949, the level of the lake having maintained itself at a stable height (281.50; 282.50), the lakeshore population was able to build a number of dams. At the end of 1949, there were 23 dams, and in the basins the dried surface represented 1,500 hectares.

These dams were made up of a sand embankment (sand being the only material available) between two fences of posts and small logs. The fences were held together by means of ropes passed through the sand mass. Their average length was between 50 and 100 meters.

B) From 1950 to 1964

As of 1950, the lake underwent a series of floods which successively grew stronger. The years from 1950 to 1964 were a period of struggle, of wresting land from the lake waters, and in summary a period of experimentation.1/

The first flood took place in 1950 just after the winter season, and submerged all the existing structures. After the flood, there remained only 200 hectares of cultivable land.

It was then that the Administration of Bol undertook to construct newer and larger dams to enable the farmers to recover their lands and intensify the exploitation of the zone. From 1951 to 1954, nine dams were built (Tchingam, Bol Guini numbers 1 and 2, No, Baga-Sola, Diboulboul, and Bol Berim numbers 1, 2 and 3).

Some of these works were 200 meters long (Bol Berim No. 2, Baga Sola), or even 250 meters (Bol Berim No. 3). Since the population was willing to help, the old construction methods were used, such as handing sand in small baskets with occasional use of mechanical excavators, but at the same time the techniques were improved (use of metal posts and metallic curtains) and the size of the construction

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1/ Because of the strength of these floods, over half the islands in the lake, 600 out of about a thousand, were covered by the waters.

was expanded somewhat.

For three years after the 1954 winter season, the flooding level increased again. This called for reinforcement of the existing dams.1/ By June 1957, the dryland surface had reached 1,070 hectares.

From 1957 to 1961, there was a period of calm waters, and this spell was used to build a few secondary dams. In June 1961, the picture in the polders area was; cultivable area 8,110 ha, 2,220 ha were cultivated [illegible] included 1,030 ha of wheat.

That same year, the Government authorized the installation of a flour mill in N'Djamena (then Fort-Lamy) and constituted the SEMABLE.

During the successive two years, however, strong floods occured. The level of the lake reached the 284 marker, the closest to the higher level reached in a century.2/ Heavy damage ensued.

C) Situation Since 1964

This catastrophe did not cause too much discouragement. The land in the polders was so rich that appropriate steps to control the vagaries of the lake waters continued to be taken. A new start was made concentrated on avoiding the previsous mistakes.

a) Initial work - With the help of the World Food Program, extensive construction was undertaken in November 1964 3/ which included:

- repair of 33 structures (179,000 cubic meters of embankment) in the N'Gouri subprefecture.

- repair of 22 structures (158,000 cubic meters of embankment) in the Bol subprefecture.

- European Development Fund credit of CFA 200 million permitted the exploitation of the Tchingam, No, Madirom, and Dalairom Polders (2,157 hectares).

Various new techniques have resulted in better yields from the polders. Mobile pumping groups have been used to dry up the basins of stagnant waters. Until the most recent construction, one had to rely on lake waters filtered through the dams, or on rain water for irrigation. In addition under the traditional system the refilling of

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1/The strenghtening of these dams required 130,200 cubic meters of embankment soil.

2/The 284.50 marker was reached in 1870. This level was determined by ORSTOM on the basis of Nachtigal's studies.

3/See map pp. 110 & 111 on World Food Program.

polder waters must be done periodically. This means alternate periods when the polders are not cultivable which forces the population to return to nomad livestock raising until cultivation becomes possible again. Therefore, the new polders include the technical foundations for polders which can be farmed continously.1/

As a result of the prior works, the lake's isolated surface reached 15,000 hectares in 1966.

Training and extension centers which would assist the population to carry out rational cultivation of polder lands were planned but never built.

B. Detailed Description

In this section the Handbook suggests that the detailed description be couched in terms of the logical framework presented in Annex D. Since the development of the Bol region is a multi-donor activity, the preferred approach is first to give a fairly detailed description of what is to be included in the AID project itself. This will be followed by a discussion of the linkage connecting the goal, purpose, outputs and inputs.

The proposed AID funded project will comprise three major activities and a series of sub-activities. In outline form, these activities are:

1. Polder Development

2. Strengthening of SODELAC as a regional development institution:

   a) Management study

   b) Equipping and operating a mobile maintenance brigade

   c) Participant training

3. Research

   a) Agronomic research at Matafo Research Station

   b) Land and water use in the polders

   c) Low lift pump research

   d) Socio-economic research and the definition of small scale local activities which complement the development of polders themselves

1/ SOGETHA studies and WAGENINGEN Institute studies.

4) Health Activities

a) Epidemiological survey

b) Health services support

1- Polder Development

The eastern shore of Lake Chad is characterized by a series of sand dunes which create elongated islands in the lake. Many of the long, narrow lake inlets between these islands can be dammed by sand dikes. When the shallow (2 - 3 m depth) water is removed, the newly exposed lake bottom polder exhibits fertile soils, which have produced sustained high yields without fertilization.

Exploitation of the polders requires infrastructure investments. The scheme adopted by the IBRD for the irrigation of 1,200 hectares in two pilot polders calls for a concrete main canal along one side, PVC distribution pipes (made necessary by the instability of the soil), a main drain down the middle of the polder, and a pumping station to evacuate the drainage water back into the lake.

Tandal is the fourth of four modern polders in the vicinity of Bol. The gross surface is about 1,000 hectares of which about 800 are cultivable in two parts. Five dikes will be necessary to establish the polder and a series of canals to irrigate and drain it. The relationship of Tandal's width to length results in a lower relative investment in primary irrigation canals. A more detailed description of the dikes and canals follows:

- Dikes (see map following)

Dikes numbered 1,2, 3, 4 will be built to a crest height of 285 meters above sea level (maximum height of structure less than 11 meters). The crests will be 7 meters wide with dike side slopes of 3:1. The lengths of dikes are as follows:

1 180 meters

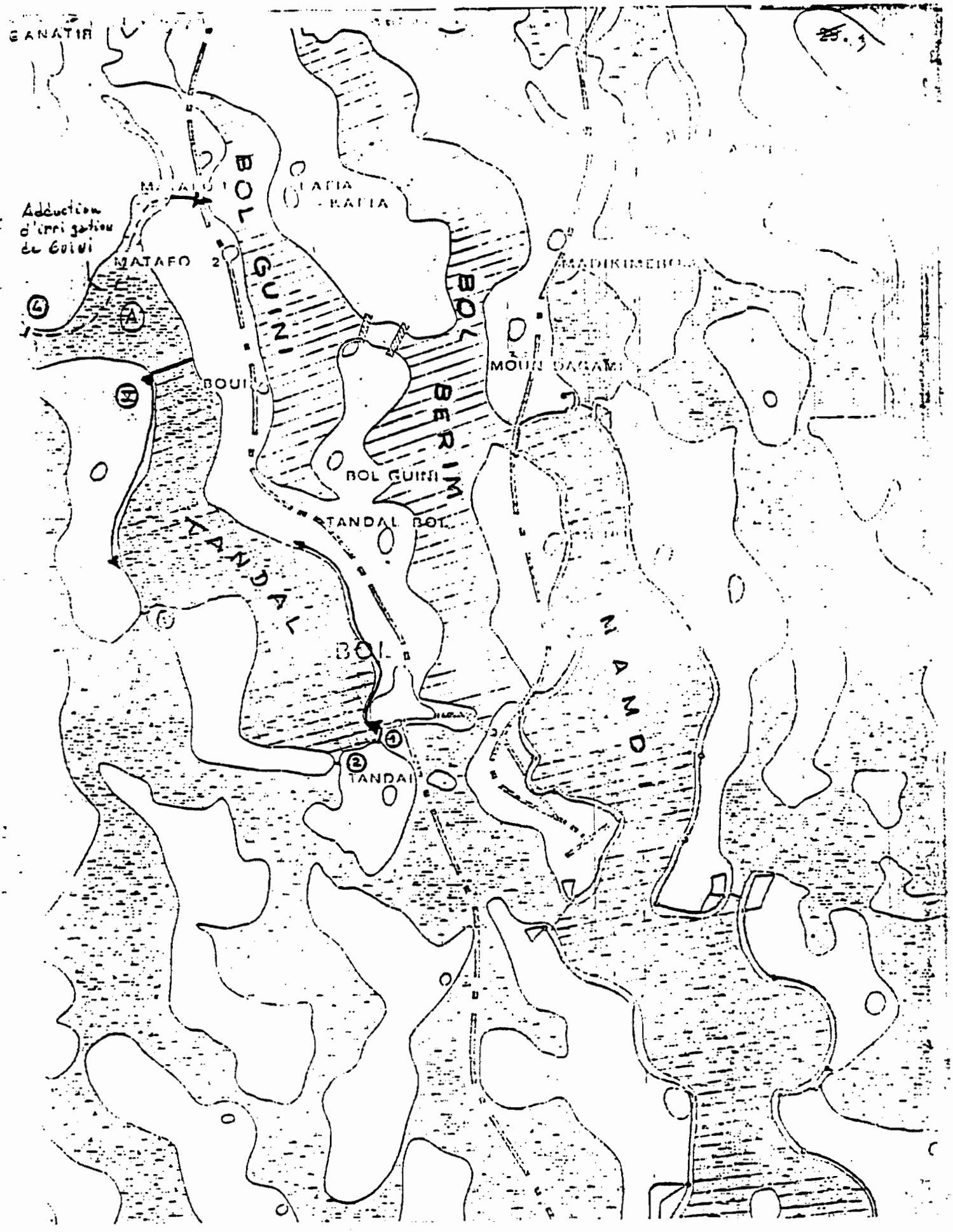
2 75 meters

3 90 meters

4 150 meters

The total estimated fill requirement is 150,000 cubic meters.

Dike number V will have a crest height of 282 meters. It will be 750 meters long and require 110,00y cubic meters of fill. Construction will be by a dredge and heavy equipment (bulldozers, truck, loaders).


GANATIR
Adduction d'irrigation de Guini
MATAFO
BOUI
BOL GUINI
BOL BERIM
MOUNDAGAM
TANDAL BOL
TANDAL BOL
TANDAI
NAMDI

- Irrigation and drainage canals:

Primary irrigation canals (reinforced concrete)	9,600 meters (total length)
Secondary irrigation canals (concrete or PCV pipe)	28,800 meters (total length)
Drainage, excavation	108,000 cubic meters
Drainage pumps capacity	1,5 cubic meters/second
Interior primary roads	6,000 meters (total length)
Interior secondary roads	14,400 meters (total length)

The roads will have stabilized surfaces and are to be placed to take advantage of drainage and irrigation construction and to provide service access.

All designs are similar to those successfully being used on the Berim and Guini polders. Pumps and equipment on all projects will be standardized for maintenance and interchangeability, to facilitate project administration and supply management.

Technical Details:

The polder Tandal is at present flooded. The general soil conditions and topography have been reviewed by previous studies and present no problems or differences from those polders now being developed. All techniques and designs are transferable with the only changes being improvements resulting from experience. Sample designs are available in SODELAC office in N'Djamena and were seen by REDSO in Abidjan.

Two types of irrigation distribution systems will be used on the first polders. These are the "classic" distribution in open sealed-earth canals and the "Californian" system which utilizes buried conduits (PVC pipes).

Studies in costs, ecology, maintenance, and efficacy favor the use of PCV pipes. These pipes allow better control of the amount of water distributed and less land is lost due to structures. The head of water can be increased in some cases thereby necessitating smaller pipes and lower costs.

The drainage quantities and costs for the polder will be a function of the level of the lake. The lake is the principal source of infiltration and if it is low, as it was in 1976/77, the cost of pumping the area dry will be lower than estimated (estimates herein are based on the highest level the lake has reached in the last 100 years). The drainage necessary is estimated to be less than 1.85 liters/sec/ha or a maximum 1.5 m^3/sec which includes infiltration, rain, and losses in irrigation. Adequate drainage and elimination of standing water is an imperative ecological and public health factor.

The drainage canals will be from 1.5 to a 2 meters deep depending on land level and will have 2:1 side slopes. It is also assumed land levels will eventually lower 40 to 50 cms upon drying. A grade in the canal of 0.07% will be used to provide positive flow. There will be secondary drains placed to take care of an observed heterogeneity of the soils and to prevent standing water.

The pipes delivering water will be based on 2 farms being served at each service outlet. The quantity of water to be delivered will be 60 l/sec, enough for 4 farms at a time. See attacement for a layout of the system. The system of using gravity water from the lake was chosen as least expensive and most troublefree.

Dike number 4, located on the north-west end of the Tandal area serves both Berim and Tandal. Dikes, numbers V and 4, will create a pond at a constant level of 282 meters which will supply water to the north end of Tandal and to Berim. The level of the pond will be automatically controlled. Its creation does away with the necessity of building a long reinforced concrete canal structure to feed Berim. Controlling the level of the pond also makes it possible to have dike V at a lower level than the other dikes. The design was chosen for economic reasons.

The canals along the side of Tandal are to be built on high ground that is stable. The alternative of locating them in the areas to be drained would present serious problems caused by uneven shrinkage, heaving, and cracking. These troubles occurred in old designs.

As the organic matter in the soil disappears, other predictable changes may also occur. These have happened in places like the delta close to Sacramento, California, and are manageable. The changes in the surface levels and conditions of soil expected to be caused by drainage and land use, justify the use of PVC pipe distribution systems and project design.

The Tandal will have two primary irrigation canals. It will also have a drainage canal running more or less down the center of the area with the discharge at the mid point of the project. The design was chosen to reduce the costs of excavation and materials necessary to make the system operative.

The primary road system will be located adjacent to primary drains and will utilize the materials excavated in construction. The location will also best serve the needs of farmers and service activities.

The construction will be done using conventional motorized equipment, hand labor, and a dredge. The structure will be built in stages to seal off the Tandal area so that a pumping station can be immediately constructed and put into operation. The design levels of dikes will be reached progressively. The dikes will have a 7 meters crest width and the crests will become part of the road system.

The first dike to be built will be number 3. This will allow the pumping station to be immediately installed. The dike construction will be done using hand labor and a dredge supplemented by motorized equipment. All final designs working drawings, final site selection and preparation will be done by SODELAC and will be approved by AID prior to work beginning.

2 - Strengthening of SODELAC as a regional development institution

a) Management Study: As discussed in further detail in Annex C (SODELAC's Financial Condition) SODELAC's basic problem stems from its involvement in a variety of both commercial and development activities. Further, their accounting system cannot adequately differentiate which commercial operations are unprofitable nor clearly define the costs of its purely developmental activities. The principle which both AID and the World Bank would like to see adopted is that SODELAC's purely developmental activities be paid for by a subsidy from the GOC, (e.g., extension services, costs of maintaining the channel, etc.); that its profitable activities be defined and presumably continued, and that its unprofitable commercial activities be dropped, or at least be covered by revenues from the profitable activities. To do this will require a study of SODELAC's operations and management.

The World Bank recognized the need for SODELAC's reorganization and pending the outcome of a reorganization study, its Project Unit was to remain financially independent of SODELAC's other activities.

In September 1975 AID agreed with IBRD to finance such a study.* In November 1976 an AID-funded technician came to N'Djamena and completed phase I of the reorganization study. A consulting firm will be scheduled to complete phase II of the study before the end of CY 77.

The complete text of the scope of work is contained in State 67589 of March 28, 1977. Briefly, the contractor will undertake a comprehensive analysis of the entire SODELAC operation to (A) identify problems and constraints in all functional areas to determine potential for improvement; (B) appraise needs in management planning, and control systems; (C) determine needs for changes in functions, operational systems, and organization; (D) prepare specific recommendations for a comprehensive reorganization of SODELAC together with a schedule and work-plan for accomplishing the major steps in the reorganization.

b) Equipping and operating a mobil maintenance brigade: Bol is in the heart of a potentially rich agricultural production area of 28 existing polders with a potential of 12,500 cultivable hectares. It is located on the fringe of the Sahel and will likely become the pipeline terminal for the petroleum fields of Kanem. It is certain to become a regional development pole and a center for economic and commercial activity north

*See IDA, Development Credit Agreement (Lake Chad Project) number 592 CD.

of the capital. It has transportation links to the capital and Nigeria. SODELAC, which has primary responsibility for the development of area must upgrade the local infrastructure and the establishment of a mobile maintenance brigade appears to be the most cost effective solution. In order to do so, however, they need additional equipment and financial capability to meet operating costs. Overall technical and management capability, on the other hand, does not appear to be a major problem. SODELAC has proved itself very effective in the organization and execution of the channel clearing operation funded by AID under the AIP program.

At present SODELAC has developed some repair shop facilities, warehousing, survey and design capabilities, and a limited construction capability. This will be augmented by a mobile maintenance brigade to be stationed in Bol. It will be responsible for maintaining the road network connected in the empoldered areas and the repair and maintenance of older polders. The brigade will use existing equipment complemented by the new equipment which will be purchased under this project.

AID would finance the purchase of the additional equipment and pay all of the operating costs of the unit for a period of two years or perhaps longer. By the beginning of the third year, SODELAC optimistically believes it will be able to begin to pay for some portion of the brigade's operating expenditures.

The first step is to make the unit's work plan to organize the use of available equipment. The work chosen will be examined and surveyed and work orders will be made. These locations and kinds of maintenance have been determined.

The second step, the actual dike and road construction, will be done using local materials including clay deposits for road stabilization. If other road stabilization materials are necessary, they will be determined during the work order preparation stage and included.

It is now planned, that 20 kilometers of road can receive major maintenance annually and 40,000 cubic meters of fill can be made. It will be possible to do minor work on the entire system at least once a year. Irrigation and drainage maintenance will also be undertaken on an as needed basis , considering operational and health factors. The unit will ordinarily consist of 10 machine operators, 3 line supervisors and 20 laborers. It will be under the general control of the resident SODELAC representative with day-to-day operations under the control of a resident Peace Corps volunteer.

The maintenance and repair of the roads, drainage, irrigation system, and dikes of Lac requires that a mobile brigade be established. It would be based in Bol and be primarily responsible for the continous protection of 12,500 hectares of existing polders and their associated road net. This activity will create the conditions necessary for the immediate promotion of agriculture in the area which has been stagnating due to the lake's high water in 1964 (284 meters) which damaged structures and by the serious droughts beginning in 1972.

The last major maintenance in the area, that was developed between 1950 and 1960, was during the years 1967 and 1969. The maintenance has been limited since 1969 by the lack of financial resources and suitable equipment.

The maintenance of the existing dikes is necessary since they protect entire polders, and a break results in crop and animal loss and perhaps the loss of human lives. A system of surveillance and routine maintenance is imperative if continuous production is to be achieved. It has been found that it is difficult or impossible to do the work manually. The manual methods of building dikes in a timely manner require an organization of large groups of people. Traditions slow down the formation of such working groups and practically make that form of work impossible. These traditional constraints are further complicated by the absence of the necessary supervision to get quality work done by hand. The amount of material carried in a headpan is about 5kgs. and this may have to be carried for about 200 meters which results in very low output. The unit work costs in some cases may therefore be significantly greater when using hand labor as compared to mechanical work.

There are 100 kilometers of roads to be maintained that connect the 28 producing polders to Bol. Those roads form the marketing and service network. The roads should be given stabilized sand/clay surfaces during the process of maintenance during the four year life of the project.

The program as planned by SODELAC during project life will provide the following dike maintenance:

1. Opening of polder at high lake level period to allow lake water to enter then let the area drain back into the lake to lessen polder surface salting effects. The dike will then be closed when the lake is at low level. The dikes will be rebuilt to design specifications. (eight polders.)

2. Strengthening and raising level of dike crest (nine dikes).

3. Maintenance and strengthening of dike (eleven dikes).

4. Lengthen and raise level of dike crest (eight dikes).

5. Maintenance and raising level of dike crest (seven dikes).

The dikes will be brought to the standard design specifications of a 7 meter crest width and height of 285 meters (above sea level) with side slopes of 3:1.

Maintenance usually consists of reestablishing dike crest widths, heights, and side slopes.

The amount of material to be moved is estimated to be 40,000 cubic meters per year. The length of the roads to receive a stabilized surface is estimated at 20 km. per year.

C. Participant Training

In order to provide short-term out of country training for Chadian research personnel, $60,000 have been included in the project to supplement on the job or in-country training. It is expected that problem specific training will mostly take place in francophone countries to avoid the language problem. Training in Mexico will be done as the research requirements of the station are more clearly defined. At this time longer term degree training does not seem appropriate, but may become a follow on activity in future programs.

The training now planned will include five extensionists in Nigeria (LCBC agriculture school), one seed specialist, two agronomists, one accountant, one business administrator, and four irrigation extensionalists. A small contingency fund is being provided for other special short term training that may be necessary.

3 - Research

a. Agronomic Research

The agronomic research will take place at SODELAC's agricultural experiment station at Matafo. The station is located at the north end of Guini polder on terrain virtually identical to the neighboring polders. It began operations in 1970 and presently is staffed by one qualified Chadian specialist (soil science), the head of SODELAC's extension service, and about ten others including laborers.

Approximately two hectares, increasing to twenty hectares, a year will be maintained under agronomic experiments. Part of this land will be used for seed multiplication and production. The testing programs will include varieties of wheat, varieties of sorghums, millet, corn, potatoes, assorted vegetables, pasture grasses, and animal feed using by-products of cotton and other crops. The research will reflect the potential of large-scale developments of the polder area.

This project provides budget support for Chadian personnel and the contracting of research personnel during the formative period. The expatriate staff to be provided will include two full time AID resident technicians, (an agronomist, and a socio-economist) and several short-term consultants. The local staff will include a pedologist, (chief of station) research and extension specialists, laboratory technicians and laborers.

The expatriate agronomist will have the following responsibilities:

1) Prepare short and long-term research plans and budgets in cooperation with other project personnel and report on these annually or as required.

2) Carry out trials independently or in cooperation with other research institutions. Research must be coordinated with institutions that are worldwide in experience and resources (such as IRCT, CIMMYT, ITTA, etc.). Trials will include wheat, sorghum, millet, corn, grasses, potatoes, and vegetables. These trials will be conducted and evaluated to determine alternate economic crops, rotations for fertility and insect or disease control, and the best use of human resources.

3) Produce improved or "pure" seed as part of an integrated seed-production campaign in the area.

4) Conduct fertility trials to determine plant responses and determine if there is a need for the use of any fertilizer. The laboratory will be able to analyze soils and make recommendations if necessary.

5) Test the validity of research data under farmer's field conditions.

6) Determine water use and control requirements, salinity, total water requirements, timing and type of water applications, and drainage.

7) Test pest and disease control methods, and modify them as necessary for the polders conditions.

Consultants familiar with international research results , connected with CIMMYT, have been used to design a three-to-five-year wheat selection program. Trials using varieties with the most probable immediate chances for success will be established. Staff members will be taught the techniques of putting in trials, observations and evaluations. Seed specialists will be brought in to strengthen the present seed production program and help design the ancillary facilities necessary and train staff for processing and quality control. This seed program is a priority to give the irrigation project impact at the farmer level.

b. Land and Water use in the Polders

Soil management work at the research center will include plot-testing the chemical and mechanical means of controlling or reducing salinity/alkalinity. This will be closely coordinated with low-lift pumping, irrigation, and drainage tests. Also, the soils/water laboratory and staff will be improved by ORSTOM and will run routine tests related to soil/water management and production factors.

In order to determine information for the necessary installation of irrigated systems, SOMELAC is making contractual arrangements for needed hydrological, meteorological and typographic work. The experimental station at Matafo cannot be expanded quickly enough to furnish the information required. ORSTOM has a laboratory and a staff in N'Djamena, and has been investigating the polders of Lake Chad since 1953. Because of ORSTOM experience, AID/W has already granted permission to contract this organization to make studies needed to collect basic information that might lead to irrigation system design improvements. For this contract funds have been obligated from Sahel Disaster Relief Assistance Funds.

c. Low-lift vs. Deep well research

SODELAC will do a study on the use of low-lift pumps for irrigation. It will evaluate the social and economic problems or advantages of using such a system in an empoldered area, as a part of the research concerning the use of and control of water. An area will be selected that is typical. The land will be cleared and wells will be dug, as necessary. A thorough base-line study of all soil, water, and health factors will be made. After the studies are made, pumps will be installed. Farmers will be organized to use the pumps and the resultant water. The irrigation operation will be observed , recorded and analyzed with respect to factors having ecological, social, economic and technical consequences. Findings will then be used to see what part low-lift pumps might play in the future development as an alternative to presently recommended gravity water irrigation from the lake.

This research activity is viewed as an important ingredient in the development of future polders. The prevailing technical opinion is that low-lift pumps utilizing surface water results in salinization/alkalinization of the soil and eventual ruin. For this reason, the two World Bank polders presently being developed (and the one proposed in this project) will utilize the lake water distributed by a series of primary and secondary canals. This may be a more expensive system,but insures no health hazards, continued soil quality and continuous agricultural productions. The proposed research will provide information for possible use of ground water as an alternative or supplement to lake water.

d. Socio-economic Research

The socio-economist will be attached to the station but will meet the requirements of both the station and the Bol area. The responsibilities will include the following:

1) Enumerate small holding labor requirements.

2) Determine and evaluate small holder incomes, social and economic constraints, and make recommendations for changes for improving small holder conditions.

3) Monitor SODELAC commercial operations, evaluating labor, machinery and other inputs. Determine ways to alleviate constraints.

4) Determine criteria on a continuing basis for the selection of farmers and evaluate farmers for possible selection. Study already selected or spontaneously settled farmers. Studies should include all the Lac area, not just the small irrigation project area.

5) Evaluate the impact of the project on the economic cultural development of Lac area, and be in a position to respond to targets-of-opportunity which arise as the development of the area proceeds. This last function is viewed as a crucial element in AID's continuing involvement in the development of the Bol area.

4 - Health Activities

a. Epidemiological Survey

The purpose of the epidemiological survey is to determine the extent to which schistosomiasis and other diseases affect the polder area population. This will require three steps. First a baseline of data must be established concerning the present health level of the population, the prevalance and distribution of the vectors of the principal endemic diseases, and the adequacy of the areas health services. Second, after a study of documents describing the anticipated activities of the project, potential health problems areas must be identified. Finally recommendations will be made to SODELAC, International Development Association, and AID to mitigate the negative effects of the development of the polder region and the steps to be taken to control such diseases.

The preliminary survey was conducted by a team of experts working under an American Public Health Association contract in April 1977. The team was composed of a physician/epidemiologist, a malacologist/parasitologist, a vector biologist/entomologist, and a sanitary engineer. A summary of their initial report is in Annex L. They found no great natural disease vector problems but potential dangers may exist that are man-made. These are associated with standing water at house construction sites and poorly maintained drainage ditches.

Two additional visits by a malcologist and a malariologist will be made in September, at the end of the rainy season, and in December , at the peak of the high water level in order to complete the epidemiological survey. The latter visits, funded by the project are necessary to account for seasonal variations in the distribution and concentration of the vectors of schistosomiasis and malaria.

b. Health Services Support

The World Bank project foresaw the inevitable increase of the health needs of the polders area and USAID agreed to make a definitive study as a component of its program. At a minimum, the influx of immigrants into the development zone will greatly increase the demand for routine health services and strain the present resources available. Some kind of immediate assistance is necessary either through a reallocation of central government operating funds or through short-term foreign donations. However, health services support can result in long-term benefits as well, endemic diseases control efforts can heighten farmer receptivity to change and worker productivity by lessening chronic anemia and reducing work days lost. Availability of health services should also make the polders area a more attractive location for settlement and so encourage immigration.

Four kinds of activities will be supported as part of this project. First, epidemiological monitoring of the polders area will be continued throughout the life of the project. Secondly, medical facilities will be repaired and re-equipped. Third, a low-cost paramedical system will be instituted in the polder area. Finally, a limited amount of endemic disease control measures will be initiated. These activities have been requested by the Ministry of Health and are in line with USAID health strategies in the DAP and the recommendations of the preliminary epidemiological survey. For these activities money has been included in the project budget.

(1) Epidemiological monitoring

Epidemiological monitoring should be a follow-up to the initial epidemiological survey. The preliminary survey will establish a baseline of data regarding the vectors of the most prevalent endemic diseases. Because of the health hazards that can accompany otherwise positive development schemes, it is important to monitor variations from baseline levels. This will include the measurement of small and mosquito vector concentration and distribution, annual blood and urine examinations to determine the prevalance of malaria and schistosomiasis, and checks on pollution levels of the major sources of water supply. Regular reports on these environmental conditions will assist SODELAC in directing its disease control activities and in planning less hazardous development strategies in orther areas of the polder region. During the first year of the project, the baseline epidemiological study will be completed. During subsequent years, it is anticipated that a Ministry of Health sanitation agent would carry out monitoring activities with some additional training and commodity support.

(2) Health Services

The medical facilities in the Bol area, as in most of the rest of the country, are poorly equipped and in poor repair. The laboratory lacks basic equipment and many of the wards and treatment rooms require structural repairs. The budget of the Ministry of Health is critically limited and cannot even supply medicines and supplies on a regular basis. Funds for any amelioration of the facilities must come from project funds. In view of the anticipated demands on the health services because of increases in population and endemic disease control activities, the following deficiencies require attention in the first year of the project:

a) painting and structural repairs for the medical center

b) Construction of a 3 room health education and MCH center from primarily local materials.

c) Purchase of microscopes for the medical center and surrounding dispensaries and a supply of staining agents.

(3) Paramedic System

One of the main AID health intervention strategies in Chad is to support the Government's program of establishing a low-cost rural health system. Chad, like most other Sahelian countries is trying to adapt the curatively-oriented, centralized system inherited from its colonial period to one that better distributes primary and preventive care to the country's rural majority. The system, drawing on the organizational and manpower resources of Chad's rural areas, will be more responsive to Chad's needs and will employ existing scarce resources in a more economic manner.

The rural health system is already being implemented in parts of Chad as well as other African countries. Briefly, it consists of setting up village-level health services using villagers, trained and supervised by government doctors and nurses, as local personnel. Each village which is interested in the program and agrees to support its health workers, selects a responsible man or its traditonal healer to be trained as a village health worker and a traditional birth attendant (TBA) to receive midwifery training. After the village health worker receives a brief training course at an area medical center in first aid, preventive care and treatment of common diseases, he will return to his village with a simple pharmacy consisting of a few medicines which will be restocked through revenues from village sales. The TBA will, in turn, receive training in prenatal services and sanitary delivery techniques before returning to the village.

Because of the increasing population concentration in the polders region the village health system concept is now a viable strategy for the area. Health workers and TBA's from the enlarged villages will be trained at the Bol medical center and returned with a simple stock of medicines to their village to deliver services under the regular supervision of the prefecture medical authorities. An alternative to the use of villages as the base of operations might be to use the Section centers of the project because of their central locations.

As a first step, the medical authorities in Bol are planning to recruit local volunteers to assist with the activities of the new health education, MCH Center. This will permit the development of the program, personnel resources and acceptance by traditional authorities before initiating the program in the new polders area in the third and fourth year of the project.

(4) Endemic Disease Control

The primary objective of the preliminary epidemiological survey is to study the present and projected prevalance of the most important endemic diseases of the area, principally schistosomiasis and malaria. Using this information as a basis, the survey will recommend possible engineering modifications and disease control programs.

The preliminary survey has recommended that the drainage ditches of the older polders be completely cleaned of vegetation or be filled in. This task will be the responsibility of the brigade mobile which is charged with polder maintenance. The old drainage ditches should be cleaned at least twice a year. The drainage ditches should be cleaned at least twice a year. The drainage ditches in the new polders have been designed to prevent these problems.

Further recommendations for disease control will be made at the conclusion of the survey when a better knowledge of year-round vector conditions is known.

c) Logical Framework Linkages:

The logical framework is outlined in Annex D. Briefly, AID, the GOC and other donors will provide the financial and human resources which will produce measureable outputs. These outputs will cause the realization of the project purpose which in turn, will contribute to the realization of the project goal.

The AID inputs are summarized in the budget tables (Part 3.B). Basically, the $6.9 million of AID resources will provide for personnel, commodities and other costs. Under the management and supervision of SODELAC, consultants and project funded technicians, these resources will be transformed, over the four-year implementation period, into a functioning irrigated polder, a function research station, and the renovation or maintenance of a series of roads, dikes, and irrigation/drainage systems in the area of BOL. The assumptions associated with the provision of the inputs (see page 4 of Annex D) are reasonable, and at this time we perceive no factors which will prevent the timely completion of the project.

The outputs of the project are best summarized by a brief "end-of-project status" statement:

> By 1984 Tandal polder will be protected from the lake by 5 by 5 dikes. The polder will be irrigated and inhabited by 800 farm families - each producing and selling agricultural products which provide them with an income of about $1,000 (1977 prices). SODELAC's experience, financial and institutional base will have expanded to the point where, with decreasing amounts of capital and technical assistance, they will be able both to administer the existing polders and construct new ones. SODELAC's requirement for a GOC subsidy, however, will still be evident. (SODELAC's break-even point is currently estimated to be met by marketing the production of an area to amount to 3,000 hectares. By 1984, SODELAC will have 2,000 hectares). The Matafo

experiment station will be fully staffed and producing and diseminating useful research for the use of farm families around Bol. There will also be about 100 kilometers of roads connecting Bol with the surrounding area, and dikes will have been constructed or repaired for the protection of 28 nearby polders.

The assumptions underlying the attainment of these outputs are somewhat more problematical than the input assumptions. It seems reasonable to conclude, however, that with close monitoring by AID, other donors and SODELAC, the implications of these assumptions will not be an obstacle to the realization of project outputs.

Once the above outputs are realized, and as similar outputs from other donor projects become evident, the project purpose will begin to be realized. The purpose is twofold: to increase the output of food by small farmers and to transform SODELAC into an effective development institution capable of replicating the present project. There is reason to believe that as the time frame is pushed beyond 1984, as more polders are brought under controlled irrigation, and as AID and other donors follow-on activities are identified and completed, the sector goal will come into focus. The sector goal is the achievement of self-sufficiency in food crop production and improvement in the social and economic status of small farmers. This should not be interpreted to mean that the Bol area will produce all of Chad's food. What it does mean is that irrigated agriculture is the key to agricultural sufficiency in much of Chad. This project will contribute to the diffusion of irrigation technology and thus to increases in food production. As incomes of farmers increase their economic status will increase, and as follow-on activities are identified, the social infrastructure will be developed, and the social status of the farm population will be improved.

There are two crucial assumptions underlying goal achievement: the continued flow of capital and technology from the rich nations to the poor, and the continued emphasis by the GOC of the agricultural sector. The commitment of the developed world to increasing food output appears permanent, and there does not appear to be a shortage of resources for well designed projects. So long as the flow of financial resources transfers can be counted upon, the second basic assumption - that the GOC interest in agriculture will continue, is realistic. There really is no other option for countries such as Chad; the rural sector directly supports 90% of the population, contributes over half of the GDP, and 80% of exports. Rural sector development <u>is</u> the development strategy for Chad.

Part 3: Project Analysis

A. Technical Analysis including Environmental Examination.

1) Appropriateness of project components

In this section the question to be addressed is the appropriateness of the project for the specific time and place being proposed.

Chad faces two immediate problems: providing enough food to feed the population and providing an option to the portion of the population living in the Chadian Sahel. The project being proposed is an attempt to provide a partial solution to these problems. Utilizing a regional development institution (SODELAC), USAID and other donors (IBRD, FAC and African Development Fund) propose to make a start in modern irrigated agriculture in Chad. An area on the fringes of the Sahel but accessible to the capital has been chosen for this effort. The land is of proven excellent quality and water is available. There is a history of irrigated agriculture and growing food crops using traditional methods. The population in the area is sufficient to assure enough labor. Available markets, in the capital and neighboring countries across the lake, are sufficient to absorb all output. Transportation links from the polders to the merchants are reasonably good, providing year round access.

There are four major components to be addressed. First, the USAID is proposing the development of a polder. Alternatives might be the following:

a) Forego the project and just rely on food relief when needed.
b) Encourage dry farming.
c) Develop the wadis.

The option to forego further project development (option a, above), is not realistic for three major reasons:

1) The people in the Sahel have no viable alternative other than to move to the edge of the lake. The technology of other solutions for them has not been found. No organization exists to help them in the interior where the problems of infrastructure are even greater. Relying on uncertain food relief measures delays the day of reckoning, and could be just as expensive as this project, but with no lasting impact.

2) The number of people in Lac region was 95,300 according to an estimate made in 1975. The zone of influence of the polders is estimated to be 3/4 of this or even 70,000 people. If five people directly benefit from each irrigated hectare of the empoldered area, it can be seen that a sizable portion of the population can be reached.

By 1979, SODELAC will develop the 1,200 hectares to be funded by IDA, plus perhaps another 1,000 hectares funded by the BADEA, plus the 800 hectares funded by AID as herein proposed. This total would be a modest yet meaningful start towards a long-term solution to the problems of the Sahel.

3) Given present subsidies, SODELAC reportedly needs to market 9,000 or more tons of wheat from the Bol area in order to break even financially. The definition of the SODELAC financial picture will be clarified in the management study, but it is now generally accepted that marketing between 7,000 and 9,000 tons of grain would make SODELAC viable. To produce 9,000 tons, the area under intense production would have to be between 2,500 and 3,000 hectares, not counting present minor amounts from the spontaneous areas. The proposed project will help SODELAC achieve the volume needed to break even.

The CDO feels that it is essential to get enough area under irrigation using higher quality lake water and avoid the short-term gains and long-term undesirable effects of using ground water without drainage or management. The increased area will allow sustained high production, which, when marketed through SODELAC, will alleviate if not eliminate the financial problems which this organization is now experiencing.

The option (b above) of developing dry land agriculture and farming the sand dunes, is not satisfactory for one major reason, the unfavorable climate. The normal climate is arid and characterized by high day time temperatures, which reach an average of 38.5°c (101.3°F) in April, and highly variable temperatures during the long dry season of October through June. The average rainfall is about 285 mm, but varies from 7mm to 700 mm. About 70% of the rain falls in the months of July and August. The evaportranpiration rate is about 2150 mm per year. The probability of producing satisfactory yields on sandy soils any time is not sufficient to warrant the investment risks.

The option (c above) of developing the wadis by using pumps, drainage, and ground water is very interesting and warrants further investigation. But at present the information available and the

infrastructure problems preclude their consideration as an immediate full scale project. Consideration is being given to continuing investigation and experimental or trial activities to develop a future program for this Sahel resource in the Lac area.

Second, AID is proposing the strengthening of the institutional capacity of SODELAC. The alternatives to this include:

a) Use another government agency to administer the program.
b) Hire an outside firm to administer the project.

The option of using another government agency (option a above) would be academic at this point. SODELAC was created in 1967, to develop the Bol area and has formed an organization and gained valuable experience in the work at hand. Changing agencies would be counterproductive.

The use of an outside firm to administer the project (option b above) has been considered, but was rejected for the following reasons:

1) One of the purposes of this project is to strengthen SODELAC's problem-solving ability and to make it an effective Chadian regional development institution. Chadians will increase their professional and administrative proficiencies by taking full responsibility for projects. At present SODELAC has the necessary number of expatriate advisors on board or planned to make contracting an outside firm redundant or duplicative. The results could be counterproductive in the long run, and are believed to be much more expensive and can be handled by SODELAC.

The need for the third component, research, can be substantiated by looking at the available alternatives:

a) to depend on research in other parts of Chad;
b) to depend on research outside of Chad.

Neither of these alternatives is acceptable technically, and both would entail high financial risks to SODELAC and the end users, The polder conditions are unique to Lake Chad, and no other region in Chad grows wheat under irrigation. The Lake's organic soils are unique and the chemistry invloved poses special management problems that are particular to it and are not found in other parts of Chad.

International research coordination is going to be most useful and the results of such research should guide Chad. However, verification of these results under polder area conditions is imperative before seeds are multiplied and distributed to farmers. Further, the valuable staff and farmer training that accrues from local research would otherwise be lost.

The appropriateness of the fourth component of the project, (i.e. health activities) is based on the increase in population which is expected. The influx of immigrants into the polder area must necessarily increase the demand for health services. Thus, the availability of health services will make the polder area a more attractive location for settlement, while disease control efforts can heighten farmer acceptance of change and consequent increased productivity. In the final analysis, the necessity of implementing an expanded health services program becomes obvious, lest repeated outbreaks of diseases and epidemics cause the project to be delayed or otherwise be impeded.

2. Initial Environmental Examination

Project Location: Chad

Project Title: Lake Chad Irrigated Agriculture

Funding:

FY 77	$1,780,000
FY 78	1,500,000
FY 79	2,390,000
FY 80	1,240,000

Life of Project: 4 years

IEE Prepared by: Jack R. Morris, CDO N'Djamena
Edward T. Costello, CDO N'Djamena
Katherine McGuhey, CDO N'Djamena

Environmental Action Recommended: The CDO has identified the environmental impacts of the project and a negative determination is recommended. However, as a part of the project the following actions are recommended:

1- The elimination of standing water and the provision of resources for health interventions.
2- Continued research on land and water use in the polders area.
3- Limiting the use of agricultural chemicals.

Concurrence: _____ Date: _____

Assistant Administrator's Decision: _____ Date: _____

Examination of Nature, Scope, and Magnitude of Environmental Impacts of Project

Description:

The entire multi-donor project consists of: a) construction, rehabilitating and completing the irrigation/drainage networks of 4 polders with an area of about 3600 ha, b) the maintenance of 28 old polders and the connecting roadnet, and c) research activities. The land will be developed at a rate of some 400 ha per year for cultivation as irrigated commercial farms. The maintenance of old polders and roads will be a continuous process. The farms in the modern irrigation projects will be about 1 ha each and some 3600 families will be settled in small villages on the dunes between the polders. The rehabilitation area (12,500 ha) will accomodate 6000-12,000 families. This project includes provisions for research, social assistance, training, credit and extension.

The polder is a dam/dike that closes the entrance to, and prevents the flooding of, a low wadi that has been formed adjacent to the lake by sand dunes. Water levels in Lake Chad vary enough seasonally to allow a simple low-cost dike to become, effectively, a water control device.

Normally the wadis that are connected to the lake fill when the water level is high and drain completely or form ponds when water recedes. Farmers traditionally grow crops along the shores as the water recedes or use a primitive dipping device (chadouf) and a shallow well to get water for irrigation.

A polder prevents flooding of the selected areas and will provide a system whereby farming can be practiced throughout the whole year. The amount of land that will be kept from flooding or put under irrigation is an insignificant percentage of the lake's total area. But there will be additional land under irrigation in the immediate Bol area during the dry season as a result of the project. Future projects to total 100,000 to 150,000 ha are the long-term goal of SODELAC's development, therefore there will be an annual increase in the land empoldered. The impact of the changes that occur will require continual surveillance and counter-measures.

Identification and Evaluation of Environmental Impacts

The project will produce three major changes that could affect the area's environment. The first is the alteration of the flooding pattern of the area through polder drainage and irrigation. The reduction of flooded areas will have an impact on the habitats of fish, snails, mosquitoes and other insects. While fish spawning grounds may decrease, so may possibly the breeding grounds of important endemic disease vectors such as the Bulinus and Biomphalaria snails and the Anopheles mosquito. To be balanced against the potential positive effects is the impact of creating year-round new vector habitats in the irrigation ditches, drainage canals, and shallow wells as a result of the irrigation component of the project. Without proper control measures, the snail and mosquito population could increase and lead to a proportional rise in the schistosomiasis and malaria levels of the population.

The epidemiological study to be conducted as part of the project is to predict the future effects on health to be caused by the project. The study which will require observations for at least one year will produce both a baseline of the present situation needed to measure changes in the future and recommendations for project modifications. Recommendations may include engineering modifications, project activities to reduce snail and mosquito habitats, additional health services, and improved sanitation measures. (See "Health Conditions" Annex.)

A second ecological change will be in the physical qualities of the soils, affected by cropping and water use techniques. The new farming techniques will eventually include the use of herbicides, insecticides, pesticides, and fertilizers to increase or maintain crop yields. However, if their use is not properly managed, the local ecosystem could be altered. Recognizing these dangers, the project has been designed to include research and training at all levels in order to prevent pollution of project areas or adjacent areas. The research component of the project will also seek to reduce the present deterioration of soils and water as to reclaim land previously damaged and now abandoned.

The principal effort of this project will be to increase the number of farmers in a concentrated area and the number of hectares under continual irrigated cultivation. The third change is, then, the resulting population pressure on the ecosystem and community services of the area. The empoldered area population is now estimated at about 7,300 and might (in three years) increase to 18,000. The overall population of Lac Prefecture may not increase, but its distribution will change, concen-

trating near the lake. This will aggravate the problem of human waste disposal and consequently the incidence of urinary and intestinal schistosomiasis as well as gastroenteritis. Later activities, to be designed in detail on the basis of the analysis and recommendations of the epidemiological survey, are to help prevent the deterioration and actually improve the ecosystem. The demand for community services as a result of the sudden increase in population is predictable in the early 1980s. This health hazard will be somewhat offset by the concentration of population closer to existing medical facilities.

The research activities that will be undertaken should have no environmental impact, since they are to determine either baseline data or social/economic information or to be oriented toward management administration.

The maintenance of roads and old polders should help the situation by increasing the availability of social services and eliminating health hazards in old polders.

Conclusion:

The project will affect the ecosystem, the endemic disease level of the local population and the demand for health, social, transportation, and communication services. The changes that will produce these effects are the alteration of flooding patterns, the use of modern farming methods, and the large increase in the are's population. The holistic methodology to be used in design and implementation of this project can be used as a model for future development activities. The epidemiological study will establish a baseline of information about the present environmental health conditions of the area and will recommend investments and changes necessary to both counteract the deleterious effects of the project on the ecosystem and community services structure and to improve it. Agriculture research will also be oriented towards finding ways to reduce the present deterioration of soils and water. Better management, as a result of research, will evolve and allow project improvements to be made a permanent practice. The maintenance brigade as part of the management system can eliminate habitats of hosts or vectors in the polders.

IMPACT IDENTIFICATION AND EVALUATION FORM

Impact Areas and Sub-areas[1]	Impact Identification and Evaluation[2]
A. Lane Use	
1. Changing the character of the land through:	
a) increasing the population	M
b) extracting natural resources	N
c) land clearing	L
d) changing soil character	M
2. Altering natural defenses	M
3. Foreclosing important uses	N
4. Jeopardizing man or his works	L
5. Other factors Enging periodic flooding	L
B. Water Quality	
1. Physical state of water	L
2. Chemical and biological states	L-M
3. Ecological balance	L
4. Other factors	

1/ See explanatory notes for this form
2/ Use the folowing symbols: N-No environmental impact, L-Little environmental impact, M-Moderate environmental impact, H-High environmental impact, U-Unknown environmental impact

C.	Atmosphere	
	1. Air additives	N
	2. Air pollution	N
	3. Noise pollution	N
	4. Other factors	
D.	Natural Resources	
	1. Diversion, altered use of water	L
	2. Irreversible, inefficient commitments	L
	3. Other factors Fishing	L
E.	Cultural	
	1. Altering physical symbols	M
	2. Dilution of cultural traditions	L
	3. Other factors	
F.	Socioeconomic	
	1. Changes in economic/employment patterns	M
	2. Changes in population	H
	3. Changes in cultural patterns	L-U
	4. Other factors	
G.	Health	
	1. Changing a natural environment	M-H
	2. Eliminating an ecosystem element	L
	3. Other factors Creation of vector habitats	M

H. General

1. International impacts	N
2. Controversial impacts	N
3. Larger Program impacts	N
4. Other factors	

I. Other possible impacts:

The SCET feasibility study addresses the ecological interference in the strongest possible terms. The process of degradation occurs when he water table comes close to the surface. Then due to the 10 month dry season, that water evaporates causing a salt concentration, the organic matter ferments which creates a reducing medium. Reduction products are Na_1CO_2 and $NA_4(CO_3)_2$. The organic matter is soluble in this medium, and is carried off to the lake by rain. As a result the land becomes hard-caked and thus impermeable.

Dyking the polders, lowers the water table while washing, draining and skimming the surface-salt helps decrease the accumulation of salts caused by evaporation. Aeration helps the formation of SO_4 which replaces the Na_2CO_3 and $Na_4(CO_3)_2$. Gypsum helps the SO_2 to form SO_4 which is a neutral salt. Thus the environmental deterioration is arrested.

B. Financial Plan

The following six tables present the financial details of the project. Briefly, the AID project will cost $6.9 million of which $4.4 million will be for the development of the polder itself; $1.6 million for the strengthening of SODELAC and the mobil maintenance brigade, and $1.5 million for research and related activities and $ .4 million for health services. Personnel costs will represent less than 10% of the total, commodities (mostly pumps amd construction machinery for the mobil brigade) about 20% and other costs, 70% (mostly construction costs and local salaries). Included in the other costs components is $260,000 for a revolving credit fund. The fund will be modeled on the World Bank's credit fund, be administered by SODELAC, and provide an average of $325 for each settler.

The most striking feature of the project is the cost per hectare of irrigation. The cost per irrigated hectare is $5,500. This cost reflects a number of conditions specific to Chad; these include (a) high external transportation costs due to Chad's landlocked position and distance from the sea; (b) high internal transportation costs; (c) and, a generally low level of experience in irrigation and major civil works in Government agencies. It does not appear that the above situation will change in the short run, although it should improve as experience is built up through the implementation of irrigation projects. Major items in project costs also reflect the diseconomies of a small scale operation. As SODELAC realizes economies of scale it is expected that per-hectare polder development costs will decline.

The recurrent budget analysis of the implementing agency is contained in Annex C.

BUDGET TABLE I

Polder Development Component - Annual Costs (000 $)

	Total	1st yr	2nd yr	3rd yr	4th yr
Personnel					
Consultants	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -
Commodities	644.0	400.0	144.0	100.0	- 0 -
Pumps Station	480.0	400.0	80.0	60.0	- 0 -
Materials	164.0	- 0 -	64.0	40.0	- 0 -
Other Costs	3.200.0	555.0	703.0	1.332.0	610.0
Salaries	340.0	85.0	85.0	85.0	85.0
Exploitation*	260.0	- 0 -	65.0	130.0	65.0
Roads	52.0	13.0	13.0	26.0	- 0 -
Leveling	168.0	15.0	75.0	78.0	- 0 -
Dikes	300.0	235.0	65.0	- 0 -	- 0 -
Pumping	80.0	60.0	20.0	- 0 -	- 0 -
Irrigation					
Headworks	400.0	100.0	100.0	200.0	- 0 -
Primary Canals	552.0	47.0	200.0	205.0	100.0
Secondary	840.0	- 0 -	80.0	400.0	360.0
Drains	208.0	- 0 -	- 0 -	208.0	- 0 -
Sub-Total	3.844	955	847	1.432	610
Total Cost includes contingencies and 10% for 2nd year, 20% for 3rd year, 30% for 4th year and rounding	4.405	955	930	1,720	800

* $260.000 to be used as a revolving credit fund.

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BUDGET TABEL II

STRENGTHENING OF SODELAC - ANNUAL COSTS

Cost ($000)

	Total	1st Yr	2nd Yr	3rd yr	4th Yr
Personnel	-0-	-0-	-0-	-0-	-0-
2 PCVs (works Supt. & Surveyor)					
Commodities	234.8	234.8	-0-	-0-	-0-
Bulldozer D4	52.0	52.0	-0-	-0-	-0-
Loader	40.0	40.0	-0-	-0-	-0-
Tractor + Low Bed	68.0	68.0	-0-	-0-	-0-
Truck	20.0	20.0	-0-	-0-	-0-
Vehicles (4)	32.0	32.0	-0-	-0-	-0-
Surveying Eqpt.	8.0	8.0	-0-	-0-	-0-
Hand tools	8.0	8.0	-0-	-0-	-0-
Site Eqpt.	6.8	6.8	-0-	-0-	-0-
Other Costs	341.0	-0-	60.0	111.0	110.0
Salaries + Costs (Works Supt. Topographers, 7 operators 10 laborers)	-0- 41.0	-0- -0-	-0- 10.0	-0- 21.0	-0- 10.0
Operations (fuel, oil, parts)	300.0	-0-	50.0	150.0	100.0
SUB-TOTAL	575.8	234.8	60.0	171.0	110.0
Total cost including contingencies and 10% 2nd year 20% 3rd year 30% 4th year and rounding	655	235.0	70.0	205.0	145.0

BUDGET TABLE III

Research Component - Annual Costs

Costs (000$)

	Total	1st yr.	2nd yr.	3rd yr.	4th yr.
Personnel	296.0	24.0	140.0	132.0	0
Socio/Economist (12 mm)	120.0	0	60.0	60.0	0
Agronomist (24 mm)	120.0	0	60.0	60.0	0
Consultants (12 mm)	56.0	24.0	20.0	12.0	0
Commodities	159.6	59.6	50.0	50.0	0
Laboratory	8.0	8.0	0	0	0
Farming	14.0	14.0	0	0	0
Vehicles (4)	25.6	25.6	0	0	0
Material	12.0	12.0	0	0	0
Pumps	100.0	0	50.0	50.0	0
Other Costs	912.4	502.6	175.6	99.6	134.6
Houses (4)	204.0	204.0	0	0	0
Utilities	84.0	34.0	45.0	5	0
Repair House	40.0	20.0	20.0	0	0
Repair Lab.	46.0		16.0	0	30.0
Salaries	112.0	28.0	28.0	28.0	28.0
Operation	226.4	56.6	56.6	56.6	56.6
Travel/Training	40.0		10.0	10.0	20.0
Contracts*	160.0	160.0	0	0	0
Totals	1,368.0	586.2	365.6	281.6	134.6
Total and Contingencies (10% 2nd yr. 20% 3rd yr. 15% 4th yr., and rounded)	1,500	590.0	400.0	340.0	170.0

*SODELAC Management study

BUDGET TABLE IV

Health Activities ($000)

	Total	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.
Personnel	-0-	-0-	-0-	-0-	-0-
Commodities	-0-	-0-	-0-	-0-	-0-
Other Costs	300.0	-0-	95.0	105.0	100.0
Hospital Program		-0-	20.0	15.0	18.0
Health Education Center		-0-	-0-	20.0	-0-
Elimination of Health Hazards		-0-	10.0	5.0	-0-
Paramedic Program		-0-	6.0	12.0	6.0
Service Centers		-0-	10.0	10.0	20.0
Endemic Disease Control		-0-	10.0	10.0	20.0
Water Wells		-0-	20.0	15.0	27.0
Village Rodent Proof Storage		-0-	4.0	8.0	4.0
Contingencies 10%		-0-	10.0	10.0	10.0
Sub-Total		-0-	95.0	105.0	105.0
TOTAL COST includes contingencies and 10% for 2nd Yr 20% for 3rd Yr 3-% for 4th Yr rounded	340.0	-0-	100.0	125.0	135.0

BUDGET TABLE V

SUMMARY TABLE ($000)

Budget by Activity and Year	Year				
	Totals	1	2	3	4
1. Polder Development	4,405	955	930	1,720	800
2. SODELAC Strengthening	655	235	70	205	145
3. Research	1,500	590	400	340	170
4. Health Activities	360		100	125	135
Total	6,920	1,780	1,500	2,390	1,250

Budget by Category					
	Totals	1	2	3	4
Personnel	340	25	155	160	0
Commodities	1,090	695	215	180	0
Other Costs	5,490	1,060	1,130	2,050	1,250
Total	6,920	1,780	1,500	2,390	1,250

BUDGET TABLE VI

SUMMARY COST ESTIMATE AND FINANCIAL PLAN
(US $ 000)

PROJECT PAPER

Source	AID GRANT FX	AID GRANT IC	HOST COUNTRY FX	HOST COUNTRY IC	OTHER(s)+ FX	OTHER(s)+ IC	TOTAL
Use*							
Personnel	340	0	0	250	2,850	2,000	5,440
Commodities	1.090	0	0	0	1.300		2,390
Other Costs	1,520	3,970	0	400		6,770	12.660
Includes Inflation factor and contingency factor	10%/year		5%/Year		15%/year		
TOTAL	2,950	3,970		650	4,150	8,770	20,490

* Includes IDA, FAC, AFDC, PEACE CORPS

C. Economic Analysis

Introduction: In determining the economic feasibility of this project it is necessary to do an analysis in terms of the macroeconomic factors (i.e. the effects on the overall economy and the rate of return on the investment) and the microeconomic factors (i.e. the financial feasibility from the point of view of the farmers in the area of influence.) After considering each of these points the cost effectiveness of the project will also be discussed.

1) Macroeconomic feasibility: The traditional measure of project's feasibility is the benefit/cost ratio. This is a measure of the project's social benefit and compares the present worth of the project's benefits to the present worth of its costs. Normally, a project with a benefit/cost ratio of one or greater is acceptable.[a]

For the present project, the direct benefits to the economy will consist of the increase in production from the polders. From Table I, which compares family production before and after the project, this can be calculated at CFA 251,900 (i.e. the increase in wheat production of CFA 119,400 and the cotton production of CFA 132,500) or $1,007.00 per irrigated hectare. Since there will be 800 irrigated hectares, the economy will realize an increase in production of about $806 thousand per year. About 30% of this will be realized in year three, 80% in year four and 100% from year five on. The costs of the polder project will amount to $4,405,000 over the four-year construction period. (See budget tables in Part 3.B). There will also be operation and maintenance costs for the polder and irrigation facilities (assumed to reach $50 thousand annually by year seven), and each farmer will have additional annual operating costs of CFA 69,300 ($277). On the basis of this information, the benefit/cost ratio (utilizing a discount rate of 12%) will be only .8 after ten years of operation.

This result pinpoints the paradox ofthis project, i.e. why is it such a good deal for the farmer, yet not so good for the economy? Part of the reason is that the traditional forms of benefit/cost analysis cannot capture the full range of benefits to be realized from the project, much less give them a monetary value. The following secondary economic benefits claimed by the World Bank's project would also apply to this project:

(a) It would create a pole of development in the so far underprivileged northern part of Chad; it would help stabilize the farm

a) See Economic Analysis of Agricultural Projects, J. Price Gittinger, A World Bank Publication.

CHAD

LAKE CHAD IRRIGATED AGRICULTURE

Settlement Farmer Income 1/

	Without Project				Under Project			
	Price	Area	Yield	Value	Price	Area	Yield	Value
Dune Cultivation - Millet	CFAF 25/Kg	1.3 Ha	600 Kg/Ha	19,500	CFAF 25/Kg	1.3 Ha	600 Kg/Ha	19,500
Polder Cultivation- Wheat	CFAF 50/Kg	0.075	1,500 Kg/Ha	5,600	CFAF 50/Kg	1.0 Ha	2,500 Kg/Ha	125,000
- Maize	CFAF 20/Kg	0.075	1,500 Kg/Ha	2,300	CFAF 20/Kg	-	-	-
- Seed Cotton	CFAF 53/Kg	-	-	-	CFAF 53/Kg	1.0 Ha	2,500 Kg/Ha	132,500
Sub-Total				27,400				277,000
Livestock Production				5,500				5,500
Total Production Income 1/				32,900				282,500
Operating Costs including investment and net credit operations				-				167,000
				32,900				115,500
Net cash Flow				($ 131)				($ 462)

1/ Does not include Polder Gardens, the production of which would be substantial but is not quantifiable at this time

Source: Adopted from World Bank Report N° 828 a - CD, Annex 3, Table 2 and 3.

community, which otherwise would continue migrating to the south and the towns; it would help reduce the income disparity between the northern and the southern regions of the country and between the rural and urban populations.

(b) It would help strengthen the balance of payments of the country by providing a permanent source of foreign exchange earnings and savings. Net foreign exchange would amount to U.S. $2 million annually by 1980.

(c) It would provide a reliable source of agricultural production, which in case of drought could be converted entirely to the production of cereals, and thus reduce the need to import food to avert famine; it would also provide the crop by-products needed to establish a livestock finishing industry in the Bol area.

(d) It would provide a basis for the development of a modern technology in irrigated agriculture, thus preventing the progressive salinization and eventual abandonment of other polders. About 70% of the 22,000 ha empoldered since 1959 have become unsuitable, possibly permanently, for cultivation, because traditional irrigation exacerbates the natural salinization process and is resulting in the destruction of this major resource.

While it is difficult to impart a monetary value to these benefits, such a value would not have to be high to produce an acceptable rate. For example, preventing migration to the cities will result in a saving in social infrastructure costs conservatively estimated at $100 per family, or a one-time saving of $80,000. The value of the annual balance of payments savings could not be estimated by imparting a 20% shadow price factor to the foreign exchange costs of an equivalent amount of wheat imports. In our case, this would amount to about $75,000 per year. The value of benefits from a reliable source of agricultural production and a modern technology in irrigated agriculture could be calculated by taking a portion of the imports which will be obviated by the increase in future output. For example, Chad is currently importing about $20 million of food annually, and virtually all observers agree that the country could be self-sufficient, or even a net exporter of food. If the spin-off and demonstration effects of the project allow a reduction of only 4% in overall food imports, an annual savings of $500,000 would result. This benefit would take time to be fully realized, but perceptible effects should begin after 5 years of operations.

Although the methodology used to determine the above values is somewhat arbitrary, the results appear compatible with the experiences in other countries where growth in the agricultural sector is the mainspring of overall economic growth. Accepting these values as illustrative, and combining them with the direct production benefits calculated earlier, produces a benefit/cost ratio of 1.01. (See Table II.)

Due to the arbitrary values assigned to the secondary benefits, an exhaustive sensitivity analysis of the project is not particularly meaningful. About all one can say is that the rate of return will be noticeably influenced by increases in construction costs because they occur early in the life of the project and heavily influence the present-value calculations.

An alternate way to approach the economic feasibility of the project is to calculate the internal rate of return (IRR). The IRR represents the average earning power of the money used in the project over the project's life. Stated differently, it is the discount rate which produces a benefit/cost ratio of one. In our case, the IRR would be slightly over 12%. In other words, at a discount rate of 12% this project just breaks even. That is, it will earn back all the capital and operating costs expended on it and pay us 12% for the use of our money in the meantime.

When viewed from this angle, is it still a good idea to move ahead with the project? To resolve this question onr must ask one's self if there is any cheaper way to increase Chad's food production by $806,000 per year and at the same time significantly improve the economic and social condition of 800 farm families in the Sahel. AID, SODELAC, the World Bank, and others have looked at this question and concluded that there is not.

The other alternatives suggested which include doing nothing, i.e. selective starvation, relying on occasional food relief operations, and carrying out deep-well irrigation projects in the northern Sahel, are either socially unacceptable or economically infeasible.

For example, to rely on food relief is an expensive operation with few lasting results. In a single fiscal year, 1974, AID spent over $7.0 million to distribute 15,364 metric tons of grain and to combat the effect of the drought. Currently, the U.S. is spending $7.5 million to purchase and deliver 13,500 tons of food relief to drought-striken areas of Chad. The results of these expenditures are hard to pinpoint since they are essentially expenditures for current operation, with no investment effect. It is clear from this that short-run

Table II
LAKE CHAD IRRIGATED AGRICULTURE[a/]
Calculation of Benefit-Cost Analysis ($ 000)

Year	Capital Costs	Operation & Maint.	Production Costs	Gross Costs	Discount Factor @ 12%	Present Worth @ 12%
1	955	-	-	955	.893	853
2	935	-	-	935	.797	745
3	1720	-	66	1785	.712	1272
4	795	10	177	982	.636	625
5		20	221	241	.567	137
6		40	221	261	.507	132
7		50	221	271	.452	122
8		50	221	271	.404	109
9		50	221	271	.361	98
10		50	221	271	.322	87
						$4180

Year	Value of Production (Gross)	Value of Secondary Benefits	Total	Discount Factor @ 12%	Present Worth (Benefit)
1	-	-	-	.893	- 0 -
2	-	-	-	.797	- 0 -
3	242	105	347	.712	247
4	644	50	694	.636	441
5	806	100	906	.567	513
6	806	125	931	.507	472
7	806	175	981	.452	443
8	806	275	1081	.404	437
9	806	375	1181	.361	426
10	806	575	1381	.322	445
-	2500[b/]	-	2500	.322	805
					$4229

a/ While the project is expected to have an indefinite life, only the first 10 years are considered here. After 10 years, the discount factor becomes quite small, and changes in cost or benefits become correspondingly less significant.

b/ Salvage value, see Gittinger, pages 60 & 106. At the end of 10 years, the economy will have a functioning polder. This amount represents the "scrap value" of the polder at that time and represents a benefit to the economy, and whose present value is $805 thousand.

$$\text{Benefit/Cost ratio} = \frac{\$4229}{\$4180} = 1.01$$

"solutions" are nonstarters, and that Chad must begin a longer run program to increase food production. This project represents such an effort.

In summary, the macroeconomic analysis has shown that while the initial production effects of the project are not sufficient to justify the project, the secondary and longer-run economic benefits are such that an internal rate if return if 12% can be anticipated. Also, in view of the alternatives, the project as designed represents the most cost-effective approach to the dual problem of increasing Chad's food supply while offering an alternative to the population of the drought-prone Sahel.

Economic Feasibility of Infrastructure Maintenance and Research

The maintenance and repair of infrastructure to be done by the mobile brigade can also be subjected to benefit/cost analysis and an IRR could be calculated. There are difficulties, however, in estimating the size of the benefits to be realized and in giving them a monetary value. Increased output can be expected from the 28 polders that will eventually be connected with the marketing center of Bol. Also, there will be user cost savings on transportation but these are difficult to estimate at this time. In view of the uncertainties involved, no attempt will be made to give a precise definition of the benefits to be expected. In view of the low cost of this activity, however, the benefits would not have to be great for an acceptable return. For example, if we can assume that the equivalent of 1,000 hectares will eventually be brought into permanent production and that the production from each hectare will be about $400 per year, then the benefit cost ratio after 10 years would be 1.3. Finally, it is the judgement of SODELAC and USAID that a mobile maintenance brigade is the most cost effective approach to the problem.

No attempt was made to estimate the economic feasibility of the research activity. This is an extremely difficult activity to evaluate, and it is probably best to consider it a current expense of SODELAC. However, an example of the type of return to be expected from crop research is contained in the September 1976 Scientific American, "In Colombia the annual expenditures on rice research and related activities never exceeded $1 million. In Colombia alone and in one year alone, (1974) the added production resulting from the introduction of the new technology was valued at $230 million".

2) Microeconomic feasibility: Small farmers' participation

As pointed out by the World Bank, the key to the project's success is the ability of SODELAC to attract enough people to become settlers. The present population in the area of influence of the project was estimated as follows in 1975, and probably increased by 2% per year since then:

	Total numbers	Farm population	Number of farm families
Within 5 km of Bol	7,300	2,900	700
Bol subprefecture (5 - 60 km)	29,300	13,700	3,400
N'Gouri subprefecture (to 60 km)	25,600	11,500	2,900
Subtotal	62,200	28,100	7,000
Remaining Lac Prefecture	33,100	13,300	3,300
Kanem Prefecture	156,000	73,000	18,300
TOTAL	251,300	114,400	28,600

By the time the two World Bank polders are complete (end CY 1978) about 1,200 of the families would be placed on the rehabilitated polders. If the third polder to be developed by the Banque Arabe de Developpement Economique de l'Afrique (BADEA) is completed on schedule (1980), an additional 1,650 families will be required. These three polders would then absorb 2,850 of the 7,000 farm families in the area of influence, leaving 4,150 families available as potential settlers on the AID polder. If only 20% were willing to participate (a low figure in view of the benefits involved), there would be enough families to populate the AID polder completely.

Also, as word of the project spreads, one can contemplate some migration of the 21,600 families living beyond 60 kilometers from Bol. The mobility of the population has already been evidenced by the mass migration that occurred when the first polders were constructed. Given the relatively low requirements of the project compared to the total

population of the area, it is safe to assume that the polders would be settled in a timely manner provided that adequate incentives are offered and maintained. Also, as more polders are developed, a significant proportion of the population of the Chadian Sahel will be given an opportunity to improve their economic and social condition.

With respect to labor requirements, the World Bank team provided estimates of the man-day requirements for double cropping a one hectare irrigated plot on the polders. The average farm family in the area can provide 70 man days per month of work (2.8 economically active people working 25 days per month); or 840 man days per year. The irrigated plot together with some millet production on the dunes will require 364 man days leaving 476 man days for the cultivation of family gardens, marketing, maintenance etc.. There are, however, heavy labor requirements for harvesting and land preparation which, in September and October, will require 127 of the 140 man days available. On the basis of this analysis it appears that a one-hectare plot can be cultivated by a family unit.

3) Farmers' Costs and Benefits:

The farmer family can be expected to participate in the program only if it represents a better alternative than traditional agriculture.

In the loan paper prepared by the World Bank for their polder development project, there is a section on farmer benefits and costs recovery. The World Bank's analysis provides estimates for a typical farmers' budget and cash flow over a seven-year period for one hectare of irrigated land. The World Bank concludes that after meeting all costs, the family would realize a net cash flow of CFA 115,500 ($462). This compares to $131 under traditional agriculture. (See Table III.)

Included in the cost are charges for the services which SODELAC provides to the farmer family (costs of the irrigation system, extension, and other overhead) and the costs incurred in collecting and delivering the family's produce. The World Bank concluded that the return to the farmer was sufficient to insure his active participation, but recognized that fee levels would have to be tested and farmers' reactions noted. Equity demands that the farm families on all three polders receive the same treatment from SODELAC, and one of the issues which SODELAC will face is to come up with an equitable schedule of charges. It is clear, however, that the farmer himself will be better off with the polder than without it, and that there is sufficient margin to insure his active participation.

Table III

CHAD

LAKE CHAD POLDERS PROJECT

Agricultural Development

Settlement: Farmer Budget and Cash Flow

(CFAF '000)

	Before Project	Under Project							
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Average Year 1-Year 7
I. Inflows									
Production value	32,900	282,500	282,500	282,500	282,500	282,500	282,500	282,500	282,500
Credit received:									
Farmer's investment	-	24,400	35,000	-	7,400	-	-	42,400	15,700
Farmer's seasonal requirements	-	63,500	67,900	67,900	67,900	67,900	67,900	67,900	67,300
Total Inflows	32,900	370,400	385,400	350,400	357,800	350,400	350,400	392,800	365,500
II. Outflows									
Farmer's Investment									
Grain for food 1/	-	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000
Sprayer	-	7,400	-	-	7,400	-	-	7,400	3,200
Cultivator & attachments 2/	-	-	9,500	-	-	-	-	9,500	2,800
Seeder 3/	-	-	6,400	-	-	-	-	6,400	1,800
Cart 3/	-	-	8,500	-	-	-	-	8,500	2,400
Oxen 4/	-	-	10,600	-	-	-	-	10,600	3,100
Total Farmer's Investment	-	24,400	52,000	17,000	24,400	17,000	17,000	59,400	30,300
Farmer's Operating Costs									
Purchase of cotton seeds 5/	-	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900
Purchase of wheat seeds 5/	-	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200
Mechanical land preparation cotton 6/	-	1,500	-	-	-	-	-	-	300
Mechanical planting cotton 7/	-	1,000	-	-	-	-	-	-	200
Mechanical land preparation wheat 8/	-	4,500	-	-	-	-	-	-	900
Mechanical planting wheat 9/	-	1,000	-	-	-	-	-	-	200
Pest control cotton 10/	-	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Fertilizer for wheat 11/	-	-	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Threshing wheat 12/	-	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Packing materials - wheat 13/	-	4,900	4,900	4,900	4,900	4,900	4,900	4,900	4,900
Packing materials - cotton	-	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800
Total Farmer's Operating Costs	-	63,800	88,000	88,000	88,000	88,000	88,000	88,000	89,300
Debt Service on Credit Received									
Farmer's investment 14/	-	2,500	15,700	15,700	17,800	17,800	11,200	11,200	13,700
Farmer's seasonal requirements 15/	-	9,400	9,800	9,800	9,800	9,800	9,800	9,800	9,700
Total Debt Service	-	12,900	25,500	25,500	26,600	26,600	18,000	18,000	20,400
Total Outflows prior to Water Charges	-	100,900	162,500	107,500	117,000	109,600	103,000	165,400	120,000
Net Cash Flow prior to Water Charges	32,900	269,500	242,900	242,900	240,800	240,800	247,400	247,400	245,500
Water Charges 16/	-	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Net Cash Flow	32,900	139,500	112,900	112,900	110,800	110,800	117,400	117,400	115,500
Man-days worked - Irrigation	93	364	364	364	364	364	364	364	364
Millet Cultivation	125	25	25	25	25	25	25	25	25
Total Man-days worked	218	389	389	389	389	389	389	389	389
Net Cash Flow per Man-day worked (CFAF	151	354	290	290	285	285	302	302	297

1/ 550 kg yield/ha.
2/ shared between 3 farmers.
3/ shared between 5 farmers.
4/ 25 kg @ CFAF 53 kg.
5/ 80 kg/ha @ CFAF 53/kg.
6/ 2 hours @ CFAF 1,300/hour.
7/ 1 hour @ CFAF 1,300/hour.
8/ 3½ hours @ CFAF 1,300/hour.
9/ 1 hour @ CFAF 1,300/hour.
10/ 6 sprays @ 3 l/spray @ CFAF 1,500/l, including battery cost of sprayer.
11/ 45 kg N + 45 kg P205.
12/ using stationary combine 0.3 hour/ha.
13/ 50% kg are consumed by the farmer.
14/ repaid over 5 years @ 10% interest rate.
15/ 1 year.
16/ CFAF 74,000/ha (O&M) and CFAF 56,000/ha (capital).

Before concluding this section it may be helpful to contrast the AID and World Bank projects. The World Bank activity consists of rahabilitating two polders already reclaimed from the lake and the provision of technical, marketing, and credit services and inputs for about 1,200 farm families to whom plots on the polders will be allotted. The cost for the entire project is $13 million of which $5.0 million were provided under an IDA credit. The cost of the civil works alone amounted to $4,800 per hectare, and this is low, since both polders were diked and dried out some 15 years earlier. In 1975 it was estimated that the cost of developing a polder from scratch would be $6,300 per hectare. The average cost for AID's project will be about $5,500 per hectare. The difference is due to economies to be realized by using the same machinery and equipment financed by the World Bank, using the same designs, and virtually the same project unit which the World Bank has put together.

The really striking difference is that the IDA credit must be repaid by SODELAC over 50 years but at a very low interest rate (0.25%), while the AID project will be grant-financed. The World Bank has estimated, however, that only 40% of SODELAC's initial investment and recurrent expenses could be recovered over the 50-year period. Hence, there is a large element of GOC subsidy in the project. The rationale for AID grant rather than a loan rests on the following:

- The AID project contains significant amounts for research and maintenance. Although these expenditures are expected to produce substantial benefits, they will generally not be available to provide revenue for loan repayment.

- The debt-carrying capacity of the GOC is extremely weak. According to the IMF (SM/76/193), during 1975, debt payment requirements were equivalent to 11% of exports, and by the end of the year, debt arrears amounted to $10 million. An AID loan would only exacerbate the situation.

- One of the important reasons for the project is to upgrade the capacity of SODELAC to act as an effective development institution (the TVA of the Sahel). The return which the project will generate will help SODELAC acquire the financial capacity to develop new polders.

- As set forth in FAA Sec 211(a), Chad is among the 40 countries in which development assistance grants may be made.

D. Social Analysis:

The purpose of the social analysis is threefold: (1) to determine the compatibility of the project with the sociocultural environment into which it is to be introduced, (2) the likelihood that the practices introduced will be difused among other groups (spread effects) and, (3) the social impact or distribution of benefits and burdens among different groups.

While some of these points have been touched upon in other sections of this PP, available information does not permit an exhaustive analysis of each of these questions. The brief discussion presented below will be augmented by social research undertaken by the socioeconomist who will be attached to the Matafo research station.

1. Socio-Economic Environment and Sociocultural Feasibility:

The archipelago of sand islands, which can be transformed into polders, occupies some 28% of the area of Lake Chad. The archipelago is located in the Prefecture du Lac (headquarters Bol) and in the Prefecture du Kanem (headquarter Mao). The total population of the two prefectures is about 250,000; population pressure averages 4/km^2, but is about 30/km^2 close to the lake. Most reside in villages of from 60 to 500 inhabitants.

In the Sahel zone of Chad, the Arabs are the most numerous ethnic group and the predominant religion is Islam. The culture and religion of an Arab society provides the major unifying influence in the Chadian Sahel, and provides for a symbiotic relationship in the areas where nomads and sedentary people live together.

Loyalty to the immediate kinship group is the predominant basis for social values. Control of behavior is exercised through a sense of reciprocity that links an individual's social and emotional rewards with fulfillment of his obligations to the group. In principal then, the interests of the group are paramount and override those of the individual in cases of conflict. Customary law demands that crimes committed by or against an outsider be judged according to the idea that the individual represents his entire group.

Chadian Arabic societies are introspective and appear to be rooted in a fixed concept of the world. They are naturally fatalistic by virtue of the exigencies of their very harsh environment. Bolstered somewhat by Koranic writ, the condition of their existence is rationalized as Allah's will. These are the general parameters of the social systems which previal in the project activity area.

There are essentially two socio-cultural groups living in the project area: the Boudouma and the Kanembous.

The Boudouma, originally inhabitants of the lake islands, are fishermen by tradition; they also grow millet on the dunes during the rainy season. In precolonial times, the Boudoumas controlled the islands and the shore, the Kanembous the mainland, and the two groups were frequently at war; the area close to the shore was a no-man's land without appreciable settlement until the French came.

As summarized in the background section (Part 2.A), with the arrival of the French, greater attention was devoted to bringing the polder area under cultivation, and by mid 1961 about 6,500 hectares had been reclaimed. Consequently, a tradition of irrigated agriculture has been established. Not much is known about the changes in social structures which accompanied the transition to polder agriculture; however, the fact that a combination of polder and dune agriculture is now widely practiced implies that the transition was successful. The social structure can accomodate migration which is common in the area.

A number of crops are grown in the lake prefecture: millet, wheat, maize and onions are some of the more important. Cotton, tomatoes, beans, peppers, okra, potatoes and sorghum are also cultivated. Millet, the basic food crop of the region, is a rainy season crop grown on the dunes. Wheat has been cultivated in the area under traditional irrigation for at least a hundred years; it is a luxury food that sells at a relatively high price. Maize is planted after millet in wet areas of the polders and along the edge if the lake; at times, it is cultivated under irrigation. As the Kanembous and Badumas appear to be the only groups in Chad who eat maize to any significant degree, the possibilities of marketing large quantities of maize are limited. Large quantities of onions are grown in the dry season and are marketed in N'Djamena.

The traditional systems of farming are extremely simple. Cultivation is carried out mainly by hand; methods such as row planting, fertilizer, improved seeds, and insecticides are virtually unknown. Irrigation, where used, is by digging shallow wells in the dry river beds (wadis) and polders, and extracting the water with the traditional shadoof. In recent years, some small motorized pumps have been introduced; but most of these are not functioning either through lack of maintenance or problems in obtaining fuel. Traditional yields are low, 500-600 kg/ha for sorghum and 1,000-1,500 kg/ha for maize and wheat.

The question of land tenure on the newly opened polders is addressed in the issues section and will be resolved by SODELAC. Land occupancy on presently settled land is rooted in tradition with the village leader (chef du canton), the primary figure in influencing its distribution.

Since the polders will represent a net addition to the land of the region (they are presently under water) no land will be "redistributed," only settled. The procedure to be used is articulated in Part 4.A (Administrative arrangements) and will be done by SODELAC in coordination with the local community leaders. In this respect, the resident socio-economist will act as a settlement advisor.

While these may be a tradition of irrigated agriculture, the traditional system is quite different than that which will be practiced on the irrigated polders. The traditional system of low-lift wells utilizing surface water will be replaced by canals utilizing lake water. This implies that the farmer must be ready when the water is, and that the control of water is no longer in his hands. It will be easy to blame someone else when the water is not there. To address these types of problems, the project has been designed to have twelve farmers share each main outlet. Also, there will be extension agents to provide assistance, and the SODELAC Commercial Unit will provide extensive technical assistance for the first full year of occupancy. (See Part 4 A). Under these arrangements it is felt that the individual's new social order will be manageable. He will be a member of a small group, and he and the other members of this group can set up the system which best suits their needs. His life style will undergo changes, but he is no stranger to change. To smooth the transition, there will be some solid economic incentives (a tripling of his realized income - see Part 3.C). On the basis of observation and reactions to the opening of other polders, the population does respond to economic incentives. Finally, the manpower requirements are manageable. (See Part 3-C for a discussion of labor requirements).

On the basis of this brief analysis we conclude that the project is feasible from the social and cultural point of view. In discussions with consultants, Chadians and other observers, we can detect no social or cultural barriers that would preclude the realization of the project goal.

2. Spread effects:

The present project is essentially a result of the spread effects of other polder projects. Just knowing how to grow crops under irrigation, however, is not enough; you need the polder, dikes, canals, etc. Consequently, the possibility of replicating the project is limited in terms of the ability to develop new polders. In an effort to lower the cost of developing other polders, however, an important ingredient in the project will be to study the feasibility of using alternate irrigation methods, i.e. low-lift pumps. (The pros and cons of this issue are set forth in Part 2.B). Once the appropriate technology is decided upon and the funds are made available, we see no limits to the facility for replicating this project. The analysis of population of the area in Part 3.C indicates there are plenty of potential settlers, and there are many polders that can be developed. As is typical, there is a resource shortage both financial and managerial. Consequently, the spread effects of the project will be limited in terms of SODELAC's ability to expand its role as a regional development force, rather than in terms of any known social or cultural barriers.

3. Distribution of Benefits:

The benefits to be realized by settlement farmers were enumerated in Part 3.C. Proper distribution will be insured by the requirement that each family have one hectare to cultivate. Also, the selection procedure to be used by SODELAC will assure that priority is given to those families whose only activity is agriculture (see Part 4.A). An improvement in the economic condition of participants is virtually assured since it is unlikely that anyone would give up a higher socio-economic position for a lower one.

Participation in economic development is more than just a sharing of benefits; it also implies a sharing of the inputs. On our case, the inputs are family labor and other purchased inputs. As indicated in Part 3.C, the family labor requirements will go up from 118 days per year under traditional agriculture to 389 man days (out of an available total of 840 man days). The small farmer will also participate in other ways. He will be involved in decisions concerning water utilization, and through local leaders he will have a voice in the Bol development commission which will establish local development priorities (see Part 2.B). In summary, we see the small farmer as an active participant in the development of the region who will have a fair share of the costs and participate in its benefits.

4. The Role of Women: The traditional societies in the area have well established roles for men, women and children which are generally not understood by westerners. It is not anticipated that this project will appreciably change these traditions in the short run.

Before concluding the social analysis, it should be emphasized that there will be a socio-economist attached to the Matafo experiment station. This person's duties will include an ongoing assessment of the social climate and the definition and design of social assistance that may be required.

Part IV: Implementation Planning

A. Administrative Arrangements: The development of Tandel polder is a part of a larger development activity in the Bol area. The two World Bank polders will be completed by 1979-80, the AID polder will be receiving settlers starting in 1980, and the BADEA financed polder shortly thereafter. As the first two polders are settled, considerable experience in settling and administering the polders will be acquired by SODELAC. Until this experience is analyzed, the best approach is to adopt the settlement plan which the World Bank has worked out with SODELAC. In what follows that plan is presented in terms virtually the same as those in which it was presented in Annex 3 of the World Bank loan paper.

Crop Production System

To maximize the benefits to the local farming community, and to minimize the cost of farming, the principle has been retained that the project polders would be settled by individual farmers, each cultivating 1 hectare, assuming 2.8 adults in the farm family. The large-scale plantation approach was rejected, as it would require scarce management talents and costly mechanization, and would in any event have a lesser impact on the local farming community.

The total irrigation program now planned, including the development of Mamdi and Tandal polders, assumes that 3,600 farmers would acquire land over the period 1976-85. Problems involving the recruitment of farmers and settlement may consequently slow down the development rate. Furthermore, there are bound to be technical and pedological limitations in the first years of cultivation. To ease the way for settlement, a Commercial Agricultural Development Section has been formed under the Project Unit; this Commercial Section is responsible for the first year of production in any given area; thereafter, the area would be settled. This Commercial Section acts as a land development agency, and is responsible for the first year of operations on all newly developed land (about 400 hectares annually), and for the basic cultivations during the following year, which would be the first year of settlement. In the latter case, the Commercial Section would clear, disk, and plant a cotton and a wheat crop, thus giving the new settler a better chance to settle down and to learn the new techniques that will be demanded of him. This is also necessary to correct leveling for production and ecological reasons.

In concert with the project, the administration of Lac prefecture is assuming responsibility for the selection of settlers and the allocation of land. The applicants are being selected according to the following criteria; (a) number of people in the family; (b) how much time they spend on agriculture; and (c) ownership of bullocks. At first only those farmers whose sole activity is agriculture are to be considered. Those farmers already living along polders and cultivating on the polders are being given first priority for land allocation.

Legal ownership of the polders is vested in the Republic of Chad (decree of August 1, 1967).

Plots are to be leased to settlers for a three--year period. Repossession would occur if farmers did not comply with the terms of their lease, which will stipulate their financial and general obligations. Among these, the settlers must agree to:

(a) cultivate their plots in a continuous, total and rational manner;

(b) follow extension agents' advice;

(c) comply with the irrigation system, in particular the rotation of water application;

(d) cultivate with their own family labor; and

(e) pay all financial charges.

A renewable three-year lease gives holders a satisfactory security of tenure, and permits the project to make changes necessary in the general interest, i.e., change of plot size or exchange of plots. Such flexibility is essential in the early years of the project. It is expected that the three-year period can be lengthened once both management and settlers have overcome the initial difficulties inevitable in a project of this type.

The Smallholder

After his first year of operation, the small holder will receive no mechanical assistance. He will divide his year into a five or six-month wheat season and a six-or-seven-month cotton season. His peak labor requirements will be in the period mid-September to mid-November, a time when he harvests his cotton, and cultivates and plants the same land

in wheat. He might use limited amounts of fertilizer on his wheat and none on his cotton. He would use no chemical herbicides, but would protect his cotton with ULV equipment. He would irrigate his land by suitable irrigation techniques and would harvest both cotton and wheat by hand. He would be able to use the project wheat thrashers if he so desired. The project would assist him by providing credit for the purchase of seeds and other seasonal inputs. It would encourage him to invest in ox-drawn equipment and would provide him with credit to do. Most importantly, the project would provide him with effective extension advice.

There will be two recruitment periods for settlers, with the latest dates of occupancy being October 31 and March 31 respectively. The incoming settlers will be directed to prelocated village sites that would consist of no more than a project-provided well. The settlers would be expected to find their own way to the scheme using local camels and donkeys for transporting their very limited household effects. Once on site, the settlers would construct the typical millet stalk house, later to be replaced by a mud construction. Although the settler would not have to plough or plant during his first year of occupancy, and thus would be able to set up his home, he would have to be on site at least early enough to understand and follow the two basic cultural operations, cotton and wheat. The project would provide each settler with 500 kilograms of grain (in loan form to be repaid over two years) to enable him to survive the first half year of occupancy before harvesting his own food crops, i.e. a March settler would, in September, harvest millet grown on the dunes and maize grown in his allocated polder garden. The October settler would, in February, harvest wheat from his main polder lot and possibly maize from his polder garden.

Extension Service

Once settled, the settler would come under the control of the extension staff who would assess his assets, oxen, ploughs, tools, etc. and advise him of additional needs and equipment. He would be expected to attend very short (from three to four days) training courses to orient him to the new techniques and crops that he would encounter. Thereafter, his training would be given mainly in the field on his own holding. The extension staff would be divided into sections. Each section would be located at a service center controlled by a Section Officer. The Section Officer would be assisted by farm instructors at a rate of 1 to 30 farmers in the first year of farmer settlement reducing to 1 to 100 farmers from the third year onwards. The Section

Officer and farm instructors would be responsible for the extension needs of the farmer, for distribution of credit in kind, for the collection of credit repayment and for the initial assembly of marketable crops. A Senior Technical Officer would have overall responsibility for operating and controlling the extension service. Training of the extension agents would be a joint responsibility of the extension and research staff and would be conducted at the Matafo Research Station.

Service Centers

The Service Centers would be the key to farmer servicing. Each center would comprise a 500 cubic meter warehouse for the storage of fertilizers, insecticides and farm equipment. Within the store would be incorporated a small office for the Service Center staff. The Center would be located on a one-hectare site and would be surrounded by a security fence. Initially one plinth, 10 x 30 meters, would be constructed for the storage of wheat. The Section Officer would live in the vicinity of the store. The farm instructors would live in the villages. The Service Centers would act as centers of initial assembly before the marketing of the crop by SODELAC.

SODELAC Commercial Unit

This Unit would comprise sufficient staff and equipment for the efficient handling of the rather difficult and sometimes unforeseen problems of the first year of land development. The Unit would be mechanized and would rely on a constant labor force supplemented at the time of the cotton harvest, which casual labor mainly from Mao prefecture would pick by hand. The Commercial Unit would also provide the first year of ploughing and planting services to new farmers, and would be responsible for the storage of farm inputs and the storage of cotton and grains until shipped out of the project area.

For the sake of simplicity, it is assumed for the first phase of the project that all yields -- small holder and Commercial Unit -- would be the same. Cotton research yields are from 4,000 to 4,500 kilograms per hectare. The farmer trial in 1972 resulted in an average yield of 3,500 kilograms per hectare from 30 hectares. Project yields are estimated at 55-60% of research results and are placed at 2,500 kilograms per hectare for cotton and 2,500 kilograms per hectare for wheat. Details on the production for wheat and cotton are as follows:

	Cotton
- Time of planting	April 20 - May 15
- Harvesting completed	September 21 - October 31.
- Planting density	50,000-60,000 plants per hectare (1 plant per hole)
- Seed	25 kilograms per hectare acid delinted.
- Fertilizer	nil.
- Spraying	ULV 1/ Minimum 6 sprays at 10 day intervals. First spraying 40 days after planting

1/ Ultra-low-volume spraying (ULV) is a technique used more frequently in recent years. At Bol, spraying would have to be carried out very early in the morning or in the late afternoon when wind speeds are less than 6 m/s and when it is cool enough to prevent immediate evaporation of the minute spray droplets. If the evaporation rate is too high, ULV will have to be replaced by conventional high-volume spraying techniques.

- Irrigation	pre-irrigation 750 m^3 up to 10 irrigations 750 m^3 each at 10 day intervals (8,000 m^3 total).
- Yield	2,500 kilograms per hectare

	Wheat
- Time of planting	November 1-November 21.
- Time of harvesting	Third week of Feb. to end of Mar.
- Seed	80 Kilograms per hectare
- Fertilizer	45 kg. P_2O_5/ha. 45 kg N/ha.
- Irrigation	1 preirrigation 750 m^3 min. 8 irrigations 750 m^3 per irrigation at 7-10 day intervals (6,000 m^3 total).
- Yield	2,500 kilograms per hectare

Part 4. B

B. Implementation Plan

The AID-financed project has four discrete parts:

1. Polder development
2. Development of SODELAC as a regional development institution.
3. Research element
4. Health Activities

1. Polder Development (See Implementation Table I)

SODELAC staff and equipment will be used for carrying out this part. The survey and final design of project construction work will begin as soon as the project agreement is formalized and funds are available.

Equipment and personnel will be mobilized to start construction work early 1978.

Dams will be built as necessary to allow pumping (drainage) to begin as early as possible. The dams will later be improved and raised to full design heights and specifications. All dikes will be completed by July 1979.

Head works will be designed at the same time the dikes are designed. The construction of dikes will proceed upon completion and approval of the designs.

The canal system will be designed, and construction will be concurrent with head work construction.

After 18 or 20 months some land should be leveled, head works should be completed and necessary irrigation canals should be in place. This land will be assigned to farmers, using the approved system, and production will begin.

The extension service will provide farmers with instructions concerning their practices.

The construction work and settling of farmers will be completed in three years after construction begins.

2. Development of SODELAC as a regional development institution. (See Implementation Table 2)

This is a very simple program to implement. A consultant from REDSO, the CDO staff, and a project unit manager will order the equipment during the first month, and the actual work will begin when equipment arrives, from nine to twelve months after ordering. A consultant from REDSO, working with the local staff, will implement the project, which will be continuous after equipment arrives. If it were to begin in January 1978, the planned AID participation could finish in January of 1980.

Peace Corps volunteers have been requested for "on-the-job" supervision. Plans of work will be made by SODELAC and REDSO as work progresses.

The regional infrastructure activity of SODELAC will be based in Bol. There is a maintenance and service center there which will serve as a base of activity.

Equipment on hand and to be ordered will be used to start up this activity. The additional equipment to be ordered will increase the mobility of the unit and its work capacity. It is believed that in 1980, after two years of full operation, revenues to SODELAC should support the operational costs of this activity.

Equipment centered in Bol will be used on a planned basis to maintain and improve the road net. The roads will be given stabilized surface using a clay/s and mix. The roads are simple to construct or maintain, since they are located where there is no capillary action in road beds.

The big problem is unstable sand which renders the road useless during most of the year for vehicles without special traction features. Reports show that clay as a mixing material is available generally.

The first work will be to connect Bol with the polders of Berim, Guini, Mandi, and Tandil. Then the road net will extend east and west to the old empoldered areas.

The repair of roads includes the systematic rebuilding or strengthening of existing polders which were built by means of self-help projects in past years. The road net in general passes over polders.

A mobile unit will serve in an "emergency" role, making repairs of a temporary nature on roads or polders to protect farmers' lands and keep communications open. This unit will be able to operate independently in the field. It will have a capacity for feeding, sleeping and repair on work sites.

3. Research element (See Implementation Table 3)

Research will begin in April 1977 with a consultant to advise on the content of the cereals research program, specifically in wheat varietal testing. The Research Unit is a responsibility of the project unit manager (SODELAC) and will have two full-time expatriate persons: an agronomist and a socioeconomist.

The research element funding will be used to supply housing, equipment and supplies to the station. The construction of housing has begun by means of an advance authorized by AID/W. The construction, laboratories and utilities will start twelve months after housing is finished. The plans will be made by Genie Rural and SODELAC staff. The equipment for laboratories and utility installations will be ordered as soon as research plans are completed, at the end of the first month of the project. This functioning will be coordinated with the return of

trained personnel. Field trials and rudimentary work, some done in N'Djamena, will have begun prior to project start-up and will continue that way until the staff and laboratories are operational. The expatriate agronomist will be recruited and hopefully will start working within six months. Peace Corps volunteers should be available after the first year.

A team including consultants will prepare, with the project unit manager, a long-range research plan, for the agronomist to implement. A qualified Chadian soils technician is on the job, and, within the limitations of his time and experience, has started a research program. A financial advance has been provided by AID to carry out trials and continue work begun in 1970 that will be incorporated into future activities. The full research plan should be in operation one year after the project begins.

The development of qualified personnel cadres is the most difficult task. There are very limited numbers of qualified Chadians available for SODELAC to hire. Mostly, they will have an education equivalent to that of high school graduates. These new hires, after a trial period of two or three years, would be sent to U.S. universities or third countries for the specialized professional training needed but not available in Chad. Time required for training cannot appreciably be reduced; there are not shortcuts for selecting personnel and arranging the training necessary to meet the present and future needs of SODELAC within its terms of references and legal responsibilities.

APHA has started an epidemiological study under an AID contract. This study should be completed within six months after project start-up. The area has to be checked for health conditions during April, October and January.

The low-lift pumping activity can begin as soon as the project agreement is signed. An engineer from REDSO with CDO staff and the project unit manager can order equipment in the first month. The equipment will take from one year to eighteen months to arrive. During the interim period, and while work is progressing, SODELAC will make detailed plans.

The clearing of land for research on shallow wells will be done by hand and can begin between the sixth and eighth months of the first project year. Wells will be dug by hand after the land is cleared. Pumps will be installed on arrival, presumably between the 16th and 18th month of the project. It is estimated that if project papers are signed in July 1977, the irrigation by low-lift pumps would start in October 1978, or as soon as possible after the rainy season.

ORSTOM will do a project soil and water study which will be financed by a direct AID grant to SODELAC for a contract with ORSTOM. This grant was authorized in September 1976, and contract negotiations are pending. Work is scheduled to begin in June 1977 and be finished by June 1979. An extension for a third year might be necessary to make a conclusive study.

4. Health Activities:

The health activities consists of five parts; a) epidemiological study, b) facility improvement, c) paramedical program, d) health campaigns, and e) wells.

a) The epidemiological study started in April 1977 and will have two follow up phases in September 1977 and December 1977. The April study had 4 people; physician/epidemiologist, malacologist/parasitologist, vector biologist/entomologist, and a sanitary engineer. The two additional visits will be by a malacologist and a malariologist. A follow up study will be made in 1979 and annually thereafter.

b) The facility improvement will take place in 1977 and will consist of repairing the hospital in Bol and . This will be done by locally hired labor supervised by SODELAC and hospital personnel. The health center will also be a simple addition , using local materials. It will be designed by SODELAC and constructed by local labor.

c) The paramedical program which has been developed for all of Chad will require the agreement of the village to support a program. Two people will be trained for each village participating, at the Bol medical center. One will be trained in first aid, preventative care, and treatment of common diseases. This person will return to his village with a simple pharmacy which will be reslocked through revenues earned. The second person will be a traditional birth attendant who will receive training at medical center Bol in prenatal services and sanitary delivery techniques.

d) The health campaigns will be area cleanup activities in year 1977. Standing water in old polders and sites where mud bricks are made are the main concerns to be eliminated. Subsequent years will be to activate programs in prophylaxis and cure of schistosomiasis and malaria.

e) Wells will be made in locations to serve population concentrations. These will be made by the Peace Corps well drillers who are working in the area. The first wells will be in the Guini, and Berim areas then along the Tandal.

PART IV C. EVALUATION PLAN

The evaluation plan will consist of three phases and a final evaluation:

1. During the first year of the project the evaluation effort will consist of organizing economic baseline data as they relate to project area inputs and outputs.

2. During the last quarter of the second year of the project a technical, economic and social evaluation will be made using four basic geographic areas related to the project:

a) the irrigated project portion

b) the research portion

c) the spontaneous settlement area, and

d) the town of Bol

Data will be compared to baseline data to see what is happening. Special attention will be paid to the ecological impact, improvement of small farms and effectiveness of SODELAC in helping small farmers. Recommendations will be sought to reduce costs of polder area development.

3. The third evaluation will occur before the end of the fourth year of the project and will consist of the same elements as those indicated in paragraph 2 above.

4. The final evaluation will take place six months after the final disbursement. This will essentially be a final audit combined with a socioeconomic evaluation of participants in the program. SODELAC as an organization will be evaluated in relation to organization plans that evolve from earlier studies.

Personnel from CDO, REDSO and consultant firms will be responsible for doing evaluations. Evaluations should be scheduled and staffed in such a way as to require not more than thirty days.

The first evaluation should support the development of the FY 79 program implementation plan. All evaluations should result in recommendations for improved and more economical program development.

Part 4

D. Conditions, Covenants and Negotiation Status

On January 25, 1977, representatives of the U.S. and Chadian governments, as authorized by AID/W (STATE 000047 dated January 3, 1977) signed a Project Grant Agreement covering an advance of $300,000 to the Chadian Government for initiating this project. This Project Grant Agreement contains the conditions and covenants required by AID and specified in AID Handbook 3, Chapter 10, Project Agreement Formats, as revised.

In order for AID to monitor the use of grant funds, the following requirements must be borne in mind relative to the establishment of project documents.

1. The lists of equipment to be purchased and methods of purchasing should be approved by AID/CDO to insure adherence to procedures and to stipulations concerning source and origin.

2. The polder development will be designed and carried out by SODELAC. In order to monitor progress and assure that high technical standards are being maintained, plans and designs for the construction of polders, pumping stations, irrigation head works and canal systems should be submitted for approval before expenditures are made to carry out construction. Money could be advanced for surveys and design. Equipment purchased for these activities would also need approval by AID/CDO to insure adherence to legal requirements.

3. The policy for settling land after development and programs to recover development costs are important issues. These plans and policies, as they are made and implemented, should be given to AID/CDO as a matter of public record. If necessary, AID would be able to comment on these and suggest changes.

4. All training or foreign travel using AID funds would need prior AID/CDO approval.

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4. All training or foreign travel financed from ~~using~~ AID funds would need prior AID/CDO approval.

Part 5. Possible Future Levels of Activity

The GOC has selected the area around Bol as a development pole for the Sahelian region. The area has a proven agricultural potential and could provide much of the food which is now imported. Bol is generally accessible to the capital and will provide the population of the Sahel region an alternative to migrating to the capital.

A separate institution (SODELAC) has been established with responsibility for the overall development of the Lake Chad region, including the provision of extension services and credit and marketing services to farmers. To implement this mandate SODELAC has entered into agreements with FAC, the World Bank and other donors to provide various forms of assistance, e.g., a hospital in Bol via FAC, and the development of two polders via the World Bank. The proposed Lake Chad Irrigation project will represent the first major A.I.D. effort in the region, and the beginning of a long-term association with SODELAC.

It is anticipated that additional activities totalling $16.5 million could be developed to be budgeted beginning in FY 79 and extending through FY 84. The following amounts/sectors are anticipated: (in millions).

Roads	$3.5
Navigation	3.0
Polders	5.0
Credit/Marketing	2.5
Health/Education	2.5
Total	$16.5

The infrastructure projects anticipated are roads in the empoldered area connecting Baga Sola and Bol, then east to Mondo, then south to Morizarak. The distance is 200 kilometers, and would cost about $3,500,000. The navigation channel improvement by deep dredging from Baga Sola to Bol then to N'Djamena is a subject that needs an updated study but it would certainly cost $1 million for equipment, then an operation cost of $300,000 to $500,000 a year. In five years a cost of $3,000,000 could be anticipated. Plans for additional drainage, water control and pumping for expanded areas will be developed. The cost of this is expected to be about $2,000 per hectare. If a goal of 500 hectares a year is sought, it would require a budget of $1,000,000 a year or $5,000,000 for 5 years.

The economic and technical feasibility and design information for additional area development would materialize as the project is developed. The research component of the project will produce solid data so that future project costs may be more accurately predicted.

The rate of development activities will be dependent on SODELAC as an organization, on the capabilities of the local government, on the felt need of settlers, plus the availability and flexibility of the donors.

Assuming that the technical production bottlenecks or constraints are overcome and that large amounts of cash crops result, these must flow into Chad's north or south, or into neighboring countries. There will be demands and needs for storage, transportation, marketing and production credits. It is predictable that input and marketing credits in irrigated agriculture would be about $200 per hectare. It can also be predicted that spontaneous farming would require $200 per family to cover marketing and production costs. If 6,250 families were to be involved in such an effort, a sum of $2,500,000 might eventually be expected in a credit operation.

If the total area involved during the programming period is 15,000 hectares and if some 30,000 new people settle along the lake shore behind polders a number of things might evolve. First if the people are "settled" they will require schooling and health services. Endemic disease control services will also be a necessity from the consequences of contamination or ecological imbalances due to population concentrations. Education might stay Koranic or it might become more public. Experiences, study and analysis will give better ideas, but a social cost of $200 per family and 6,000 families might be reasonable projections for FY 79 to 84. This would cover costs of construction, supplies and operations.

In order to make estimations, an investment rate of $20 per new settler might be used as a rough first estimate. This would cover the cost of building schools and health facilities. The costs of operating a facility and the costs of doctors, practitioners, teachers, etc. could be also $20 a year per person ($10 for health, $10 for schooling).

If in the first year of the project 400 new settlers are attracted, this would mean, 2,000 people or $80,000 per year available for health and schooling. Assuming that in a five-year time span

there would be 1,200 new farm families on irrigated lands and 5,000 families or more on spontaneous settlement this would be 6,200 x 5 or 31,000 new persons.

The cost of building and operating the facilities, if 40% are in place and in use in 1979, would be $248,000 in 1979; $372,000 in 1980; $496,000 in 1981; $620,000 in 1982; and $620,000 in 1983; or a total of $2,356,000 rounded to $2,500,000 for a five-year period.

The A.I.D. documentation to support these activities will be initiated by the resident technicians. To complete the programming processes short-term assistance from AID/W or REDSO would be necessary.

ANNEX A

UNITED STATES GOVERNMENT

Memorandum

TO : AFR/DS, Mr. Graham Thompson

DATE: MAY 9 197

FROM : AFR/CWR, David Sh[illegible]

SUBJECT: Lake Chad Irrigated Agriculture

In response to your memorandum of April 1, this will confirm AFR/CWR's intention to pursue the development of an irrigated agriculture project on the Lake Chad polders. The following summarizes our understandings and views with respect to this project.

1. The project will consist of two elements: (a) a research project on irrigated food crops in support of the IBRD canal irrigation scheme and A.I.D.'s own interest in a low lift pumping irrigation scheme; and (b) pilot testing of the low lift irrigation scheme on approximately 500 hectares on a polder still to be identified.

2. The total initial funding of the project will be from about $2 to $2.5 million of Special Sahel Funds. The higher figure will be available if it is found that we will not be able to proceed with the Lake Chad Basin Water Strategy under sponsorship of the LCBC before FY 1977.

3. The research component of the project must meet the requirements which the IBRD has defined to support its project. It is understood that this would call for three researchers for a period of three years, beginning field work in late calendar year 1976. Beyond this, A.I.D. is free to develop the research component of the project in line with A.I.D.'s perception of needs. Our preliminary views is that this project component should probably extend over a longer period of time (say five years), that it should be designed to develop a Chadian research capability, that it should include socio-economic research relevant to the setting of farmers on the irrigated polders and the organizational/managerial problems which this entails, and that it should, of course, include such research inputs as are necessary to implement and evaluate the low lift pumping system and eventually enable the extension of this type of irrigation to other locations. It is our belief that some phases of this overrall research effort could be initiated by early CY 1976. We would see initial funding of this component in the neighborhood of $1 million.

Mr. Graham Thompson

4. The selection of the location of the low lift pump scheme, will require some additional data inputs which are being immediately sought from ORSTOM. If there are any costs to A.I.D. for the gathering of this data, they will be met from the project for Development Studies of the Sahel-Sudano Zone. Such costs are expected to be minimal.

5. Meta Systems will process the above data in order to arrive at a site selection. Cost of these services are included in the contract extension for which funding approval is now being sought.

6. Actions described in para four and five above should be completed by early summer permitting preparation and approval of a PP, including an approximately 500 hectare pilot low lift pumping scheme at a cost of $1 to $1.5 million, by the end of September.

7. Field work on the low lift scheme could begin early in CY 76.

Please note that a PRP is technically not required for this project and our feeling would be that there are no issues which suggest the necessity of preparing such a document at this time. If you agree and concur in the understandings and views above, it is proposed that we initiate preparation of the PP at the earliest practical date.

Annex B , Technical Details
Part 1 , Project Area Soils

The following analysis was presented in Annex 2 of the World Bank project paper. It is reproduced here for two reasons:

1. To emphasize the need to use lake water rather than ground water for irrigation since the effects of using ground water will rendee the polders useless in eight years, and

2. To emphasize the need for systematic agricultural and soil research to determine the effects of long-term cultivation on the polder's soil. This research is an important ingredient in the proposed project.

General

1. The soils of Guini and Berim polders have been examined and described by a number of investigators and classified according to various technical characteristics: depth to water table, salt content of groundwater, salt content of the top 0.4 m of soil, and problems such as salinity and alkalization. Despite all these studies, a systematic soil survey based on physical characteristics that are important for long-term crop production (para 6) has not yet been done, and will be undertaken prior to the start of the project.

2. Over most of Guini and Berim, a dark, loose, mulch-like mixture of clay or clay-loam, with 6 - 15% organic matter and 0.1 - 0.4 m thick, overlies a sandy or calcareous layer (or both) from a few to 50 cm thick; these are underlain by a thick (0.5 - 2.0 m or more) lay of blocky, columnar, fissured (highly permeable) heavy clay, generally coated with iron oxides. Other layers, including mucks and loose muds, are sometimes encountered. There is considerable subsidence of the soil's surface related to the polderization process, owing primarily to irreversible shrinkage of the heavy clay layer upon dessication and also because of rapid decomposition and hence shrinkage of the highly organic surface layer.

3. The soils of Guini and Berim polders are high in nutrient elements and in clay and in cation exchange capacity; their clays are largely montmorillonite (50-70%) with lesser amounts of kaolinite (20-40%) and illite (trace- 10%), are slightly to moderately saline, and are slightly to moderately calcareous. Chemical reducing conditions in the highly organic, waterlogged areas lead to formation of alkali soils in some locations and to acid soils in others.

Soil Salinity

4. Based on the electrical conductivity of the lake, which varies from about 50 micromhos at the mouth of the Chari to a high of about 800 micromhos along the distant northern shore, the salinity content varies from about 30 mg/1 - 550 mg/1. When land is empoldered, the saline water evaporates in a few years leaving a residue of salt in the soil and the groundwater slightly saline. Neither soil nor groundwater normally is too high in salinity for reasonably good crop production. However, such empoldered land, which is usually cleared and planted as soon as possible, would contain enough moisture for growth of only one crop if it were not for seepage of lake water through and under the intervening dry land into the polders. It is estimated that seepage amounts to about 2 m/ha/year. Thus, at a concentration of 400 mg/1, the salt content in the polders would increase 800 g/m^2/year. If all of this

salt was concentrated in the surface two meters of soil, the average salt content in the polders' soil would increase 0.04% per year, and reach the danger level of 0.3% in less than eight years. The rate of salt accumulation is, however, decreased by (a) precipitation of much of the calcium and some of the magnesium in the soil mass as carbonates, (b) by diffusion of salts into the groundwater and/or deep subsoil, (c) the blowing away of loose surface deposits of salt by winds, (d) occasional submergence and desalinization of polders by lake water and (e) slow seepage of diffused underground salts away from some polders. Conversely, the rate of salt accumulation is increased by the capillarity process, which accumulates salt close to the soil surface, and on balance the danger level could be reached in less than eight years.

5. Salinity surveys of Guini and Berim polders in 1966 showed that only a small portion of each had a damaging concentration in the surface half meter of soil where the salts tend to concentrate; furthermore, in contrast with other polders, the severity of the salinity problem has increased very slowly since the mid-1960s indicating almost certainly that some salt is being eliminated, probably by seepage from these polders. Alkali problems have developed only in a few spots where the soils are high in organic matter and waterlogged to the surface.

Assessment

6. Salinity and alkali problems have heretofore received much attention and have been considered to be the primary constraints to productivity. However, they are important constraints only if drainage is not provided. Other problems such as exhaustion of essential nutrients, irreversible shrinkage of the columnar clay layer with formation of laterite-like material, and weed and insect control may be more troublesome in the long run, and should be the object of systematic agricultural and soil research. It is intended that research be financed by USAID under a separate project agreement with Government and that coordination between both projects be carried out by project management.

Annex B, Technical Details
Part 2, Crops and Crop Research Results

The following was prepared by the World Bank and included in Annex 3 of their project paper. It is still considered valid and reproduced here to indicate the scope and nature of agriculture being conducted on the polders.

Crop Research Results

Since 1970, SODELAC has carried out cropping experiments and trials at the Matafo Agricultural Research Station. The aim is to determine the optimum cultural methods and potential yields of various varieties of cereals and cotton. Although these trials suffered from the general lowering of the lake water level, and lack of funds, they have demonstrated for the crops tested an extremely good potential under soils and conditions similar to those of Matafo. Yields obtained by farmers in 1973 on 30 ha of properly irrigated land averaged 3,500 kg/ha for cotton and 3,000 kg/ha for wheat. The initial research effort has been devoted mainly to cotton and witner wheat because these two crops will provide the basis for the polders cropping system. In addition, a few trials have been carried out on maize; and some interesting livestock fattening trials have been undertaken using cottonseed and pennisetum.

Cotton

Experimental results indicate significant yield differences between G. hirsutum and G. barbadense varieties. The results of the 1972 trials indicate average yields of 4,500 kg/ha for G. hirsutum varieties and 2,300 kg/ha for G. barbadense varieties. The U.S. Coker 310/312/417 varieties consistently gave high yields. Ston 213 yielded well as did Ston okra-leaf varieties. Average yields during 1973 were 4,000 kg/ha.

An analysis by IRCT for 1972 variety trials gave the following results:

Variety and Origin	Production kg/ha	% Fiber	Length 2.5%	UR %	Finess Micro	Pressly Resistance Index	1,000 PS
Chad HG9	3,795	36.8	30.2	48.0	4.30	8.20	88.6
USA - Coker 310	4,843	37.8	30.1	48.2	4.45	8.26	89.2
USA - Coker 417	4,706	37.8	30.4	48.4	4.20	7.70	83.2
USA - Acala SJ1	4.342	37.1	29.6	47.6	3.65	10.85	117.2
USA - Ston 213	4,904	38.4	29.1	47.8	4.50	8.42	90.9
BC6 - Ston 7A okra	4,050	36.8	29.5	47.4	3.43	7.95	85.8

On the basis of total performance, and particularly with regard to excellent quality length, the Coker varieties are favored. During the initial phase of the project, Coker 417 is likely to be the variety used. Also, because of the dense vegetative growth of cotton at Bol, the less dense okra-leaf varieties would be tested under field conditions.

Time of cotton planting is very important in order that the crop is renewed in time to ensure that wheat is planted at the optimum time in November. Also, trials indicate that cotton planted before mid-May significantly outyields later planted crops.

Planting densities do not appear to show significant differences. It is recommended that the planting density be 55,000 - 65,000 plants/ha -- on a basis of one plant per hole.

To date, cotton varieties have shown no significant response to fertilizer. Indications are that yields could be maintained for 5 - 10 years without fertilizer, but without continuous cultivation trials no definite recommendation can be made at this time.

Due to the present low incidence of pests at Bol, experiments on insect control have not been carried out. However, since pests would undoubtedly build up as the project expands, precautionary measures would be taken. Spraying would commence at six weeks after planting and continue at 10-day intervals for up to 10 sprays, depending on the results of pest scouting. The main pest is currently Pink bollworm (Platyedra gossy Piolla).

Irrigation trials on cotton indicate that 750 m^3 is required for preirrigation, followed by up to 10 irrigations of 750 m^3 each at 7 - 10 day intervals (800 m^3 total). Under Bol conditions, the polder water table fluctuates about 2 m, and this would make it possible to reduce the number of irrigations when the water table is higher, assuming that cotton is planted early enough for the cotton roots to grow quickly down to the water table; this makes it possible that the number of irrigations for cotton be reduced to about six.

Wheat

According to varietal trials, the Mexican variety Penjamo 62 outyields most other wheats tested at the Matafo station (4,000 kg/ha). Dambata, another Mexican variety, has good potential. Yields are very sensitive to time of planting. Trials indicate that planting is best carried out during the first two weeks of November, and should on no account be delayed beyond November 21; thereafter, yields decline at a significant rate of 500 kg/ha per week.

Other trials involving fertilizer, planting density and irrigation show no response to phosphate; 90 kg of P_2O_5/ha gave no significant response; however, 100 kg of urea and 200 kg of triple superphosphate raised yields by 900 kg/ha; and, at present day food and fertilizer prices, this is economic. Trials did not indicate any significant yield differences due to planting densities. The best results were obtained at 75 and 100 kg of seed per hectare. Irrigation trials indicate 750 m^3 of preirrigation, and thereafter at 7 - 10 day frequency, gave the best response; a total delivery of about 6,600 m^3 is required.

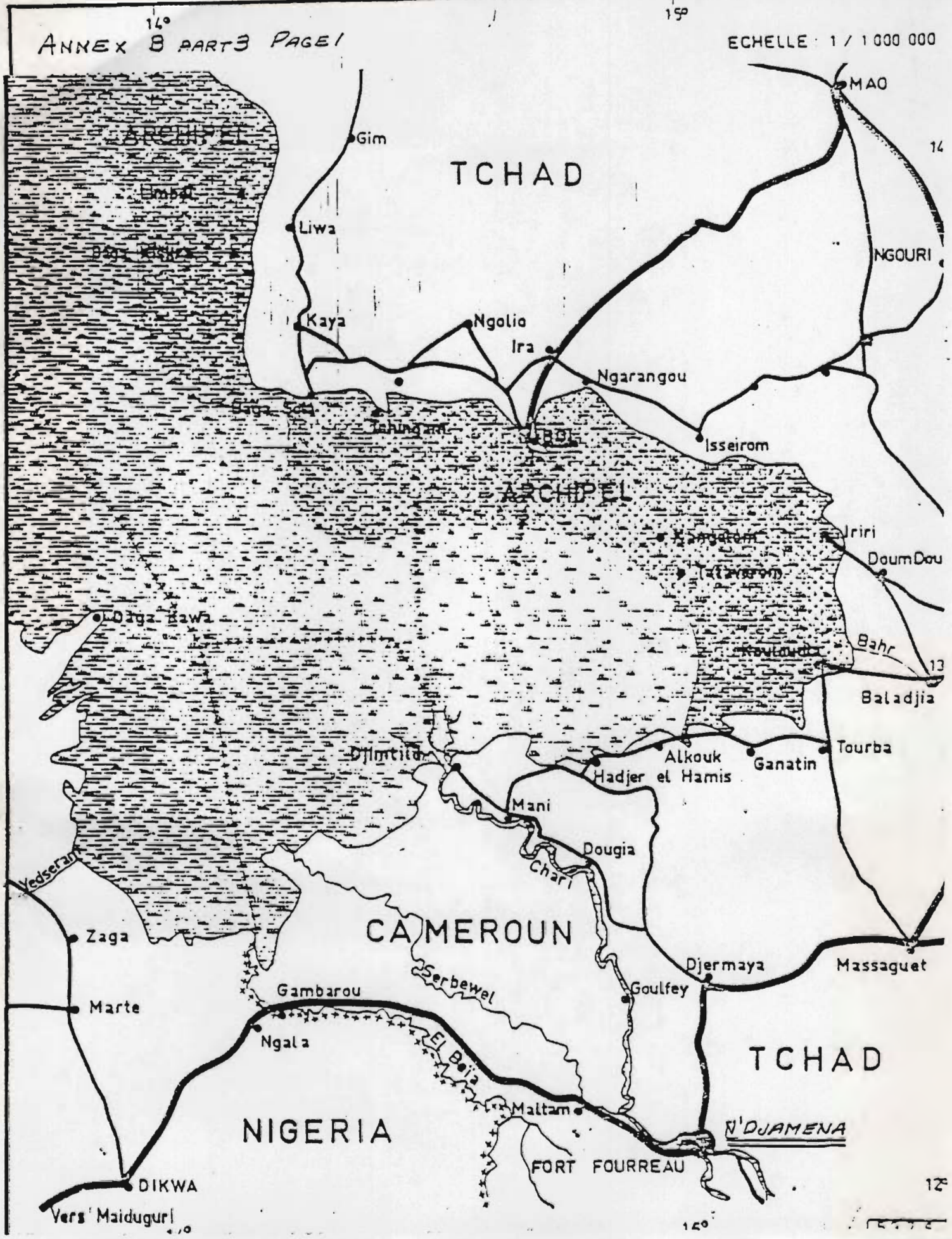
Maize

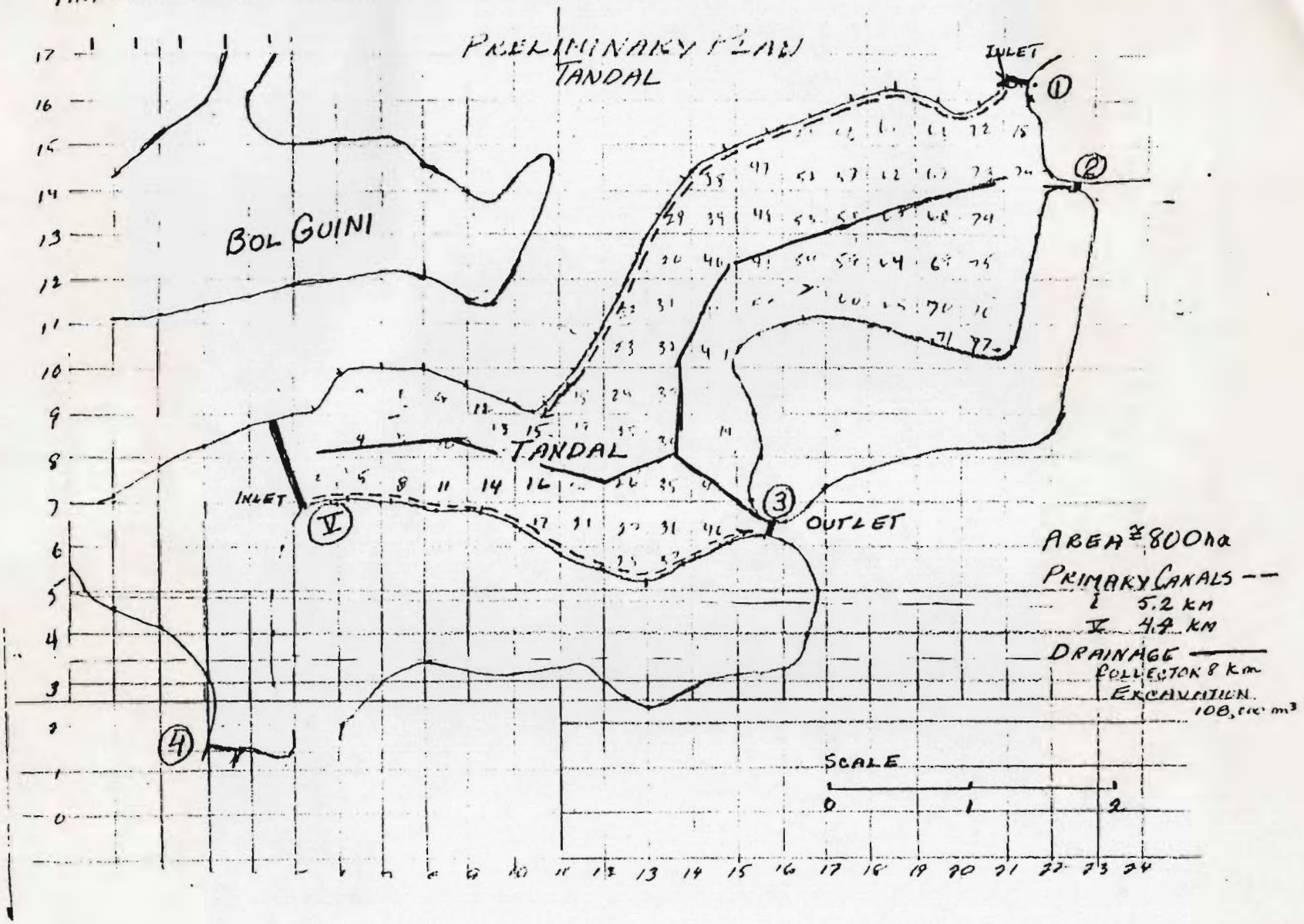
Maize research, limited so far, has been directed towards time of planting and response to fertilizer. Results to date indicate optimum planting dates as mid-June, and that N and P_2O_5 applications do not show marked yield improvements. Average yields are at 2,500 kg/ha. Trials to test possible deficiencies in sulphur, magnesium and zinc should be undertaken. Given the climatic conditions at Bol, yields of over 6,000 kg/ha should be obtainable.

Crop Rotations

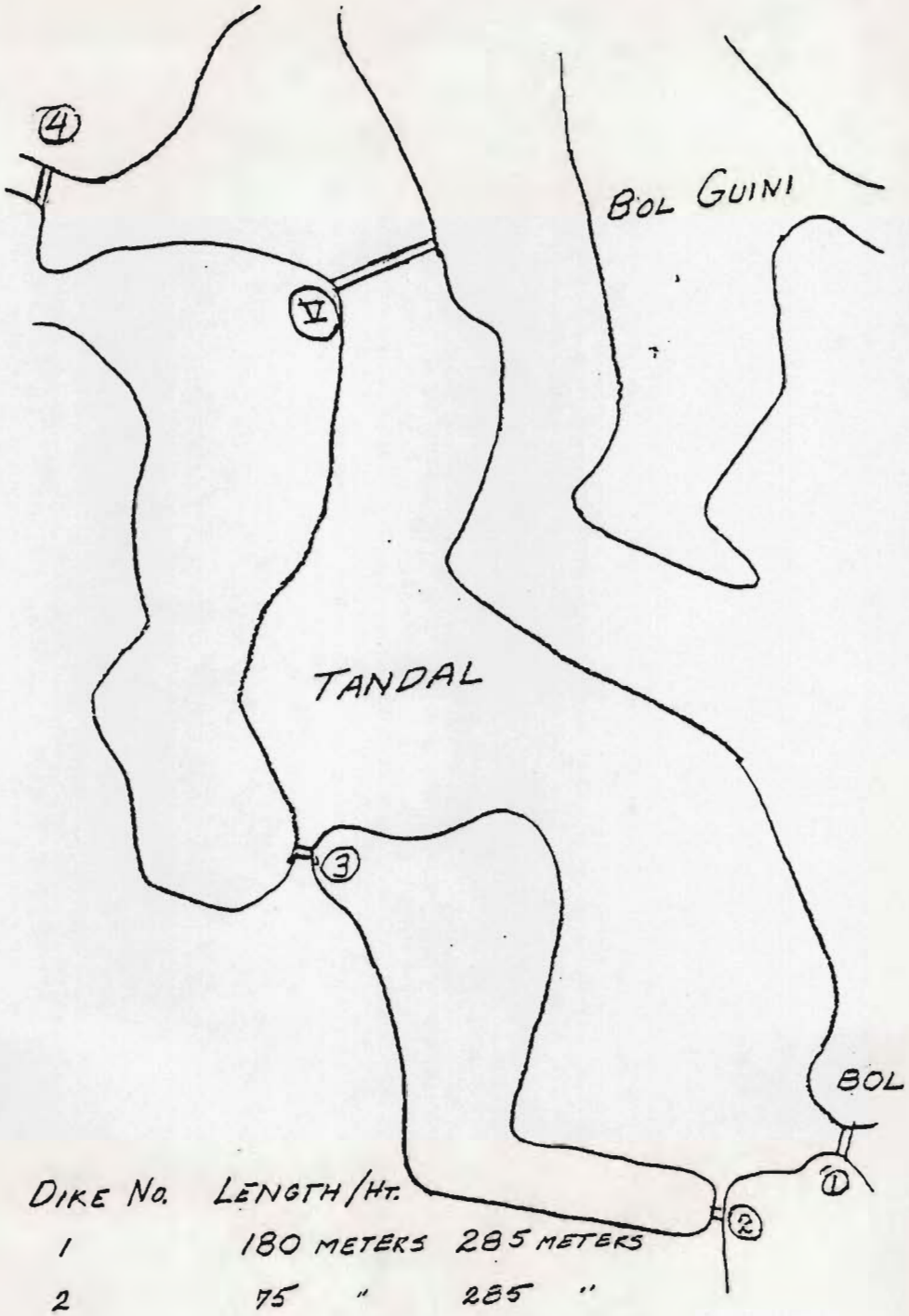
Studies have not been undertaken on crop rotations. During the first 5 years of the project, a cotton/wheat rotation can be followed without significant reduction in yields. However, for the long term, a rotation must be found that would keep the soil in reasonable equilibrium. If significant improvement in maize yields can be achieved, cotton could be replaced by maize. Eventually, it may be necessary to have a complete fallow, or a leguminous fodder crop.

ANNEX 8 PART3 PAGE1



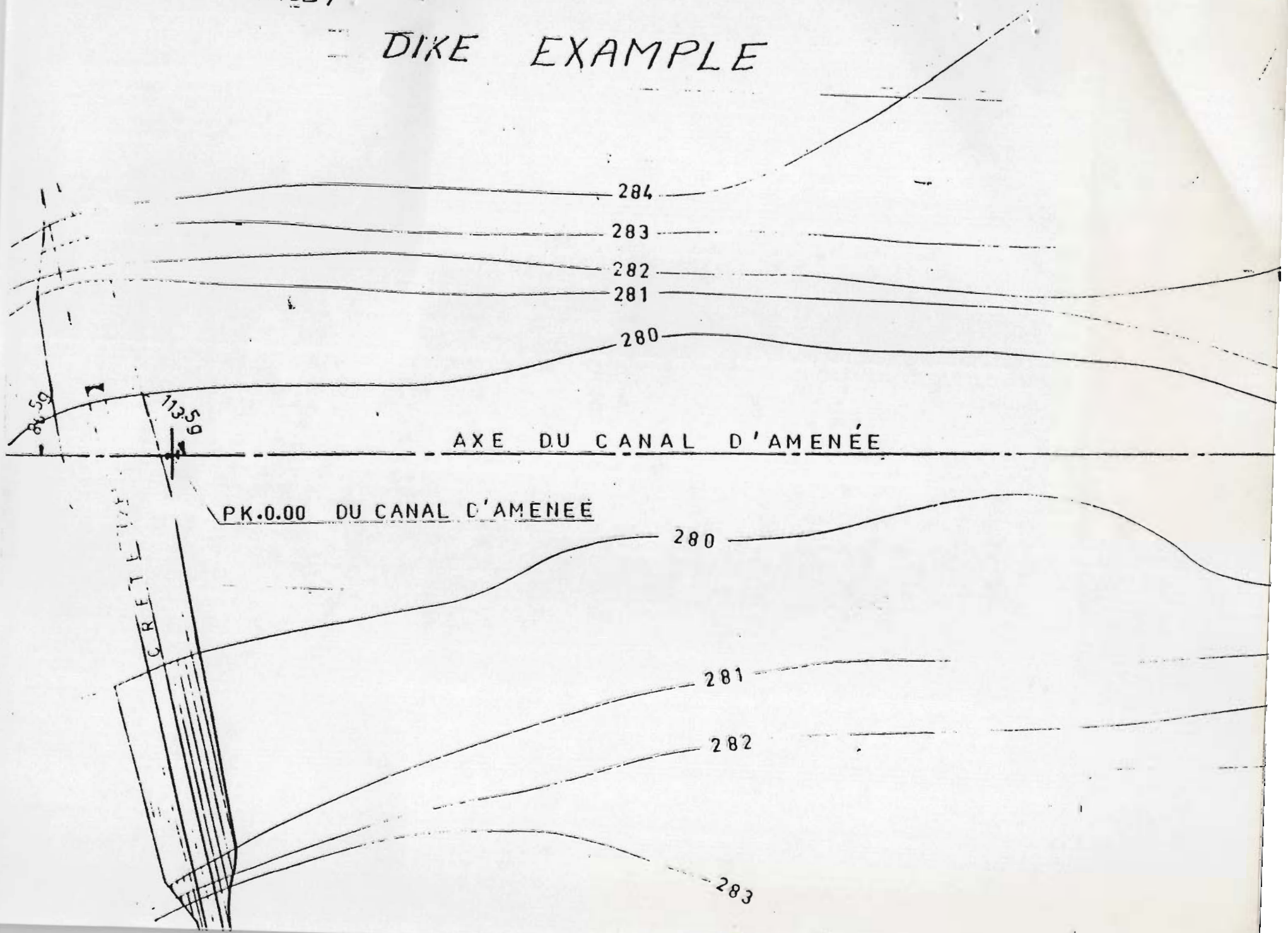

PRELIMINARY PLAN
TANDAL
INLET
BOL GUINI
TANDAL
INLET
OUTLET
AREA ≅ 800 ha
PRIMARY CANALS --
I 5.2 km
V 4.4 km
DRAINAGE
COLLECTOR 8 km
EXCAVATION
SCALE
0
1
2

← ANNEX B PART 3 PAGE 3 PROPOSED TANDAL POLDER

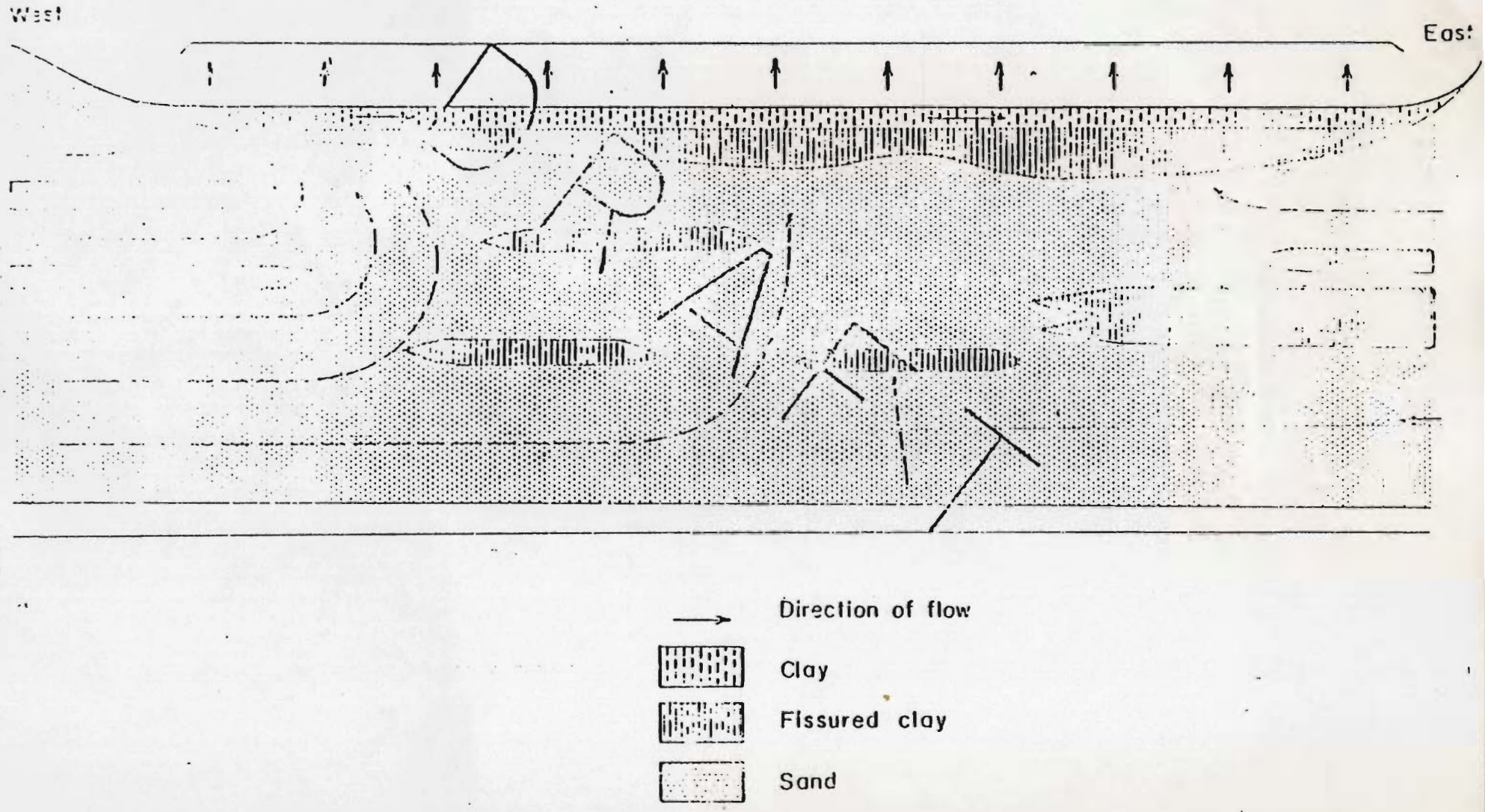


DIKE No.	LENGTH	HT.
1	180 METERS	285 METERS
2	75 "	285 "
3	90 "	285 "
4	150 "	285 "
V	750 "	282 "

DIKE EXAMPLE



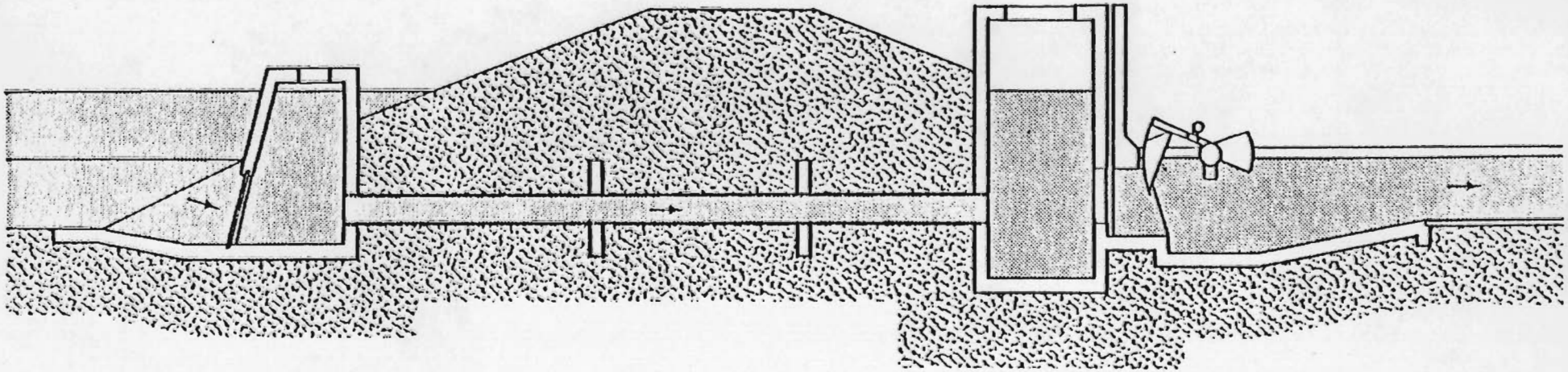
SCHEMATIC OF POLDER



ANNEX B PART 3 PAGE 6

prise principale

Avec vanne AVIO



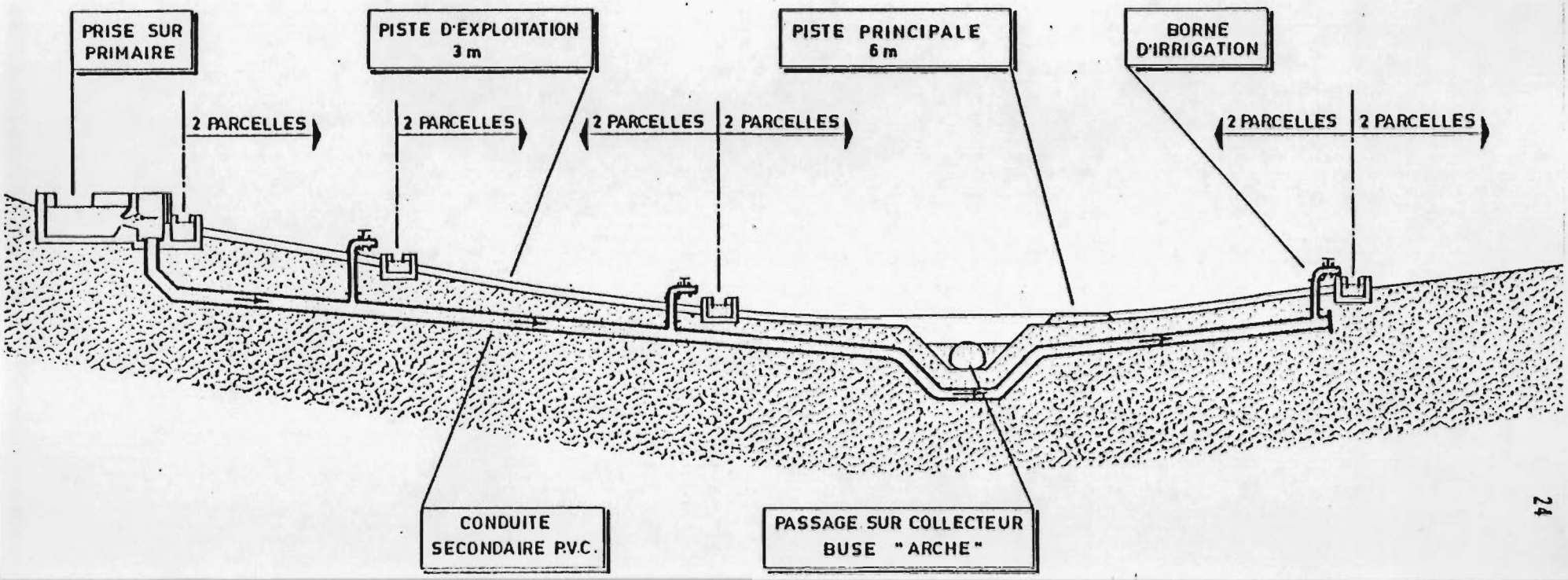
ANNEX B PART 3 PAGE 7

SYSTEME TYPE "CALIFORNIEN"

TUYAUX EN POLYCHLORURE DE VINYLE

principe de distribution

Coupe transversale type d'un Polder

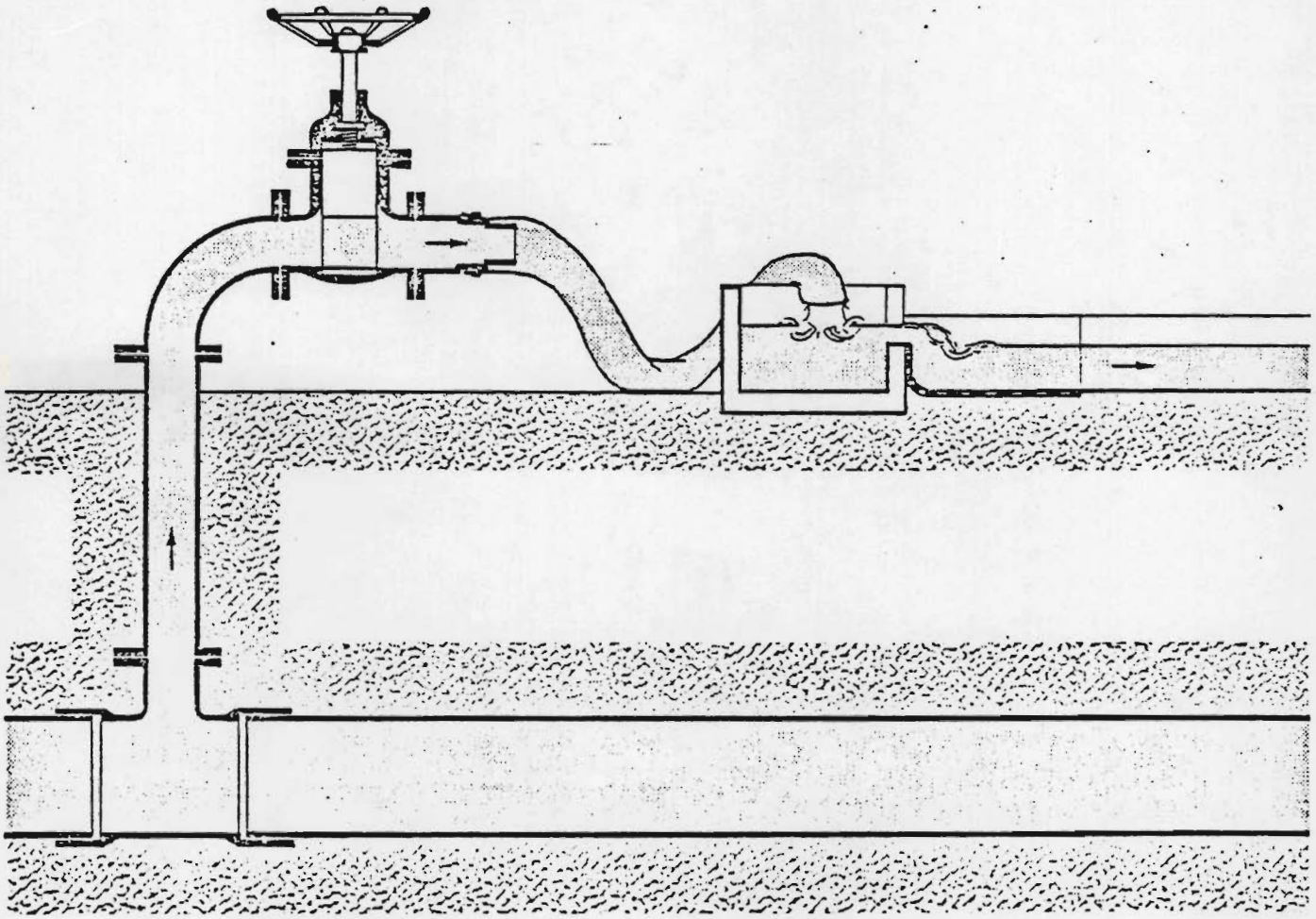


SYSTEME TYPE "CALIFORNIEN"

TUYAUX EN POLYCHLORURE DE VINYLE

borne d'irrigation

Debit 60 l/s



ANNEX C

Societe de Developpement du Lac [a/]
(SODELAC)

Statutes

Societe de Developpement du Lac (SODELAC) was created in August 1967 --Ordonnance 22--to carry out projects in the "Prefecture du Lac"; it took over services already provided to farmers by another Government agency, the Semable, which was then discontinued. SODELAC has share capital of CFAF 180 million, 95% owned by the Government. Its statutes give it broad powers to conceive programs in the spheres of rural, industrial or social development, and to provide extension, credit and marketing services to farmers. The President is appointed by the President of the Republic. SODELAC is under the general supervision of the Minister for "Amenagement du Territoire". Although basically SODELAC has a high degree of autonomy, Government has control over SODELAC's operations through its "Commissaire du Gouvernement" and "Controlleur du Gouvernement". These officials may veto proposed actions by SODELAC, but the veto expires if within a fixed period, it is not upheld by the Minister. SODELAC has all the autonomy necessary to carry out its statutory functions.

Activities

SODELAC presently carries out three types of activities:

(a) Irrigated Development: providing extension,credit and marketing services to those 19,000 farm families who practice traditional shadoof irrigation in polders along the lake shore. In the recent period of rainfall deficits and low lake-water levels, some farmers have abandoned these activities as water tables fell too low to permit lifting water with traditional equipment. The area cultivated with wheat is estimated to have varied as follows: 3,000 ha in 1970/71, 2,500 in 1971/72, 3,500 in 1972/73, and 2,600 ha in 1973/74. The resulting wheat crop marketed by SODELAC decreased from 1,300 tons in 1970/71 to 150 tons in 1973/74, as most wheat was consumed locally. Since 1970, SODELAC has also supervised construction of the irrigation water intake in Guini polder, operation of the Matafo Agricultural Research Station, and execution of the feasibility study for the World Bank's polder rehabilitation project.

[a/] Source: Much of this section was taken from Annex 4 of the World Bank report.

It should be noted that SODELAC has not yet been able to realize economies of scale. According to SCET projections, the financial position of SODELAC could theoretically be viable after five years if all four polders in the Bol area are constructed, i.e., the two being financed by the World Bank, AID's polder, and another being planned by the Arab Development Fund. Once 3,000 irrigated hectares are operational SCET feels SODELAC can become financially sound. Also, according to the analysis of farmer costs and benefits, the farmers will be able to repay SODELAC enough to cover SODELAC's current expenditures associated with the project (see Part. C). This will assist in providing SODELAC with current revenue. Unfortunately, at this time we are unable to provide realistic financial projections for SODELAC over the life of the project. However, to prevent the deterioration of SODELAC's financial condition, AID will include as a covenant that an annual budget review will be conducted. It is likely that disbursements will be tied to the results of these reviews.

While SODELAC's management of its marketing and general development activities may be questioned it is generally agreed that it is a technically competent organization. With technical assistance from SCET the construction of the World Bank's polders is about on schedule and in 1977 SODELAC did a fine job in opening the canal connections Bol to the lake. SODELAC's biggest problem may be its looseness of its organizational structure and its accounting system. The management/reorganization study component of this project will directly address this problem.

On balance, the USAID concludes that SODELAC is a viable development institution. Care will be exercised to insure that it is run in a business-like fashion and that unprofitable operations be identified as such and covered by the GOC subsidy. What we want to avoid is the tendency for such organizations to become a charity for the "poor" which dies a sudden death when the subsidies are cut off.

TABLE VI

CHAD

LAKE CHAD POLDERS PROJECT

Financial Statement of
Société de Développement du Lac
(SODELAC)

at June 30
(CFAF 000)

	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75
Sale of produce		12,584	11,906	20,126	6,186	10,293	31,003	25,488
Expenses								
staff salaries	5,675	13,714	14,916	15,076	17,268	15,936	17,392	12,921
taxes	787	1,083	851	714	941	1,944	1,207	2,131
cost of goods	8,964	19,740	24,478	22,885	35,777	41,059	22,727	16,069
transportation	8,574	7,362	6,405	1,692	3,349	2,940	751	1,218
administration	688	1,119	2,111	2,399	3,824	2,581	1,122	1,358
finance charges	369	510	183	17	107	959	551	2,119
	25,057	43,527	48,944	42,783	61,266	65,409	43,552	35,819
Operating Losses	(25,057)	(30,943)	(37,038)	(22,657)	(55,080)	(55,116)	(12,544)	(10,331)
Exceptional Loss[illegible] Profits	(40)	(2,503)	9,793	(2,423)	(672)	(1,513)	(5,651)	(7,959)
Total Losses	(25,097)	(33,446)	(27,245)	(25,080)	(55,752)	(56,629)	(18,195)	(18,290)
Cumulated Losses	(25,097)	(58,543)	(85,788)	(110,868)	(166,620)	(223,249)	(241,543)	(259,833)
Government Subsid	10,000	20,000	42,000	31,000	31,000	7,749	4,089	16,000
Cumulative Subsi[illegible]	10,000	30,000	72,000	103,000	134,000	141,749	145,719	161,719

Source: For 1967/68 through 1972/73 from World Bank loan
For 1973/74 and 1974/75 from SODELAC

(b) Rainfed Development: very limited activities are centered around N'Gouri from which SODELAC has marketed small quantities of gum arabic grown on the dunes (6 tons in 1972/73 and 4 tons in 1973/74).

(c) Other: various extraneous activities, such as use of corporation vehicles for general transportation purposes, marketing of dry fish, management of BOL Restaurant and Lodge, construction of refrigerated rooms at N'Djamena Airport for storage of potatoes grown in the polders, and the Air-Tchad Agency at Bol. These activities have resulted in a dispersion of SODELAC's management efforts, and may have contributed to its financial losses.

Organization

Headquarters are at N'Djamena, where the President of the Corporation resides together with two expatriate technical assistance and supporting office staff. Twenty-one agricultural agents from the Civil Service are posted to the two field branches of Bol and N'Gouri, and 22 additional agents are employed under contract. Two expatriate technical assistants are employed at Bol (one at the Matafo Research Station, and one at the Corporation's workshop). Through a contract with SCET (financed under the World Bank project), the staff has been increased by five: a project manager (agronomist/economist), an agricultural engineer, a topographer, a construction overseer and an agricultural production overseer.

Overall Financial Position

Any discussion of SODELAC's financial condition should be prefaced with a caution about the internal consistency of the figures. It is recognized that their accounting practices in the past were non standardized and it is therefore difficult to get a clear picture of the details. However, the big picture one gets from the following table is that SODELAC presently needs financial support. It has experienced operating losses every year since it was founded. While the operating losses for the last two years were reduced substantially over the previous years, we understand that amortization charges are not included in the operating loss figure, but probably are included in the exceptional loss figure. (SODELAC offers no explanation for the source of exceptional losses). As a result of these losses, the cumulative loss reached almost CAF 260 million ($1.0 million) in 1975.

With respect to expenses, there appears to be very little consistency. For example, the item "cost of goods" shows a very erratic relation to the item "sale of produce" and implies that SODELAC is absorbing considerable losses on its marketing operations. The transportation expenses are quite erratic, and most disturbing of all is the sharp increase in finance charges. Given the growing difference between cumulative losses and the GOC subsidy,it appears that SODELAC is paying substantial interest charges on its unpaid bills. These charges and the bills themselves could be eliminated if the GOC would pay the subsidy which has been budgeted, but not yet paid (CFA 30 million in 1973-74).

To reduce the losses which SODELAC has been experiencing the USAID agrees fully with the World Bank that the following steps need to be studies and appropriate remedial actions taken:

(a) SODELAC should introduce a cost-accounting system that would discriminate between those activities which should be conducted with a profit motive--i.e., marketing, and distribution of credit--and those which are in fact more of a social nature, i.e., provision of extension services to farmers.

(b) SODELAC should eliminate all commercial activities which are not profitable, i.e., marketing of dry fish and gum arabic, and of the wheat grown far from the collection centers of Bol and N'Gouri and requiring excessive transport costs. SODELAC should also trim its payroll and study moving its headquarters to Bol.

(c) Government should subsidize those activities which are not commercial in nature. An annual subsidy of CFAF 20-30 million may be sufficient once cost-saving measures have been introduced. This subsidy would be in addition to Government costs in paying the aalaries of civil servant and expatriate personnel seconded to SODELAC.

It is expected that the management study of SODELAC which will be a component of this project will make concrete recommendations on how to improve its organization structure and financial condition. These recommendations will be reviewed by the World Bank, AID, and SODELAC and an implementation schedule will be agreed upon. Disbursement will be tied to the implementation schedude.

ANNEX F - Statutory Checklist

The country checklist has been completed. See the Comprehensive Human Resource Development project paper, Project No. 677-0005. The Project and Standard Item Checklists follow.

6C(2) - PROJECT CHECKLIST

Listed below are, first, statutory criteria applicable generally to projects with FAA funds, and then project criteria applicable to individual fund sources: Development Assistance (with a sub-category for criteria applicable only to loans); and Security Supporting Assistance funds.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? IDENTIFY. HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

GENERAL CRITERIA FOR PROJECT.

1. App. Unnumbered; FAA Sec. 653(b)

   (a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure plus 10%)?

   (a) Project is in FY 78 CP. (See p. 2-8)

   (b) Yes

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

   (a) Yes

   (b) Yes

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

   No further legislative action required.

4. FAA Sec. 611(b); App. Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per Memorandum of the President dated Sept. 5, 1973 (replaces Memorandum of May 15, 19[illegible] see Fed. Register, Vol 38, No. 174, III, Sept. 10, 1973)?

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified the country's capability effectively to maintain and utilize the project?

   Yes. (See Annex G)

A.

6. FAA Sec. 209, 619. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate?

Project is multilateral effort involving World Bank(IDA), FAC and ADB. Further, within AID, it will become part of the Sahel Development Program.

7. FAA Sec. 601(a); (and Sec. 201(f) for development loans). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

There are no objections to efforts (a) through (f) under present form of government in Chad, and all objectives are possible, bearing in mind however the country's poverty and actual level of socio-economic development.

8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

Present state of market opportunities in Chad offer only limited incentives to U.S. private trade and investment, though this project lays the foundation for possible future increased interest in part of U.S. private sector.

9. FAA Sec. 612(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.

The budgetary condition of Chad precludes a major contribution to contractual and other services costs.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency and, if so, what arrangements have been made for its release?

U.S. owns no excess CFA.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(c); Sec. 111; Sec. 281a. Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production, spreading investment out from cities to small towns and rural areas; and (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions?

(a) This project is directly aimed at the subsistence sector of the economy, and will impact in a predominantly rural area.

(b) Participation of local population will be encouraged through the use of existing traditional governing structures, and by helping to open communication channel - between local population and central authority.

B1

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: [include only applicable paragraph -- e.g., a, b, etc. -- which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.]

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers;

This project is specifically designed to increase agricultural production and the income of the rural poor. The research is directed at the needs of the small farmer.

(2) [104] for population planning or health; if so, extent to which activity extends low-cost, integrated delivery systems to provide health and family planning services, especially to rural areas and poor;

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development;

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

(a) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development organizations;

(b) to help alleviate energy problem;

search into, and evaluation of, ic development processes and iques;

(d) reconstruction after natural or manmade disaster;

(e) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(f) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

B1

(5) [107] by grants for coordinated private effort to develop and disseminate intermediate technologies appropriate for developing countries.

c. FAA Sec. 110(a); Sec. 208(e). Is the recipient country willing to contribute funds to the project, and in what manner has or will it provide assurances that it will provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)?

Chad is on the UNCTAD List of least developed countries and therefore eligible to request waiver of 25% contribution requirement.

d. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing?

Yes, and justification satisfactory to Congress will be made.

e. FAA Sec. 207; Sec. 113. Extent to which assistance reflects appropriate emphasis on; (1) encouraging development of democratic, economic, political, and social institutions; (2) self-help in meeting the country's food needs; (3) improving availability of trained worker-power in the country; (4) programs designed to meet the country's health needs; (5) other important areas of economic, political, and social development, including industry; free labor unions, cooperatives, and Voluntary Agencies; transportation and communication; planning and public administration; urban development, and modernization of existing laws; or (6) integrating women into the recipient country's national economy.

This project is designed to address points 1 thru 6. See project description in part 2.B.

f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.

This project is being undertaken at the request of the GOC and it has been determined that SODELAC is a satisfactory implementing agency - SODELAC will be further strengthened with training in necessary skills. Further, SODELAC will engage in further training activities.

B1

g. FAA Sec. 201(b)(2)-(4) and -(8); Sec. 201(e); Sec. 211(a)(1)-(3) and -(8). Does the activity give reasonable promise of contributing to the development: of economic resources, or to the increase of productive capacities and self-sustaining economic growth; or of educational or other institutions directed toward social progress? Is it related to and consistent with other development activities, and will it contribute to realizable long-range objectives? And does project paper provide information and conclusion on an activity's economic and technical soundness?

The primary need in Chad is to increase food production and this project directly addresses that need.. Agricultural development is recognized as the first step in a self-sustaining process of economic growth.

h. FAA Sec. 201(b)(6); Sec. 211(a)(5), (6). Information and conclusion on possible effects of the assistance on U.S. economy, with special reference to areas of substantial labor surplus, and extent to which U.S. commodities and assistance are furnished in a manner consistent with improving or safeguarding the U.S. balance-of-payments position.

The project will have little impact on the U.S. Economy and U.S. commodities will be used to the most practical extent possible.

2. Development Assistance Project Criteria (Loans only)

N.A.

a. FAA Sec. 201(b)(1). Information and conclusion on availability of financing from other free-world sources, including private sources within U.S.

b. FAA Sec. 201(b)(2); 201(d). Information and conclusion on (1) capacity of the country to repay the loan, including reasonableness of repayment prospects, and (2) reasonableness and legality (under laws of country and U.S.) of lending and relending terms of the loan.

c. FAA Sec. 201(e). If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to AID an application for such funds together with assurances to indicate that funds will be used in an economically and technically sound manner?

d. FAA Sec. 201(f). Does project paper describe how project will promote the country's economic development taking into account the country's human and material resources requirements and relationship between ultimate objectives of the project and overall economic development?

e. FAA Sec. 202(a). Total amount of money under loan which is going directly to private enterprise, is going to intermediate credit institutions or other borrowers for use by private enterprise, is being used to finance imports from private sources, or is otherwise being used to finance procurements from private sources?

f. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Project Criteria Solely for Security Supporting Assistance — NA

FAA Sec. 531. How will this assistance support promote economic or political stability?

4. Additional Criteria for Alliance for Progress — NA

[Note: Alliance for Progress projects should add the following two items to a project checklist.]

a. FAA Sec. 251(b)(1), -(8). Does assistance take into account principles of the Act of Bogota and the Charter of Punta del Este; and to what extent will the activity contribute to the economic or political integration of Latin America?

b. FAA Sec. 251(b)(8); 251(h). For loans, has there been taken into account the effort made by recipient nation to repatriate capital invested in other countries by their own citizens? Is loan consistent with the findings recommendations of the Inter-Amer Committee for the Alliance for Pro (now "CEPCIES," the Permanent Execu Committee of the OAS) in its annual review of national development activities?

6C(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by exclusion (as where certain uses of funds are permitted, but other uses not).

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed?

   This project will be advertised via AID's small business office.

2. FAA Sec. 604(a). Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him?

   Yes.

3. FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed?

   Chad does not discriminate against U.S. Marine insurance companies.

4. FAA Sec. 604(e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?

   No agricultural commodities will be procured.

5. FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?

   USG excess property is not practicable

6. MMA Sec. 901(b). (a) Compliance with requirement that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.

   Yes

7. FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized,

   Yes

A7

are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

8. International Air Transport. Fair Competitive Practices Act, 1974

If air transportation of persons or property is financed on grant basis, will provision be made that U.S.-flag carriers will be utilized to the extent such service is available? — Yes

B. Construction

1. FAA Sec. 601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest? — Yes

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — Yes

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million? — Yes

C. Other Restrictions

1. FAA Sec. 201(d). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? — NA

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — NA

3. FAA Sec. 620(h). Do arrangements include promoting or assisting the ign aid projects or activities of unist-Bloc countries, contrary to best interests of the U.S.? — Yes

4. FAA Sec. 636(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S. or guaranty of such transaction? — Yes

5. Will arrangements preclude use of financing:

a. FAA Sec. 114. to pay for performance of abortions or to motivate or coerce persons to practice abortions? Yes

b. FAA Sec. 620(g). to compensate owners for expropriated nationalized property? Yes

c. FAA Sec. 660. to finance police training or other law enforcement assistance, except for narcotics programs? Yes

d. FAA Sec. 662. for CIA activities? Yes

e. App. Sec. 103. to pay pensions, etc., for military personnel? Yes

f. App. Sec. 106. to pay U.N. assessments? Yes

g. App. Sec. 107. to carry out provisions of FAA Sections 209(d) and 251(h)? (transfer to multilateral organization for lending). Yes

h. App. Sec. 501. to be used for publicity or propaganda purposes within U.S. not authorized by Congress? Yes

Annex H. Synthesis of Requests for Lake Chad Irrigation Project

The genesis of this project is long and complicated and began in 1975 as the World Bank was putting together its project and requested the involvement of AID for specific activities. A detailed history of the evolution of AID's involvement through September 1976 is contained in a 45 page CDO document. Since that time the relevant document is a letter from SODELAC to the CDO (dated February 28, 1977 see attached copy) requesting AID financing for three activities:

1) Agronomic Research at Matafo

2) Development of SODELAC's infrastructure maintenance

3) The construction and development of a polder

After reviewing the above request, and after taking into consideration prior AID commitment to the GOC, World Bank and AID's priorities including those articulated by AID/W, the design of the present project was finally settled upon. At a meeting on April 7, 1977 attended by John A. Lundgren (CDO/N'Djamena), Kamougue Guidingar (President Director General of SODELAC) and working level representatives from both organizations, the following outline was agreed upon:

1. Polder Development

2. Development of SODELAC as a regional development institution
   a) Management study
   b) Equipping and operating a mobile maintenance brigade
   c) Participant Training

3. Research
   a) Agronomic research at Matafo Research Station
   b) Land and water use in the polders
   c) Low-lift pump research
   d) Socioeconomic research and the definition of small-scale local activities which complement the development of polders themselves.

4. Health Activities

a) Epidemiological Survey

b) Health services support

The PP reflects this agreement and contains all of the above components.

SODELAC

SOCIÉTÉ DE DÉVELOPPEMENT DU LAC

PROJET D'AMÉNAGEMENT DES POLDERS

N'DJAMENA, le 28 FEV 1977

N/Réf : PAP/ 082 /77

V/Réf :

Objet :

LE PRESIDENT DIRECTEUR GENERAL

A

MONSIEUR LE CHEF DU BUREAU DE L'USAID

(Attention M. MORRIS)

N'DJAMENA

Monsieur,

J'ai pris connaissance, en même temps que les services du Bureau du Projet, des intentions de l'USAID manifestées dans la minute du rapport général qui est destiné aux instances supérieures de votre organisme à Washington.

Je suis touché et impressionné par l'effort important que vous avez l'intention de fournir pour le développement de la SODELAC et du Lac. Je vous en remercie profondement. Cependant, les soucis et besoins de la SODELAC, à l'heure actuelle, sont tels qu'il serait très souhaitable de reéquilibrer le volume total de votre aide de 1ère phase (environ 1.415 millions de F CFA) autour de trois grands axes :

- Recherche agronomique à MATAFO
- Infrastructure régionale (route, barrages)
- Aménagement d'un polder moderne en totalité.

Le volume total du financement de 1ère phase est en effet suffisant pour mener à bien ces trois actions pendant une période de trois ans.

1) Recherche agronomique à MATAFO.

C'est depuis l'origine, sur ce point que votre participation était demandée. Nous avons transmis sous la signature de M. le Ministre de l'Agriculture par une lettre adressée à M. l'Ambassadeur, (13 / 12 / 1976) un projet de budget s'élevant à 201.230.000 F CFA. Dans ces conditions, la somme d'environ 830 millions qui est prevue dans le rapport minute me parait surabondante. Si

.../...

l'on y adjoint une certaine somme pour formation à l'étranger de techniciens SODELAC et imprévus, un total de 250 millions de F CFA me paraît souhaitable. Cette somme correspond d'ailleurs sensiblement à la participation de l'USAID telle qu'elle avait été prevue au sein du groupement IDA/FED/FAC (rapport IDA/ en date du 16 Octobre 1976 N° 628 - a - C.D) Nous pouvons rattacher à ce point l'appui de l'ORSTOM à la station de MATAFO pour la recherche pédologique (45 millions au maximum).

2) Infrastructure regionale (barrages, route... etc)

La SODELAC a évidemment une vocation pour le développement de l'ensemble de la Prefecture du Lac. Dans ce cadre, l'équipement d'une unté mécanisée chargée d'améliorer l'infrastructure existante (barrages, route) jouerait un rôle important. Elle permettrait de donner à Bol, la fonction de pôle développement.

L'équipement nécessaire et son budget de fonctionnement s'élèverait à 148.000.000 F CFA selon budget annexé.

3) Aménagement d'un polder moderne près de Bol :

Le reliquat de la somme prevue en première phase (environ 970 millions) est suffisant pour amenager un polder moderne de l'ordre de 800 à 1000 hectares. En concentrant ainsi son effort plutôt qu'en intervenant par de multiples sous projets dispersés (Low lift lump, recherche hydrologique, etc), l'USAID renforcerait la capacité de production contrôlée que la SODELAC est en train de mettre en place avec les polders de GUINI, BERIM et vraisemblablement MANDI. Vous savez en effet que l'avenir de la SODELAC et du Lac se trouve dans l'augmentation massive de production que permettent les polders modernes.

Dans des delais très brefs, les services du Bureau du Projet, sont en mesure de vous communiquer le détail du coût de l'opération d'aménagement et d'effectuer les reconnaissances permettant de choisir les surfaces à mettre en valeur.

J'espère que ces propositions vous agréront. Les services du Bureau du Projet se tiennent à votre disposition pour toutes informations supplémentaires que vous souhaiteriez.

Enfin un certain nombre des projets envisagés dans votre rapport minute pour la phase I, pourrait être avantageusement reporté en phase II. (L'étude de réorganisation, par exemple, sera plus utile lorsque le problème de la fusion et de la redistribution des activités de la SODELAC se posera. A l'heure actuelle, la gestion de la SODELAC Agence est relativement simple et ne pose pas de problèmes particuliers. Celle du Projet IDA est faite selon les règles commerciales en vigueur. D'ailleurs, ces deux gestions bénéficieront en 1977 d'une mission d'audit par un expert-comptable agréé par la BIRD).

Je vous remercie encore une fois et vous prie d'agréer, Monsieur, l'assurance de ma parfaite considération.

LE PRESIDENT DIRECTEUR GENERAL

KAMOUGUE GUIDINGAR.

ANNEX L

Health Conditions

An April 1977 study reported on the present and anticipated health conditions in the polders:

Health Services

The Lac prefecture is served by a medical center in Bol and 6 dispensaries in the other main villages. At thepresent time, the medical center can usually manage to treat the sick of the polder region who come to seek care, in spite of the disrepair of its building, the lack of basic equipment, the insufficient numbers of personnel and preventive health services, and chronic shortages of medicines and supplies. However, the influx of immigrants into Bol and the polders surrounding it will exacerbate these deficiencies and could seriously disrup services. What has been suggested is (1) the extension of health service into the polders area, (2) the strengthening of referral links between Bol and its dispensaries and Bol and N'Djamena, (3) a sizeable increase in health education and other preventive programs, (4) the re-equipment and repair of the health facilities and (5) the assignment of an additional laboratory technician and pharmacy assistant to the medical center.

Environmental Sanitation

The towns and villages of the area are generally built on the sand dunes surrounding the polders. The hot sand dunes, which act as natural filters and neutralize the potential danger of the defecation areas outside of the villages, are one of the main reasons for the generally satisfactory sanitation conditions of the area. The second reason is the presence of sealed, small-bore wells which have been installed by the Peace Corps with AID drought relief funds. The wells have lessened the incidence of gestro-intestinal illness and provide an alternative water source to schistosomiasis infested ponds and ditches. Environmental sanitation problems will begin to develop as immigration into the area, and especially Bol, overloads the present simple sanitation system.

Malaria

In spite of reports of malaria symptoms, only 4 Anopheles mosquitoes were collected during the 2 week study period. The paucity of vector mosquitoes was expected because the study took place at the end of the dry season. Anopheles larvae were mainly found in the puddles in the

adobe brick quarries at the edge of Bol rather than in the Lake. This observation leads to a conclusion that the increasing urbanization of Bol and the consequent demand for housing material may aggravate the malaria problem. Final conclusions will be made following the 2 subsequent visits by a malariologist.

Schistosomiasis

The schistosomiasis part of the study resulted in some unexpected findings which will be verified during the 2 subsequent visits by a malacologist. Instead of a very high level of schistosomiasis endemicity and a profusion of vector snails in the Lake, a very different situation was found. Preliminary findings based on a sample survey indicate that schistosomiasis is primarily a problem of villages which use the over-grown polder drainage ditches for their water needs, bathing areas, and swimming holes. Approximately 35% of a sample of boys from polder villages had positive urine specimens in contrast to about 16% of similar specimens from two island villages. In addition, the typical vector snail for urinary schistosomiasis was not found during the study visit and an examination of another snail variety, which occasionally serves as a vector, has not yet produced any evidence of infection. The first task in schistosomiasis control then should be the cleaning of the old drainage ditches and proper construction of the new project and World Bank drainage canals.