AGENCY FOR INTERNATIONAL DEVELOPMENT

# PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE) — PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: CHAD

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 677-0001

6. BUREAU/OFFICE: A. SYMBOL: AFR; B. CODE: 1

7. PROJECT TITLE (Maximum 40 characters): Lake Chad Irrigated Agriculture

8. ESTIMATED FY OF PROJECT COMPLETION: FY 82

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 77; B. QUARTER 4; C. FINAL FY 81 (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 | 680 | 385 | 1065 | 1,405 | 1,350 | 2755 |
| (GRANT) | ( 680 ) | ( 385 ) | ( 1065 ) | ( 1,405 ) | ( 1,350 ) | ( 2755 ) |
| (LOAN) | ( ) | ( ) | ( ) | ( ) | ( ) | ( ) |
| OTHER U.S. 1 p.c. | 20 | | 20 | 920 | | 920 |
| OTHER U.S. 2 | | | | | | |
| HOST COUNTRY | | 140 | 140 | | 400 | 400 |
| OTHER DONOR(S) | 500 | 2000 | 2500 | 10,000 | 2,000 | 12,000 |
| TOTALS | 1200 | 2525 | 3725 | 11,325 | 3,750 | 16,075 |

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 | | 1065 | | 570 | | 670 | |
| (2) | | | | | | | | | |
| (3) | | | | | | | | | |
| (4) | | | | | | | | | |
| TOTALS | | | | 1065 | | 570 | | 670 | |

| A. APPROPRIATION | N. 4TH FY 80 O. GRANT | N. 4TH FY 80 P. LOAN | Q. 5TH FY 81 R. GRANT | Q. 5TH FY 81 S. LOAN | LIFE OF PROJECT T. GRANT | LIFE OF PROJECT U. LOAN |
|---|---|---|---|---|---|---|
| (1) | 450 | | | | 2,755 | |
| (2) | | | | | | |
| (3) | | | | | | |
| (4) | 450 | | | | | |
| TOTALS | | | | | | |

12. IN-DEPTH EVALUATION SCHEDULE: MM YY

13. DATA CHANGE INDICATOR. ARE CHANGES MADE IN THE P.D. FACESHEET DATA BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 10? IF YES, ATTACH CHANGED PID FACESHEET. 1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: John A. Lundgren

TITLE: Country Development Officer

DATE SIGNED: MM 06 DD 30 YY 77

15. DATE DOCUMENT RECEIVED IN AID W, OR FOR AID W DOCUMENTS, DATE OF DISTRIBUTION: MM 05 DD 12 YY 77

AID 1330-4 (3-78)

# PREFACE

"If the people of the poor countries are to be fed, the food will have to come from their soil, their resources and their farm economies. The surplus production of a few exporting countries can serve on occasion to buffer the impact of bad weather or other calamities, natural or man-made, but there should be no illusion that the world's food security can be ensured by abundant harvests from the fields of Kansas and Saskatchewan, Argentina and New South Wales. Very few of the developing nations give evidence of having understood that food independence is an internal affair, and that if agricultural development is given priority, it can lay the foundation for modernizing an entire economy. The rich industrial nations have also not fully recognized that such development, on which depend both the world's future food supply and an easing of the tension between the rich and the poor, calls for a massive transfer of technology and capital from rich and poor countries".

Scientific American, Sept. 1976

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 $2,755,000
for contract services, commodities, participant training and other costs associated with agricultural research, water use and control research including irrigation, regional infrastructure and supplies, health activities, and special studies

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

For Phase Two

-(Nature and amount of Phase II to be determined.)

# 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 Specializaing in Engineering |
| SEMABLE | Organization for Developing Wheat Production |
| PVC | Polychlorine de Vinyle |

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 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 irrgated agriculture along the shores of the lake, and in 1975, the World Bank (IDA) approved a $5 million loan for the gravity flow irrgation project on two empoldered areas (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.

As a complement to IBRD project USAID and other donors indicated interest and willingness to participate in the project. Specifically, the USAID expressed interest in financing costs of 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 project. (Guini). The USAID also agreed to consider undertaking a limited epidemiological study of the area to determine the extent to which schistosomiasis and other diseases affect the

a/ The terms "polder" and "empoldered areas" are used interchangeably.
b/ See the World Bank's report #828a-CD dated October 16, 1975. At that time, the research program was estimated to cost $1.0 million.

population and what steps could be taken to control them. The agricultural research and a more complete epidemiological study, the first phase of which has already been undertaken, will be components of the proposed project. While rainfed projects will continue to be allotted the highest priority by the Government of Chad (GOC) and the USAID, it is becoming increasingly apparent, that it will be necessary to develop the irrigation potential of Lake Chad and the Chari and Lagone rivers. 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, only irrigation can help solve the critical food production problems. 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 it is imperative to make a start in developing a basis for instituting and expanding agricultural irrigation in Chad:

(a) greater diversity of crop production: Chad is now dependent on the importation of farm products 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 their supply is beyond the country's control.

(b) better utilization of the country's livestock resources: Chad's Sahelian pastures are breeding areas, but maintaining and raising 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 could permit the development of a dairy industry;

(c) evolution of a higher technology agriculture: Yield potentials are limited under the rainfed system as the availability of water affects the efficiency of fertilizer and improved seed. Irrigation would allow the utilization of modern agricultural technology to a much greater degree than now possible and permit Chadian personnel to learn, employ and further develop modern agricultural techniques. 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 localized supply of food staples such as grains: among other effects, livestock are 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.

(e) development of the rural sector: Irrigation in Chad would involve 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, the development of irrigated agriculture is a powerful tool in the quest for greater equity, and the involvement of the small farmer in the development process,

Project Description:

The proposed A.I.D. funded project comprises two phases. Phase one involves irrigated agricultural research, development and improvement of SODELAC, health services development and special studies designed to establish the feasibility of a discrete project for increasing agricultural production through irrigation in the polder areas. Phase two would be the development of the agricultural production project. In outline form, these activities are:

Phase One

1. Development and Strengthening of SODELAC as a regional institution:

   (a) Management study
   (b) Equipping and operating a mobile maintenance brigade
   (c) Participant training

2. Research

   (a) Problems and Objectives of Research at Matafo Research Station
   (b) Land and water use in the polders
   (c) Production program development
   (d) Socio-economic research

3. Health Activities

   (a) Epidemiological survey
   (b) Health services support

4. Special Studies

(a) Technical Review of Polder Development Analysis
(b) Environmental Assessment
(c) Sociological - resettlement analysis

Phase Two

1. Development of an Irrigated Agriculture Project in the Polder Formations of the Bol Area of Lake Chad

Phase One Activities - Detailed Description

A. Development of SODELAC (the implementing agency):

In Chad, the few successful development stories one can relate resolve 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 accepted 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, four 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. 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 mobile maintenance brigade to rebuild and maintain the irrigation network and road infrastructure around Bol. Restoration and maintenance of roads and polders is the responsibility of SODELAC. At present SODELAC lacks the maintenance and reconstruction capability which is essential to the accomplishment of its developmental and conservation objectives.

It is feasible and economically sound to improve the existing infrastructure network. 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 advice of two Peace Corps volunteers. Engineers from REDSO have done requisite 611A certification and will help monitor the activity. The AID support will cover the purchase of machinery and costs for personnel and operations during the life of this project. Subsequently, SODELAC will take over fiscal responsibility for the maintenance functions.

(c) Participant Training: Short-term training in specialized areas of administration and accounting to strengthen SODELAC's administrative and financial management capacities are contemplated. Also, training for Matafo research station personnel will be arranged at the IITA in Ibadan, and at the LCBC agricultural school in northern Nigeria.

B. Research

Since 1970, SODELAC has engaged in agricultural research at Matafo, six kilometers from Bol. Research concentrated on the choice of appropriate wheat and cotton varieties and production practices for the empoldered areas. The Matafo station is to be strengthened under the project by the provision of expatriate research personnel, local staff training, and a building program. A.I.D. would finance all research with the exception of cotton components, which will be financed by FAC and IDA.

Research efforts under the proposed project will address problems for irrigated agriculture in the polder areas. The principal emphases for research will be the development of:

1. information and techniques for soil and water management;

2. economic production packages for farm enterprises incorporating improved technology;

3. farm management programs and policy recommendation for increasing irrigated agricultural production with special attention to sociological and economic considerations.

C. Health Activities

The World Bank foresaw increased needs for health sector data and planning and health support services as a result of intensified development in the polders area and USAID agreed to include an epidemiological study in its program. Two sub-activities are contemplated in the total program:

1. an epidemiological 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 American Public Health Association. Additional, follow-up observations will be made in 1977 and recommendations will be made to deal with health problems and improve health services in the Bol area.

2. Health services support. Four kinds of activities will be supported as a part of this project:

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

   - Bol hospital facilities will be repaired and the laboratory will be equipped. A medical training center will be added.

   - A low-cost paramedical system will be instituted in the polder area. One unit to each 400 ha. cultivated will be the goal.

   - Certain 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.

D. Special Studies

1. Technical reviews of an agricultural production-irrigated agriculture project in the polder formations (Phase Two). Review will examine design, cost effectiveness and appropriateness of alternatives and select preferred choice for proposed AID support.

2. Sociological study of the factors affecting the development-resettlement of the polders and polder areas. The availability of settlers, their selection and measures to address settlement problems and provide incentives to small farmers to participate in the program will be analysed.

These special studies are expected to establish the feasibility of a Phase Two proposal and would serve as the basis for a Project Paper submitted for AID/W review and approval.

3. As any Phase Two project is expected to have significant environmental effects, an environmental assessment will be necessary. Environmental assessment will be a detailed study of reasonably foreseeable environmental effects, both positive and negative, of the proposed polder development.

Phase II Activity - Detailed Description

A. Development of an Agricultural Production - Irrigated Agriculture Project in the Polder Formations

The purpose of this project will be to assist Chad in developing its ability to feed itself and to provide the small farmers of the Sahel lands surrounding the Lake Chad shoreline in the Bol area with an alternative to traditional low yield agriculture. The Chadian government created SODELAC to do this, using the waters of Lake Chad and adjacent organic soils as the basic resource. To the extent possible, SODELAC's activities should generate financial revenue to defray all or substantial portions of its operating budget, given the GOC's limited financial resources. In the Lake Chad area SODELAC is responsible for processing and transport of agricultural output and will rely on revenues from these activities to fund its continual and expanded development services to the Lake Chad area. Given the estimated yields of cotton and wheat - the two major crops handled by SODELAC - under intensive modern irrigation cultivation on high quality polder land, 3,000 or more hectares should be in production.

As noted above, Chad faces two immediate problems: producing and providing enough food to feed the population and providing opportunities for increased incomes and welfare to the portion of the population living in the Chadian Sahel. The proposal to investigate and establish the feasibility of a cost effective agricultural production - irrigated agriculture project in the polder formations near Bol is an attempt to provide a partial solution to those problems. The approach to be selected will be formulated to provide the best potential for expansion and replicability.

Through the provision of assistance to and through SODELAC, the Chadian regional development institution for the Lake Chad area, the IBRD, FAC, African Development Fund and the USAID (through the Phase One assistance described earlier), are supporting initial efforts in developing high-yielding irrigated agricultural practices in Chad. The USAID's Phase Two activity would build upon and expand those efforts in order to provide more opportunities for increased incomes and welfare to the Chadian small farmer and to increase Chad's ability to feed itself. Based on analysis to date, the USAID is of the tentative opinion that the preferred method to

achieve those objectives is the development of a polder to provide full control over drainage and irrigation as well as the ability to influence and monitor the practice of modern, higher technology agriculture by small farmers on polder lands. The tentatively identified polder development scheme would be similar to that supported by the IBRD in the Bol area; the technical feasibility of that scheme has already been established. However, as an element of the Phase One special studies component, the appropriateness of such a scheme and design particularly with respect to considerations of cost-effectiveness through comparison with alternatives to achieve the same objectives will be carefully reviewed.

If full-scale polder development as in the IBRD project is shown to be the preferred approach, the project area proposed would be adjacent to the city (village) of Bol, on the fringe of the Sahel but accessible to the capital. Land in similar polders nearby is of proven excellent quality and, with irrigation waters from Lake Chad immediately available, is capable of producing high agricultural yields. There is a history in the area of irrigated agriculture, as well as of using traditional agricultural methods. Earlier analyses of the area's population, to be confirmed during the special studies, show sufficient available labor and interest in participating in a SODELAC-sponsored irrigated agriculture project. Accessible markets, both in the capital and neighboring countries across the lake, generate adequate demand to absorb all proposed output. Transportation links from the polders to marketing areas are reasonably good, providing year round access.

Alternatives to intensive polder development might be the following:

1. Forego the project (and rely on emergency food relief when needed.)

2. Encourage and develop dry land farming.

3. Develop the wadis. (Note: the wadis are encircled areas along the shores of Lake Chad which are alternately covered and uncovered by water seeping from the water table as influenced by the water level in Lake Chad. Water soils also show high-yield potential.)

The option to forego further project development (option 1, above), is not realistic for the following major reasons:

Small farmers in the Sahel have no economic alternative to improving their condition 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 inadequate or non-existent 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.

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 70,000 people. If five people i.e., 2 adults, 3 children directly benefit from each irrigated hectare of the empoldered area, the incomes and quality of life for a sizable portion of the population can be improved through a long term effort of polder development.

By 1979-80, SODELAC will have developed the 1,200 hectares to be funded by IDA, plus perhaps another 1,000 hectares funded by BADEA, plus whatever area could be supported by AID in Phase Two. This total would be a modest yet meaningful start towards a long-term solution to the problems of food production in the Sahel.

The option (2 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 700mm. About 70% of the rain falls in the months of July and August. The evapo-transpiration rate is about 2150mm per year. The probability of producing satisfactory yields on sandy soils any time is not sufficient to warrant the investment risks.

The option (3 above) of developing the wadis by using pumps, drainage, and ground water is very interesting and warrants further investigation. But at present the insufficient information available on technical aspects and related infrastructure problems appears to preclude consideration of wadis development an an immediate, full scale project. Continuing investigation and experimental or trial activities to develop a future program for this Sahel resource in the Lac area will be considered as an alternative or complement to the polder development proposal during the technical review element of the Special Studies activity of Phase One.

In order to build the basis for a successful and expanding program of irrigated agriculture in the Sahel, it appears 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 adequate 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.

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 of grain, 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, thereby assisting it to continue and expand its developmental and support activities in the Lake Chad shore areas.

Tandal, a polder of 800 irrigatable hectares can be developed near Bol. The current level of experience within SODELAC, plus the planning previously done, the existence of trained technical crews, and suitable equipment in place, make the construction of a polder there feasible and desirable. The project would substantially assist the Government of Chad to increase food production and the incomes of small farmers in the Sahel.

The Tandal polder 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. If the Special Studies reviews concludes that the construction of a polder at Tandal is the favored alternative, SODELAC would use its staff to: (1) 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 toal number of farms possible at one hectare each would be 800 planned assuming approximately 5 persons per family unit, 4,000 Chadians would be direct beneficiaries.

I. B. Summary Findings

In view of the imperative need to increase food production in Chad and provide an alternative productive, economic activity to the population of the Sahel, CDO and the Government of Chad have designed this two-phased proposal as part of and supportive of a multidonor project and recommend that it be undertaken. The existence of Lake Chad, a reservoir of scarce water, has long been recognized by the Government of Chad and by potential donors as a resource which should be developed. This project has been designed to exploit that resource in a systematic, phased manner with due regard for consideration of technical feasibility and cost-effectiveness 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. Phase Two would 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. The project to be recommended for funding will meet the criterion of replicability.

2. Through the provision of Phase I assistance, SODELAC will have the capability to carry out polder development and support activities as the sole host country,governmental implementing agency with adequate financial resources, expatriate staff, advice and assistance, a sufficient number of qualified Chadians in addition to Peace Corps volunteers, and AID technical support.

3. Prior identification of health factors involved in a Phase II proposal will be made. An epidemiological survey, to be completed early on in Phase I implementation, will supply additional data on current and potential health problems being faced by the polders population. The health services support activities will achieve a reduction and/or elimination of presently 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. Source and origin waivers are not anticipated for equipment in Phase One. Construction supplies would be purchased in Chad, Cameroon or Nigeria for Phase Two. Irrigation equipment may have to be purchased in France if unavailable in U.S. for Phase Two.

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

7. 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.

In summary, the USAID believes the proposal reflects a sound and coherent approach to achieve joint USAID/GOC goals in Chad in the agriculture sector by providing immediate Phase I assistance to support and further the development of recently initiated irrigated agriculture experiments on the Lake Chad shoreline and to establish the feasibility of expanding such efforts in a second stage for possible subsequent AID support.

I. E. Project Issues

Project issues relating to Phase I and Phase II are as follows:

1. Phase I. 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 SODELAC 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 strengthening as an organization. In view of the tasks ahead, can SODELAC's capabilities be sufficiently strengthened through the technical assistance contemplated to enable it to take on the Phase II activities subsequently, and can SODELAC successfully address the many and difficult problems of polder settlement?

   As discussed in Appendix C, the proposed Phase I assistance to SODELAC will strengthen its organization, define its operational tasks and organize them in a work plan with provision for adequate financial, equipment and personnel resources including expatriate assistance needed for the job. Through such an approach, the mission is confident SODELAC will become a capable development institution.

A related issue revolves around SODELAC's ability to act in both a commercial and developmental capacity. It is possible for its goals to become confused. For example, a policy of providing low wheat to the capital conflicts with a policy to optimize the income of the small farmers. 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 study will include an accounting system which will define the costs of its commercial activities and those of its purely developmental activities. A GOC subsidy will be recommended and designed to cover the costs of the latter.

2. Phase II - Development of an Irrigated Agriculture Project in the Polder Areas.

Probably the most troublesome issues which SODELAC will face are those relating to 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 the process Phase I assistance includes a socio-economist who will be attached to the research station. This person will study the local population and advise in matters of farmer selection and training. Issues to be examined by the Socio-economist include the "control" of production on the polders. The project seeks to avoid the possibility of converting the polders into communes or giant share-cropper plots. Under the present approach, SODELAC will provide subsidies for some crops, but, prices can change. Will SODELAC eventually require forced marketing at prices below the prevailing market price? Will SODELAC find it necessary to cut off irrigation 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, and with expatriate technical advice, the CDO feels these issues can be resolved.

Polder development as perceived in this project is a complicated process. Three related basic issues are addressed: (1) the engineering design of the project, (2) the socio-logical factors involving the farmers related to relocation, breaking of social-economic traditions, and intensification of work effort and (3) the effect of the project on the environment.

The appropriateness of the earlier developed technical design of a polder development proposal is an issue which will be reviewed during the technical review element of the Phase I Special Studies.

The Sociological questions involve numerous factors. Tribal rivalry is not considered to be a problem. Neither is the availability of farmers although this will be reconfirmed. The necessity for family members to work more days in a year when farming polder lands is another question. The higher production will require greater sustained energy outputs. Studies have concluded the people react to economic stimuli. If this is true, there is no problem - if they do not, the USAID believes there is a surplus of people who could be employed and the feasibility of the project will therefore not be seriously affected. These and other issues will be reviewed indepth as part of the Special Studies effort.

Environmental questions concern the impact upon the ecology of the area from any intensive land use or polder development - resettlement project and will be thoroughly studied as part of the identification of specific Phase II proposal.

## Part 2. Project Background and Detailed Description

### A. Background

#### The Lake Prefecture Polders

##### 1. 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 southeasternly 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.

##### 2. 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).

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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.

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, traditional construction methods were used, such as transferring sand in handling 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 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 has.; with 2,220 has. cultivated including 1,030 has. of wheat.

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

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

3. Situation Since 1964

The damage suffered did not cause great discouragement to the farmers. 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 which concentrated on avoiding the previous mistakes.

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

- 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 subprefectures.

1/ The strengthening 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.

- 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 has 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 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 continuously.[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

The proposed AID-funded project will comprise four major activities and a series of sub-activities to be carried out in Phase I. Phase II, if approved, would involve a major project undertaking of increasing agricultural production. In outline form:

Phase One

1. Strengthening of SODELAC as a regional development institution:

   a. Management study
   b. Equipping and operating a mobile maintenance brigade
   c. Participant training

2. Research

   a. Agronomic research at Matafo Research Station
   b. Land and water use in the polders
   c. Socio-economic research

3. Health Activities

   a. Epidemiological survey
   b. Health services support

1/ SOGETHA studies and WAGENINGEN Institute studies

4. Special Studies

   a. Technical Review
   b. Environmental Assessment
   c. Sociological - resettlement

Phase Two

1. Development of an Agricultural Production - Irrigated Agriculture Project in the Polder Formations:

Phase One

1. Strengthening of SODELAC as a regional development institution

   a. Management Study: As discussed in further detail in Annex C (SODELAC's Financial Condition), many of SODELAC's problems stem from its involvement in a variety of both commercial and development activities when its 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 and clearly developmental activities be paid for by a subsidy from the GOC, (e.g., extension services, costs of maintaining the channel from the capital to Bol, etc.); that its profitable activities be defined and presumably continued, and that its unprofitable non-developmental 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.

      In September, 1975 the USAID agreed with IBRD-IDA to propose to undertake a critical management study of SODELAC.* In November, 1976 an AID-funded technician completed a preparatory review of SODELAC and completed an outline of the scope of the complete study to follow. A consulting firm will be scheduled to complete the study before the end of CY 77 with funding from Phase I of this project.

      The complete text of the scope of work to be followed 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 contraints in all functional areas to determine potential for improvement; (b) appraise needs in management planning;

*See IDA, Development Credit Agreement (Lake Chad Project) number 692 CD.

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 workplan for accomplishing the major steps in the reorganization.

b. Equipping and operating a mobile 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 of the capital. It has transportation links to the capital and Nigeria. SODELAC, which has primary responsibility for the development of the 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, it needs additional equipment and financial capability to meet operating costs. Overall technical and management capability, on the other hand, do not appear to be a major problem. SODELAC has been 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 funds would be used to purchase 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 believes it will be able to begin to pay for some portion of the brigade's operating expenditures and eventually assume responsibility for all those expenses if sufficient agricultural output can be stimulated in the Lake area.

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

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.

c. Participant Training

In order to provide short-term out of country training for Chadian 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 African francophone countries. Training in Mexico (at the international corn/wheat center) 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.

2. Research

a. Purpose

The development of SODELAC's research station capabilities at Matafo is central to the development of any irrigated agriculture production projects in the wadis or polder areas. The AID-financed research component will assist and enable SODELAC to develop and provide on a current basis, a scientific understanding of the physical, biological, economic and sociological processes involved in irrigated agriculture in the project area, and to devise solutions to identified constraints inhibiting project purpose and goal achievement. The program will develop and implement adaptive research in soil-water management, farm management, economic and technological farm enterprise production packages and sociological design of production programs. Research experience from past local efforts will be drawn upon as will information and experience available from international research stations such as IITA, CIMMYT and IRRI. Least-cost soil-water and farm management systems will be developed. Farm enterprise production packages will be designed for the management capabilities of Chadian small farmers and to attract them to participate in the program.

b. Soil-Water Management

Research will focus on the following specific areas:

-- water sources and means of delivery (i.e., both lake water and water drawn from shallow wells will be compared);

-- Salinity and alkalinity control (soils under irrigation will be continually monitored for salt build up and ways and means of preventing such build-up through both chemical and mechanical measures identified);

-- on-farm water management procedures.

The soil-water element of this activity will be implemented with technical assistance from ORSTOM which has a laboratory and staff in N'Djamena and has been investigating the polders of Lake Chad since 1953. Sahel Disaster Relief Assistance Funds have already been obligated for a contract by SODELAC with ORSTOM.

SODELAC will study 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 baseline 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.

c. Improved Technology Farm Enterprise Production Packages

Research will examine crop combinations, rotation systems, recommended varieties of plant species, and measures to maintain and enhance soil fertility. Food and cash crops will be considered, and consideration given to the social and economic patterns and traditions of polder settlers.

d. Farm Management

Research will address questions relating to:

-- social structure constraints to achievement of project objectives;

-- development of farm budgets;

-- land tenure issues.

Agronomic research will take place at SODELAC's agricultural experiment station at Matafo. The station is located at the north end of Guini 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 inset 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 any irrigation project impact at the farmer level.

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 as settlers on polder lands. Study already selected or spontaneously settled farmers. Studies should include all the Lac area, not just irrigation project areas.

5. Evaluate the impact of the IBRD-IDA project and any USAID project subsequently approved on the economic and cultural development of the Lac area as the development of the area proceeds.

3. Health Activities

a. Epidemiological Survey

The purpose of the epidemiological survey is to determine the extent to which schistosomiasis, malaria, 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 prevalence 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 problem areas must be identified. Finally, recommendations will be made to SODELAC, IDA and AID to mitigate any negative effects of the development of the polder region around Bol and the steps to be taken to control diseases.

A preliminary epidemiological 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 malecologist 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 this 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 IBRD-IDA project foresaw the inevitable increase of the health needs of the polders area and USAID agreed to make a definitive study 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, Bol medical facilities will be repaired and re-equipped. Third, a low-cost paramedical system will be instituted in the polder area. A unit will be located at the service centers, one for each 400 ha. 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 snail and mosquito vector concentration and distribution, annual blood and urine examinations to determine the prevalence 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 other 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 at Bol.

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

c. Purchase of microscopes for the Bol 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 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 polder development projects 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 and personnel resources and allow for acceptance by traditional authorities before initiating any programs in new polders areas possibly in the third and fourth years of this project. It is anticipated there would be a unit in Guini, two units in Berim and 2 units in Tandal, if Tandal polder is constructed.

4. Endemic Disease Control

The primary objective of the preliminary epidemiological survey is to study the present and projected prevalence 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 recommeded 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 mobile brigade which is charged with polder maintenance. The old drainage ditches should be cleaned at least twice a year.

Drainage ditches in any new polders will be 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.

4. Special Studies

This component of the Phase I program provides for intensive feasibility analyses of an irrigated-agricultural production scheme to be undertaken concurrently with the aforementioned project elements designed to strengthen and improve the capabilities of SODELAC to manage and support such schemes along the Lake Chad shoreline. In this fashion, efforts will proceed to identify the most appropriate project proposal for reaching in a cost effective manner

significant numbers of AID's target group along the shores of Lake Chad through a program administered by SODELAC while SODELAC's capabilities are being strengthened, so that the proposal identified can be reviewed by AID for approval and initiated by SODELAC at an early date.

The studies to be undertaken will include technical-engineering, sociological and environmental analyses. The objective of the first two is to identify and analyse alternative schemes for increasing irrigated agricultural production in the polder areas and select one for proposed AID funding which most satisfactorily addresses the following AID policy concerns:

a. that sociological feasibility is established (or highly probable);

b. that the proposal is cost-effective, i.e., that it will produce significant benefits for substantial numbers of AID's target group in relation to the costs of the proposal

c. that the feasibility of technical design of the proposal selected be clearly established

d. that the proposal's impact upon the natural, human and social environment be clearly understood, with measures proposed as necessary to minimize environmental disruption-damage.

The studies will give careful consideration to possible proposals for increasing production on or near existing polder formations and nearby areas through measures short of complete development or re-development of polders.

(See "Phase Two Activity - Detailed Description", in Part I, above, for further description of some alternatives to be examined and issues involved.)

If a polder development or similar proposal involving significant environmental disruption is selected, an Environment Assessment (rather than the more simple Initial Environmental Examination) will be performed.

The assessment will be made in accordance with Title 22 of the Code of Federal Regulations, setting forth "Environmental Procedures"

in accordance with the requirements of the National Environmental Policy Act of 1967 (NEPA) as amended by a new Part 216 June 28, 1976. In essence, the Assessment will involve a detailed study of the reasonably foreseeable effects, both positive and negative, of a proposed action and its reasonable alternatives carried out within or affecting specific developing countries. To the extent practicable, the Assessment will be developed in close collaboration with the Chadian institutions and subject to Chadian review.

Phase II

1. Development of an Irrigated Agriculture-Agricultural Production Project in the Polder Areas

As noted above, the specific nature and design of a project to be selected for proposed Phase II funding will be determined by the results of the Special Studies to be undertaken in Phase I on technical-engineering, sociological and environmental aspects. However, based on available data, experience in the area, and feasibility studies done in recent periods on polder construction and alternate forms of irrigated agriculture in the polder areas, the Mission believes that the construction of a polder at Tandal will be shown to be the preferred project proposal. A general description of the rationale for a Tandal polder project was presented above in Part I, Phase II Activity-Detailed Description. For a more complete discussion of a Tandal polder construction project and a description of the characteristics of the waters of Lake Chad, please see Annex B, Project Technical Details.

C. Logical Framework Linkages:

The logical framework is outlined in Annex D. Briefly, AID, the GOC and other donors will provide 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.

AID inputs are summarized in the budget tables (Part 3.B). Basically, AID resources will provide for personnel, commodities and other costs. Under the management and supervision of SODELAC, consultants and project funded technicians,a functioning system of irrigated polders, a functioning research station, and the renovation or maintenance of a series of roads, dikes, and irrigation/drainage systems in the area of BOL will result. 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 output of the project are best summarized by the "end-of-project status" statement:

> SODELAC's experience, financial and institutional base will have expanded to the point where, with decreasing amounts of capital and technical assistance, it 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. The Matafo experiment station will be fully staffed and producing and disseminating 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 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 two fold: to increase the production of food by small farmers and to transform SODELAC into an effective development institution capable of replicating the proposed Phase II project. There is reason to believe that as more area is 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 one 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 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 is 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.

There are four major components in Phase One.

a. First, 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, is technically competent and has gained valuable experience in the work at hand. Changing agencies would be counter-productive.

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, making contracting an outside firm redundant or duplicative, as well as more expensive.

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

1) to depend on research in other parts of Chad
2) 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 involved 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.

c. The appropriateness of the third 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 analysis, the necessity of implementating an expanded health services program becomes obvious, lest repeated outbreaks of diseases and epidemics cause the project to be delayed or otherwise be imperiled.

The fourth element is required before Phase Two activity begins. The fourth element will consist of studies: 1) technical review of engineering, 2) environmental assessment, and 3) sociological study of issues of resettlement and intensive agricultural production by Chadian farmers not accustomed to such practices, as well as other related issues.

In Phase II, USAID proposes the development of an irrigated agriculture production project as soon as Phase I analyses and studies are completed and the recommended alternative is chosen. At this time, the Mission believes polder development project at Tandal is the most appropriate scheme to increase agricultural production and small farmer welfare.

Alternatives might be the following:

a) Forego the project and just rely on food relief when 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 of grain, 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 285mm, but varies from 7mm to 700mm. About 70% of the rain falls in the months of July and August. The evaportranpiration rate is about 2150mm per year. The probability of producing satisfacory 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.

B. Financial Plan

The following tables present the financial details of the project. Phase I consists of: $0.73 million for the strengthening of SODELAC and the mobile maintenance brigade, and $1.5 million for research and related activities, $.36 million for health services. Personnel costs will represent more than 10% of the total, commodities (mostly pumps and construction machinery for the mobile brigade) about 20% and other costs, 70% (mostly

construction costs and local salaries). Phase II costs cannot be estimated at this time.

## BUDGET TABLE I

STRENGTHENING OF SODELAC - ANNUAL COSTS

| | Cost ($000) Total | FY 77 1st Yr | FY 78 2nd Yr | FY 79 3rd yr | FY 80 4th Yr |
|---|---|---|---|---|---|
| Personnel | -0- | -0- | -0- | -0- | -0- |
| 2 PCVs (works Supt. & Surveyor) | | | | | |
| Commodities | 314.8 | 314.8 | -0- | -0- | -0- |
| Portable Pumps | 80.0 | 80.0 | | | |
| 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 | 171.0 | 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 | 655.8 | 314.8 | 60.0 | 171.0 | 110.0 |
| Total cost including contingencies and 10% 2nd year 20% 3rd year 30% 4th year and rounding | 735.0 | 315.0 | 70.0 | 205.0 | 145.0 |

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## BUDGET TABLE II

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 |

## BUDGET TABLE III

| Health Activities ($000) | Total | (FY 77) 1st Yr. | (FY 78) 2nd Yr. | (FY79) 3rd Yr. | (FY 80) 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. 30% for 4th Yr. rounded | 360.0 | -0- | 100.0 | 125.0 | 135.0 |

## BUDGET TABLE IV

| Special Studies ($000) | Total | 1st Yr. | 2nd Yr. | 3rd Yr. | 4th Yr. |
|---|---|---|---|---|---|
| Other Costs | 160 | 160 | -0- | -0- | -0- |
| Total Cost* | 160 | 160 | -0- | -0- | -0- |

*No Contingencies

## BUDGET TABLE V

### SUMMARY TABLE ($000)

| Budget by Activity and Year | YEAR | | | | |
|---|---|---|---|---|---|
| | Totals | 1(FY 77) | 2(FY 78) | 3 (FY 79) | 4 (FY 80) |
| Phase One | | | | | |
| 1. SODELAC Strengthening | 735 | 315 | 70 | 205 | 145 |
| 2. Research | 1,500 | 590 | 400 | 340 | 170 |
| 3. Health Activities | 360 | | 100 | 125 | 135 |
| 4. Special Studies | 160 | 160 | 0 | 0 | 0 |
| Total | 2,755 | 1,065 | 570 | 670 | 450 |

| Budget by Category | | | | | |
|---|---|---|---|---|---|
| | Totals | 1 | 2 | 3 | 4 |
| Personnel | 340 | 25 | 155 | 160 | 0 |
| Commodities | 490 | 375 | 55 | 60 | 0 |
| Other Costs | 1,925 | 665 | 360 | 450 | 450 |
| Total | 2,755 | 1,065 | 570 | 670 | 450 |

BUDGET TABLE VI

SUMMARY COST ESTIMATE AND FINANCIAL PLAN
(US $ 000)

PROJECT PAPER

| Source | AID GRANT FX | AID GRANT LC | HOST COUNTRY FX | HOST COUNTRY LC | OTHER(s)* FX | OTHER(s)* LC | TOTAL |
|---|---|---|---|---|---|---|---|
| Use* | | | | | | | |
| Personnel | 340 | 0 | 0 | 175 | 2,850 | 2,000 | 5,365 |
| Commodities | 490 | 0 | 0 | 0 | 1,300 | | 1,790 |
| Other Costs | 575 | 1,350 | 0 | 225 | | 6,770 | 8,920 |
| Includes Inflation factor and contingency factor | 10%/year | | 5%/Year | | 15%/year | | |
| TOTAL | 1,405 | 1,350 | | 400 | 4,150 | 8,770 | 16,075 |

* Includes IDA, FAC, AFDC, PEACE CORPS

## C. Economic Analysis

### 1. Economic Feasibility of the Maintenance, Research and Health Components (Phase One)

The maintenance and repair of infrastructure to be done by the mobile brigade can be subjected to benefit/cost analysis and an IRR could be calculated. There are difficulties, however, in estimating 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 to realize acceptable return on investment. 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 only 10 years would be 1.3. Finally, it is the judgement of SODELAC and USAID that a mobile maintenance brigade is the most effective approach to the maintenance problem which SODELAC will face in the Bol area.

No attempt was made to estimate the economic feasibility of the research activity. Thisis 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".

A similar approach was taken for the economic feasibility of the health component project. The costs of the health activities will be small ($340,000 over four years) while the benefits could be extremely high if, for example, an outbreak of malaria or schistosomiasis is prevented. Further, AID's experience in other countries is that resources spent on health are repaid many times by the increase in worker productivity which results. The same results will be assumed for this project, and a benefit/cost analysis will not be attempted.

## 2. Phase II, The Irrigated Agriculture Production Project

See Annex B, Project Technical Details, Part 4 for the preliminary economic analysis of costs, benefits, internal rate of return and other calculations estimated to result from the construction and implementation of the proposed Tandal polder. That analysis indicates that an irrigated agriculture production project of polder construction or other type should be undertaken. Calculations made show an estimated Benefit/Cost Ratio of 1:2 and an Internal Rate of Return of 18% from such efforts to expand agricultural production.

## D. Social Analysis

This analysis attempts to establish the sociological feasibility of those elements of Phase I, to be authorized following review and approval of this document, which will directly affect or involve Chadian small farmers and settlers in the polder areas. The analysis also attempts to establish that the introduction of a Phase II activity subsequently, involving controlled irrigated agricultural production, appears to be feasible from a sociological perspective. Those elements of Phase I which are subjected to this analysis are the activities of the SODELAC road and dike infrastructure, mobile maintenance brigade, and the outputs of the SODELAC agricultural research activities which are intended to benefit and be accepted by local small farmers.

Accordingly, the social analysis attempts to determine: (1) the compatibility of the proposed two-phased project with the sociocultural environment into which it is to be introduced, (2) the likelihood that the practices introduced will be diffused among other groups (spread effects) and, (3) the social impact or distribution of benefits and burdens among different groups.

### 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 (headquarters Mao). The total (1968-1972) population of the two prefectures was about 250,000; population averages 5/km$^2$, but is about 30/km$^2$ close to the polders and 15/km$^2$ in dunes within 5 km of polders. 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 prevail in the project activity area.

The Boudoums are originally inhabitants of the islands but today they tend to live on the shores of the lake and are farmers, cattlemen and fishermen.

The Kanembous lived on the dryland part of the prefecture and are divided into many subgroups. They are equally farmers and cattlemen.

The cultivators of the dunes could be either group but the majority are Kanembous who have practiced irrigation with the "chadouf" for many generations.

The inhabitants of the area are characterized by their mobility, passing from one polder to another as the level of the lake and the water table changes but migration has been toward the region of Bol during the last 15 years.

The population of the area of influence has been estimated at 250,000, the population of the islands and the dunes within a circle of 5 kms from Bol was estimated to be between 11,000 and 12,000 in 1977.

The survey of potential settlers in 1972 sought to segregate the population into activity groups; commerce, cattle, fishing, and farming. This was not too successful since people change to the most remunerative activity possible; people move to opportunity. It was concluded however that the area of influence had 114,000 farmer people, more than 25,00 families. The study of where old polder settlers came from, showed only 10% came from Bol canton, 25% from cantons of Nguelea and Ngarangou (15 to 30 kms), 33% from Ngouri and Isseirom (40 to 60 kms), 15% from Mao (60 kms) and 17% from other areas (within 60 kms). It was concluded that settling was not a function of distance from the polder.

The migration to Bol polder area during 1968 to 1972 was 500 persons per year and the population growth rate of the entire zone of influence has been estimated to be 0.6%.

The old polders near Bol are settled by families with exploitations that have 4.3 persons per family of which 2.9 are active producers (over 15 years). They farm 1.56 ha ( 1 ha dune - millet, 0.3 ha in polder wheat, corn or late millet and vegetables), cattle were held by 40% of the people (7.6 head per family). 90% of the people were sedentary, 27% settled since 1968.

The polder population was compared with the dune settler (within 5 km from polders). Family size was 3.8 persons, 2.7 active farming 1.34 ha. Fifty percent of the families had cattle (about equal to polder people. 87% were sedentary and 25% had arrived since 1968.

The size of exploitations in the 5 km radius varied greatly, 15% had 4 or more active workers, 50% had two active workers or less. The size of holding was related to the size of family since the extended family is the dominant unit.

The study found that the dune region exploitable near Bol was 5,750 hectares and only 15 to 20% was used. Tradition rests the land three of four years.

In the traditional area the income per family was about $120.

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. 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 practices implies that the transition was successful. The social structure has demonstrated it can accommodate 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; is planted after millet in wet areas of the polders and along the edge of the lake; at times, it is cultivated under irrigation. Lake 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 from the high water table 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.

While there is a tradition of irrigated agriculture, the traditional system is quite different than that which would be practiced utilizing surface water would 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 solely in his hands. It will be easy to blame someone else when the water is not there. To address these types of problems, twelve farmers would share each main outlet with extension agents to provide assistance. The SODELAC Commercial Unit will provide extensive technical assistance for the first full year of occupancy. (See below.) Under these arrangements it is felt that the individual families will more readily adapt to the new social order. Individuals will be members of a small group, and they and the other members of this group can set up the system which best suits their needs. Life styles will undergo changes, but the Chadian rural family is no stranger to change. To smooth the transition, there will be some solid economic incentives (a tripling of realized income is estimated see Annex B, Part 2). On the basis of observation and reactions to the opening of other polders, the population does respond to economic incentives. Finally, the labor requirements of cultivating irrigated agriculture polder plots by the family unit appear to be manageable.

Land tenure arrangements on newly opened polders constructed under other donor financing will be administered by SODELAC. Land occupancy on presently settled land is rooted in tradition with a tribal leader (chef du canton), the primary figure in the influencing its distribution. Legal ownership of newly developed polders is vested in the Republic of Chad by the Decree of August 1, 1967.

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 below and will be administered by SODELAC in coordination with the local community leaders. On this matter, the resident socio-economist will act as a settlement advisor.

The two World Bank polders will be completed by 1979-80, and the BADEA financed polder shortly after 1980. 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 settlement plan which the World Ban has worked out with SODELAC is to be followed.

To maximize the benefits to the local farming community, and to minimize the cost of farming, the principle has been retained that polders be settled by individual farmers, each cultivating 1 hectare, assuming 2.8 adults in the farm family. A 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 currently included in SODELAC's planning, including the development of Mamdi and Tandal polders, assumes that 3,600 farmers would acquire land over the period 1976-1985. Problems involving the recruitment of farmers and settlement may consequently slow down the development rate. Furthermore, there are bound to be technical limitations in the first years of cultivation. To ease the way for settlement, SODELAC has formed a Commercial Agricultural Development Section responsible for the first year of production in any given area; thereafter, the land would be settled. The Commercial Section would act as a land development agency, and be 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, disc, 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 approach is also necessary to correct leveling for production and ecological reasons.)

In concert with SODELAC the administration of Lac prefecture would assume responsibility for the selection of settlers and the allocation of land. The applicants would be 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.

Plots are to be leased to settlers for a three--year period with option to renew the lease. 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 regulations of 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 exchanges 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.

After the first year of operation, the small holder would receive no mechanical assistance. He would 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 wheat and none on his cotton. H would use no chemical herbicides. 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 wheat thrashers owned by SODELAC if he so desired. He would receive credit for the purchase of seeds and other seasonal inputs. To encourage him to invest in ox-drawn equipment, credit would be provided. Most importantly, effective extension advice would be readily available.

There would be two recruitment periods for settlers, with the latest dates of occupancy being October 31 and March 31 respectively. The incoming settlers would be directed to pre-located village sites that would consist of no more than a project provided well. The settlers would find their own way to the area using local camels and donkeys for transporting their 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 currently planned by SODELAC, 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.

Once settled, responsibility for assisting the settler rests with the extension staff who would assess his assets, oxen, ploughs, tools, etc. and advise him of additional needs and equipment. The settler 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 would be set up and 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. One center is contemplated for each 400 hectares.

On the basis of this preliminary analysis we conclude that development of a polder, if selected as the proposed Phase II activity, would be 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. Nonetheless, as noted earlier, more intensive study of sociological considerations will be undertaken during Phase I to more firmly assess whether any unforeseen or unaddressed sociological or cultural constraints/barriers may exist which would affect a polder development proposal.

The above analysis focused on polder development for two reasons: 1) SODELAC is involved in implementing the IBRD-IDA polder development activity, and Phase I assistance is intended to contributed to its effectiveness in carrying out those responsibilities; and 2) the most complex proposal from considerations of sociology and cultural issues which could be chosen for a Phase II submission would be development of a polder. Other alternatives if chosen

would involve either lesser amounts of organized resettlement or, possibly, rely on spontaneous settlement as in the case of the alternative of development of the wadis. Based on analysis of the most difficult alternative, the Mission concludes that any of the available options for implementing an irrigated agriculture project should be feasible.

With respect to the outputs of the Agricultural Research Station (Matafo), it should be noted that the agricultural production packages both for irrigated farming and dry land farming will be developed with the advice and counsel of the socio-economic consultant to be provided to SODELAC under this project. Accordingly, adoption of these packages by the target farmers should be facilitated.

2. Spread Effects

The spread effects of Phase I outputs will be principally concentrated within developed polder areas, with the possibility of the diffusion of innovation technologies occurring in other areas (e.g. wadis) depending upon the specific nature of research outputs. If, for example, low-lift pumping research produces replicable conclusions for wadi development, efforts would be undertaken through SODELAC to promote such practices.

If a polder development activity is selected for Phase II consideration, the replication-spread effect will be different because of the nature and the investment required.

Just knowing how to grow crops under irrigation, however, is not enough; you need the polder, dikes, canals, etc. Consequently, replication would be limited by the ability to develop new polders. However, if funds are made available, there are no limits to the facility for replicating a polder development activity. The analysis of population of the area 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 would 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 barrier.

3. Distribution of Benefits

The estimated benefits to be realized by settlement farmers receiving assistance from SODELAC as a result of Phase I inputs were enumerated in Annex B, Part 2 (Benefits received by non-settlement farmers through dissemination of research results cannot be reliably calculated at this stage.) 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. 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. In this case, the inputs are family labor and other purchased inputs. As indicated in Annex B, Part 2, 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 bcal leaders he will have a voice in the Bol development commission which will establish local development priorities. In summary, we see the small farmer as an active participant in the developnent 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. The socio-economic consultant will advise SODELAC of measures to increase the participation and flow of benefits to women.

Part IV. Implementation Planning

A. Administrative Arrangements - Implementation Plan
Phase I

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

Phase II - Development of an Irrigated Agriculture Project in the Polder Formations of the Bol Area of Lake Chad.

An implementation plan for this activity will be developed following the identification of the specific activity selected.

Phase I

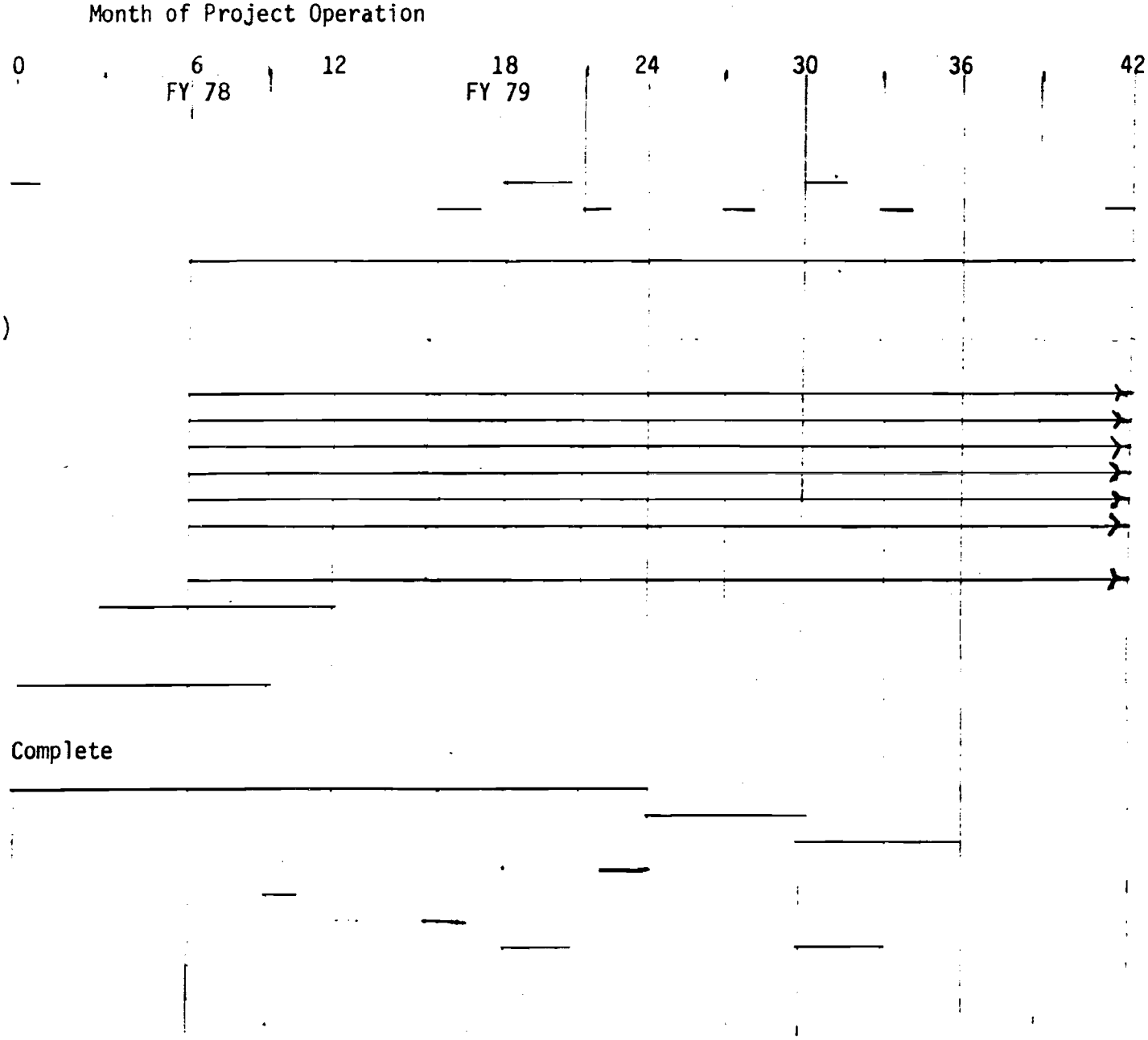
1. Development of SODELAC as a regional development institution with maintenance and construction capability. (See Implementation Table 1)

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 78, the planned AID participation could finish in January Of 1980.

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

Implementation Table # 1

## SCHEDULE OF WORK - SODELAC STRENGTHENING



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 surfaces using a clay/sand 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 roads 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 possibly Tandal. Then the road net will be extended 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.

For the other major sub-element of the SODELAC strengthening - The Management Study- 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 workplan for accomplishing the major steps in the reorganization. It is expected that the study can be completed within nine months.

2. Research Element (See Implementation Table 2)

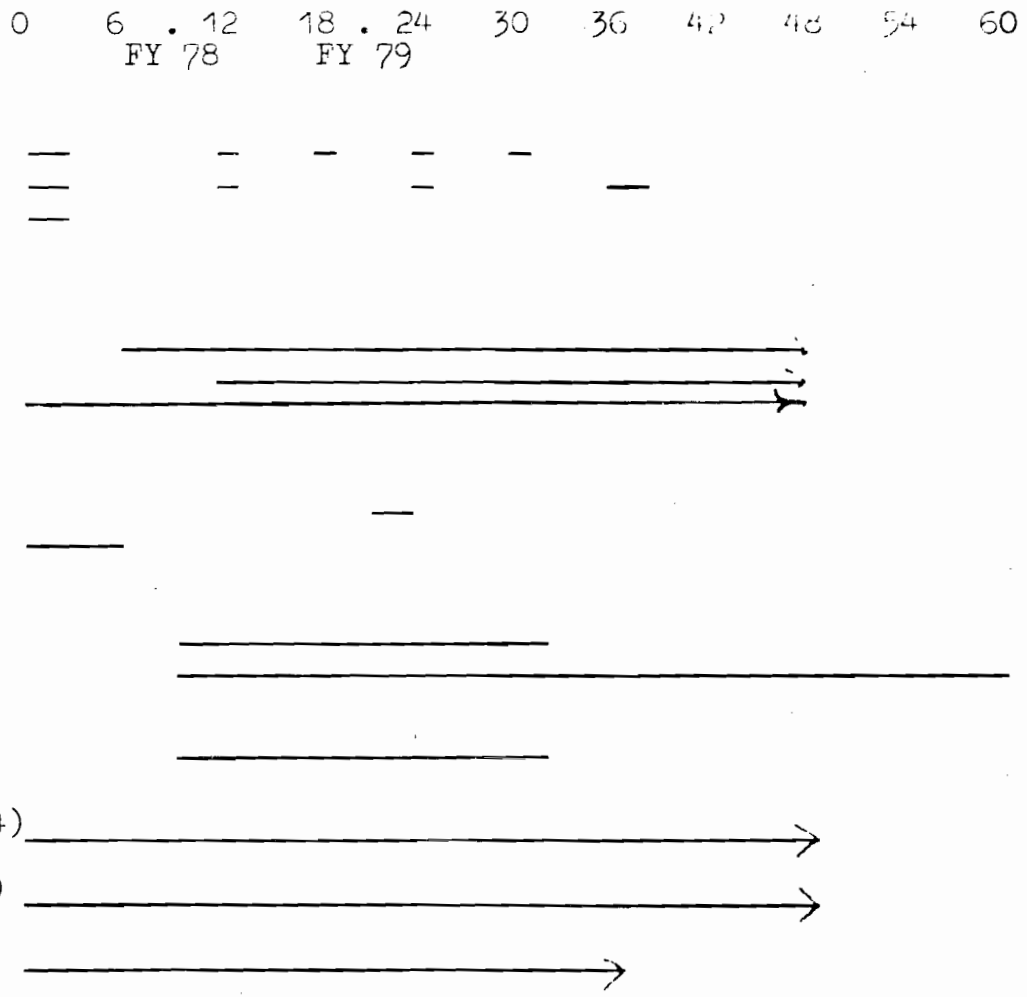
Research will begin in April 1977 with a consultant to advise on the content of the cereals research program, specifically in wheat varietal testing. The Research Unit is a responsibility of the project unit manager (SODELAC) and

Implementation Table 2

## SCHEDULE OF WORK - RESEARCH PROGRAM

ACTIVITY

Month of Project Operation



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 theproject 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 to 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 eight 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.

3. Health Activities (See Implementation Table 3)

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 and 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.

## SCHEDULE OF WORK - HEALTH ACTIVITIES

IMPLEMENTATION TABLE 3

| | 0 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
|---|---|---|---|---|---|---|---|---|---|
| | | FY 78 | | | FY 79 | FY 80 | | | |
| 1. Epidemiological Study | — | — | | — | | — | | | |
| 2. Facility Improvement | | — | | — | | — | | | |
| 3. Paramedical Recruitment and training | | | — | | — | | — | | |
| 4. Health Campaigns | | — | | — | | — | | | |
| 5. Wells | | | — | | — | | — | | |

(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.

4. Special Studies

(a) Technical Review of Phase II Activity - Irrigated Agriculture Production Project in the Polder Formations Near Bol.

The technical review will carefully review the advantages and disadvantages of all possible project proposals for increasing irrigated agricultural production in or near existing polder formations and surrounding areas. The review will assess the cost-effectiveness and technical feasibility of those schemes considered and recommend one alternative for funding by AID.

If the review concludes that polder construction meets and satisfies AID criteria, the technical review will particularly determine:

(1) safety of dike design
(2) drainability of area
(3) cost effectiveness
(4) 611(b) requirements are satisified
(5) hydrology of area
(6) O and M provisions
(7) standby arrangements for drainage or irrigation pumping.

(b) Sociological feasibility and resettlement issues. This study will consider the sociological, legal, health, and historical information relative to intensive agricultural cultivation without complete polder development, and with polder settlement. It will consider adequacy of incentives to farmers, constraints to their participation in any proposed project, availability of settlers for polders, selection of farmers and problems and costs of settling, payments by farmers, land tenure (leasing, etc.) production and sales of agricultural production, production capability, relationship traditionally with leaders and changes imposed by project, and a general overview of socio-economic changes and their consequences.

(c) Environmental Assessment. To provide AID EPRC with a comprehensive understanding of the reasonably foreseeable environmental effects of proposed actions and their reasonable alternatives so that the expected benefits of development objectives can be weighed against any adverse short or long-term impacts upon human environment. If there is found to be any significant adverse effect, satisfacory safeguards will be suggested for incorporation in project. The details for this kind of study are contained in Federal Register, Vol. 41, No. 127, Wednesday, June 3, 1976.

B. Evaluation Plan

The evaluation plan will consit 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 spotaneous 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.

C. 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.

Special covenants recommended for this Phase I Project Agreement are as follows:

1. That no maintenance or rehabilitation activities of roads, dikes or related irrigation infrastructure in the polders areas will be undertaken by SODELAC's mobile maintenance brigade unless the plans for such work can be shown to be compatible with AID's environmental policy regulations as defined in AID Regulation 16.

2. That dissemination of any small farmer/agricultural production packages developed by the SODELAC research station at Matafo under this project which involve use of fertilizers or chemicals such as pesticides/herbicides/fungicides will not be made unless the use of those fertilizers and chemicals is shown to be compatible with AID's environmental policy regulations as defined in AID Regulation 16.

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. All training or foreign travel 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 Phase II, Lake Chad Irrigation project, would 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 in addition to the amounts for a Phase II activity which might be submitted for FY 1978 funding, 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 five 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 Phase II 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 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 1975

FROM : AFR/CWR, David Shear

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.

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 PP is technically not required for this project and my 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 render 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/l - 550 mg/l. 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/l, 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.

# TECHNICAL DATA ON LAKE CHAD AND A PROPOSED POLDER-IRRIGATED AGRICULTURE PROJECT (TANDAL POLDER)

## Technical Information on Lake Chad

The volume of water in the lake varies from; 75 billion $m^3$ when the level of the lake is 282 m, to 40 billion $m^3$ when the lake is 280 m. The amount of(above sea level) water lost by evaporation is about 35 billion $m^3$. Drainage waters effects losses are not significant in the total picture.

Lake Chad is the remnant of a paleotechadian sea which stretched up to the foot of the Tibesti mountains. Lake Chad is the fourth largest lake in Africa. It shows a surface area ranging on average between 10,000 and 26,000 $Km^2$ according to variations in precipitation. Four countries border on its banks and it lies at the average height of 282 m above sea level. It is situated in the Sahel zone and its shores are in majority flat and swampy except in the northeast, where they are bounded by the dunes of the Kanem region which are up to 30 m high. All along the eastern coast, the emerging dunes of a sunken erg oriented south-east/north-west, form a multitude of islands which are extended by a network of reeds and papyrus from which floating islands become separated.

The lake is constituted by two basins separated by an extensive flat called the Great Barrier, which may dry-up on occasion and then stop the circulation of water to the northern basin.

East of the archipelago where the waters are eutrophic in nature and the bottom covered with phanerogams, there are large areas of free waters of dystrophic nature with bottoms covered with papyrus wastes.

The lake receives on average 50 billion $m^3$ water per year of which 83 percent are supplied by the Chari, 7 percent by the rivers El Beid, Yedseran and Komadougou, and 10 percent by direct rainfall. Its flat shores make its area very sensitive to water variations.

At the mean height of 282 m over sea level, its total area is about 22,000 $Km^2$ and its water area 18,000 $Km^2$.

During the years of important precipitations its level may exceed 282 m and its total area 25,000 $Km^2$. The southern lake is then diverted toward the low countries where it forms a string of basins called Bahr el Ghazal or Sara, a situation which happened in the 19th century.

During the years of scarce precipitations, the northern and southern basins are spearated, the total area falls under 9,000 $Km^2$, and the height over sea level under 28 m. The 1906, and 1976/75 the northern basin dried-up. Natron (sodium carbonate) is contained in the waters of the lake in

amounts ranging from about 60 grams/$m^3$ in the archipelago and the Chari Delta, to 400 gram/$m^3$ in the surrounding swamps and residual pools.

The rate of evaporation is about 2 m per year and the lake is slowly filling with sand carried in by the wind. It is also getting choked by the growth of plants such as papyrus and ambatch. Crocodiles and hippopotamuses are found in relative abundance. The fish fauna is mostly concentrated in the waters of the archipelago and scarce in the free waters. As a result of the strong evaporation, the average temperature of the water remains at about 26 degrees C. The annual rainfall decreases from 550 mm in the south to 240 mm in the north. The primary fish productivity of the lake averages 5 $g^{O}2/m^2$ per day.

Project Area Soils

The soils of Guini and Berim polders have been examined and desoribed by a number of investigators and classified accoring 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. A systematic soil survey based on physical characteristics that are important for long-term crop production will be undertaken prior to the start of the project.

The soils of Tandal are expected to be like 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)layer of blocky, columnar fissured (highly permeable) heavy clay, generally coated with iron oxides. Other layers, including mucks and loose muds, will sometime be encountered. There will be 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.

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

Based on the electrical conductivity of the lake, which varies from about 50 micromhos at the mouth of the Chari to a high amount 800 micromhos along the distant northern shore, the salinity content varies from about 30 mg/l-500 mg/l. 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/l, 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.

## Assessment

Salinity and alkali problems are considered to be the primary constraints to productivity. However, they are important constraints only if drainage is not provided. Otherproblems 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.

# COMPENDIUM OF DATA ON LAKE CHAD BASIN HYDROLOGY

## LAKE CHAD

**Mean Chad:**

Altitude above sea level - 282m
Average depth - 4 m
Maximum depth - 11 m
Drawdown - 1.3 m
Evaporation - 2.2 m (over 40 billion $m^3$)
Maximum length - 250 Km
Width - 70 to 140 Km
Shore length = 1 000 Km
Catchment area = 2 500 000 $Km^2$
Total surface area in December = 22 000/$Km^2$
Area of the islands = 4 000 $Km^2$ (number=1900)
Remaining water area = 18 000 $Km^2$
Total surface area in July - 11 000 $Km^2$ (50% of December area)
Mean annual average - 18 000 $Km^2$
Volume at level 282 m = about 75 bil. $m^3$
Volume at level 280 m = about 40 bil. $m^3$

**Great Chad:**

Altitude above sea level = 282 m total surface area in December = over 25 000 $Km^2$
Latest date of occurrence = 1965/1966

**Little Chad:**

Altitude above sea level = 280 m
Total surface area in December = 9 000 $Km^2$
Corresponding area of swamps = 5 000 $Km^2$
Latest date of occurrence = 1972/1974

**OTHER DATA:**

Average rainfall: - southern part = 550mm/yr
northern part = 240 mm/yr.

**Mean Water Supply:**

Chari System - 84 percent (about 45 billion $m^3$)
Other rivers (El Beid, Komadugu etc.) - 2 percent (or about 1 billion $m^3$)
Direct rainfall = 10 percent (about 5 billion $m^3$)
Total supply = about 50 billion $m^3$/year

**Mean Water Loss:**

Evaporation = 90 percent (about 45 billion $m^3$)
Seepage = 10 percent(about 5 billion $m^3$)

Water Characteristics: Temperature - July 28 degrees C
pH = about 7.5
Conductivity = 50 to 1 000 mho along the shore
Natron content = about 60 gr/m
Primary productivity = 5 g 2/$m^2$/day

## Phase Two - Possible Irrigated Agricultural Production Project

### 1. Polder Development at Tandal

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 (2-3m 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 would be 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:

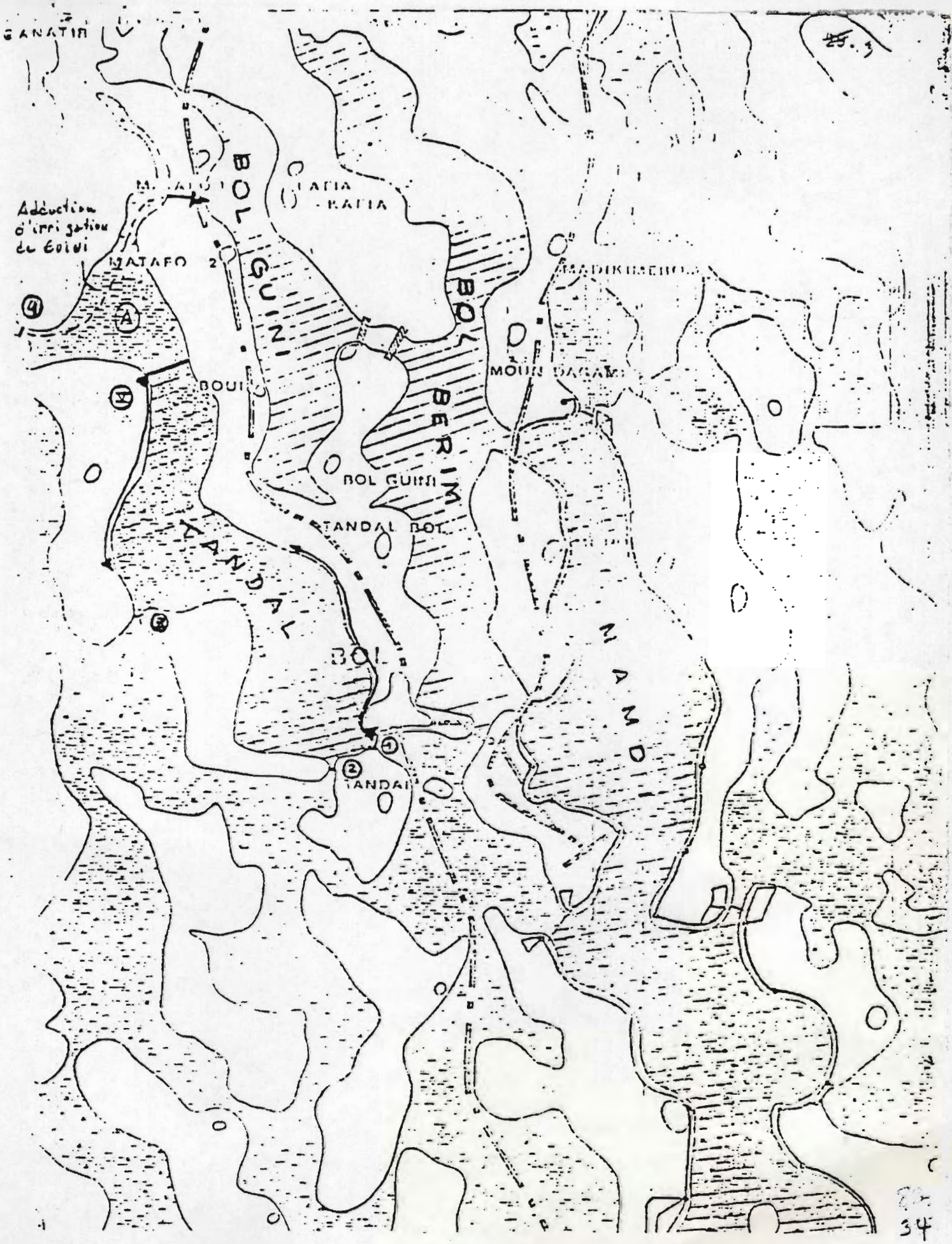
- Dikes (see map following)

Dikes numbered 1,2,3,4 would be built to a crest height of 235 meters above sea level (maximum height of structure less than 11 meters). The crests would be seven 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 would have a crest height of 282 meters. It will be 750 meters long and require 110,000 y cubic meters of fill. Construction would be by a dredge and heavy equipment (bulldozers, truck, loaders).


GANATIR
Adduction d'irrigation de Bidzi
MATAFO
BOL GUNI
BOL BERIM
BOUI
BOL GUINI
TANDAL BOL
TANDAL
BOL
TANDAI
NAMDI
MOUN DARAM

- Irrigation and drainage canals:

| | |
|---|---|
| Primary irrigation canals (reinforced concrete) | 9,600 meters (total length) |
| Secondary irrigation canals | 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 would have stabilized surfaces and be placed to take advantage of drainage and irrigation construction and to provide service access.

All designs would be 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 design for this polder would be based on a feasibility study financed by Fonds d"Aide et de Cooperation (FAC) who employed SCET of France, an experienced, reputable organization for preparing the study. SCET personnel are now employed by SODELAC and integrated into their organization in the Project Unit to carry out irrigation projects and construction of works.

The design of the gravity irrigation system proposed was based on experience on the polder Guini since 1970. The irrigation water would come into the system from the lake and flow by gravity to all parts of the polder. The water table would be maintained at 1.2 meters from the surface through continuous drainage. The drainage system is collective, with the drained water being pumped into the lake far from the polder water intakes. The method provides complete water control and separation of irrigation and drainage waters. The method does not damage the soils, the irrigation water has the lowest

salinity content, there is continuous leaching of salt from soils and the effects of capillary rise of moisture in soils is controlled. There is no pumping for irrigation and there is complete control of water distribution.

The choice of this method appears preferable to other alternatives:

a) improvement of traditional irrigation by partial mechanization.

b) stabilization of the water table and sub-irrigation.

c) pumping from the water table.

These alternatives appear undesirable for two main reasons:

a) Improvement of traditional irrigation and sub-irrigation does not solve the problems of progressive salinization of polders, but increases it.

b) Testing of ground water use by pumping did not succeed in an AID/AIP project and further testing is needed.

It has been found that the polders have the same physical characteristics (same elevation at bottom and about .8 km width) and that the maximum length of primary distribution system is limited to about 5 km. Therefore, the polder would be dividided roughly into two 400 ha units, each with a separate intake and irrigation networks.

Intakes would be designed so that pumping, although not anticipated, could be possible.

The primary canals would be concrete with a slight slope. The water level would be regulated so that there will be no excess flow in the PVC pipes.

PVC pipes would be used to distribute water to meet the needs of an impermeable distribution system and possess flexibility. The polder soils are very permeable and do not seal; therefore the distribution system must be made with impervious materials. Concrete lined canals across earlier constructed polders broke when the soils were alternately wet and dry. Plastic linings did not stand up the the harsh climatic conditions.

The design appears fully appropriate and takes advantage of the experiences since 1970 and meets all design criteria. The costs of construction would be based on detailed analysis of unit costs by SCET and backed by on going construction experience. Inflation factors and contingency factors adequate at the level recommended by REDSO would be used.

The costs of such a polder development reflect high external costs of transportation, high costs of internal transport, and limited experience in construction. It is believed that experience now being gained will lessen future costs.

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 would 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 of the use of PVC 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 $1.5m^3$/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 would be from 1.5 to a 2 meters deep depending on land level and would have 2.1 side slopes. It is also assumed land levels would eventually lower 40 to 50 cms upon drying. A grade in the canal of 0.07% would be used to provide positive flow. There would be secondary drains placed to take care of an observed hetrogeneity of the soils and to prevent standing water.

The pipes delivering water would be based on two farms being served at each service outlet. The quantity of water to be delivered would be 60 l/sec, enough for four farms at a time. The system of using fravity water from the lake would be least expensive and most troublefree.

Dike number 4, located on the north-west end of the Tandal area, serves both Berim and Tandal. Dikes No. 5 and 4 would create a pond at a constant level of 282 meters which would supply

water to the north end of Tandal and to Berim. The level of the pond would 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. This design has economic advantages.

The canals along the side of Tandal would 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 caused by drainage and land use, justify the use of PVC pipe distribution systems and project design.

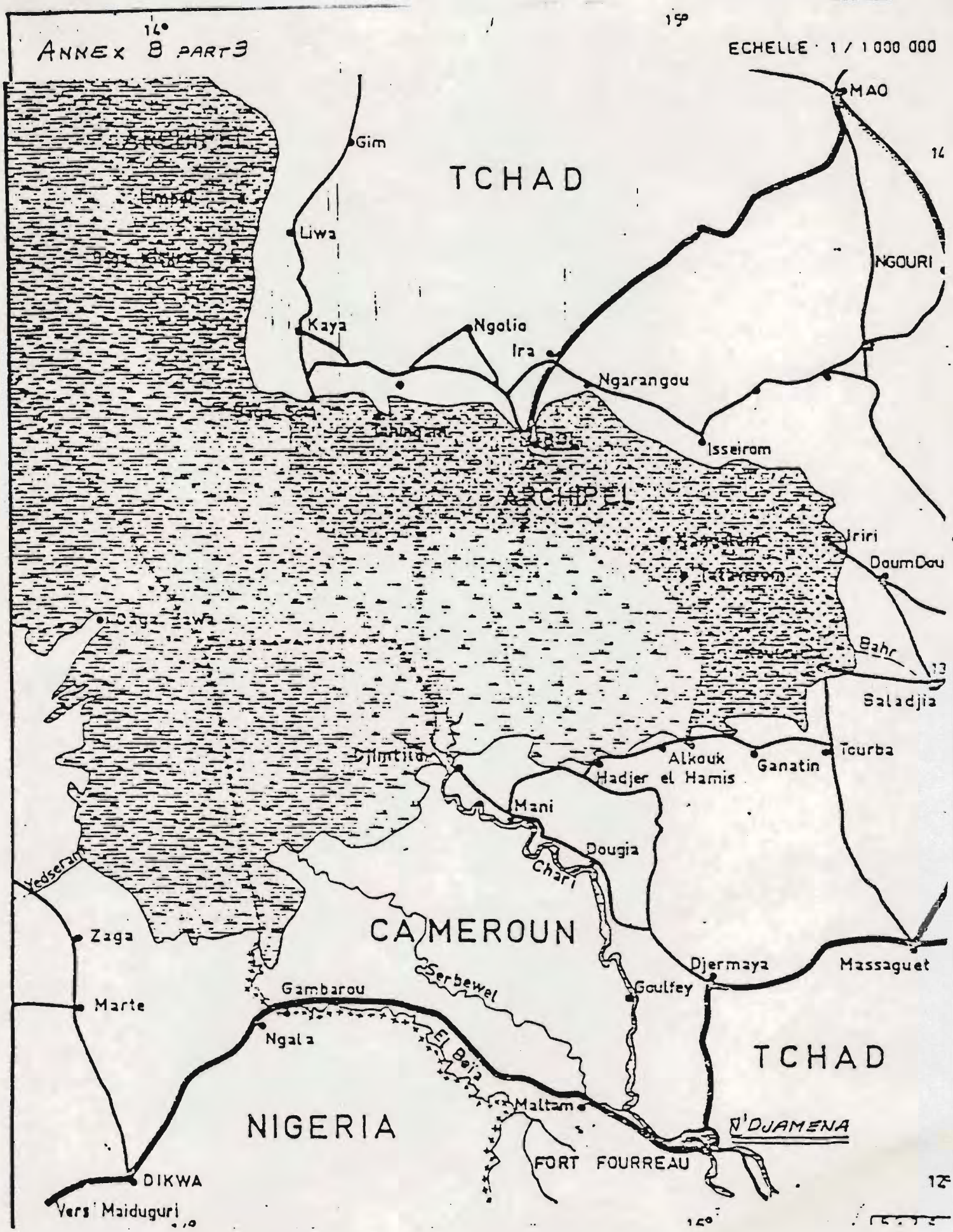
Tandal Polder would have two primary irrigation canals and also have a drainage canal running more or less down the center of the area with the discharge at the mid point of the project to reduce the costs of excavation and materials necessary to make the system operative.

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

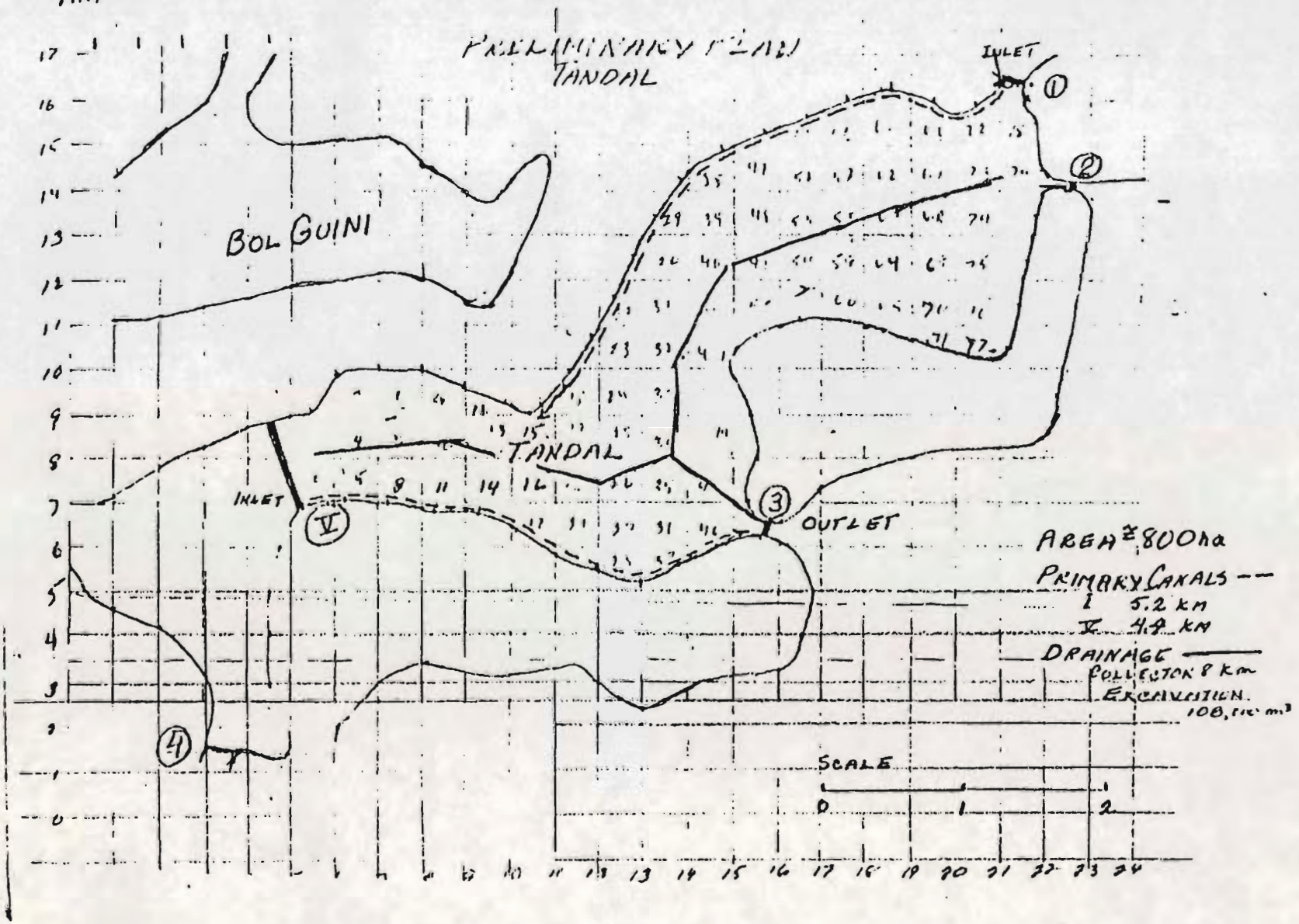
Construction would be done using conventional motorized equipment, hand labor, and a dredge. The structure will be built in stages to seal off the Tandal area so that a pumping station can be immediately constructed and put into operation. The design levels of dikes would be reached progressively. The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

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

ANNEX 8 PART 3

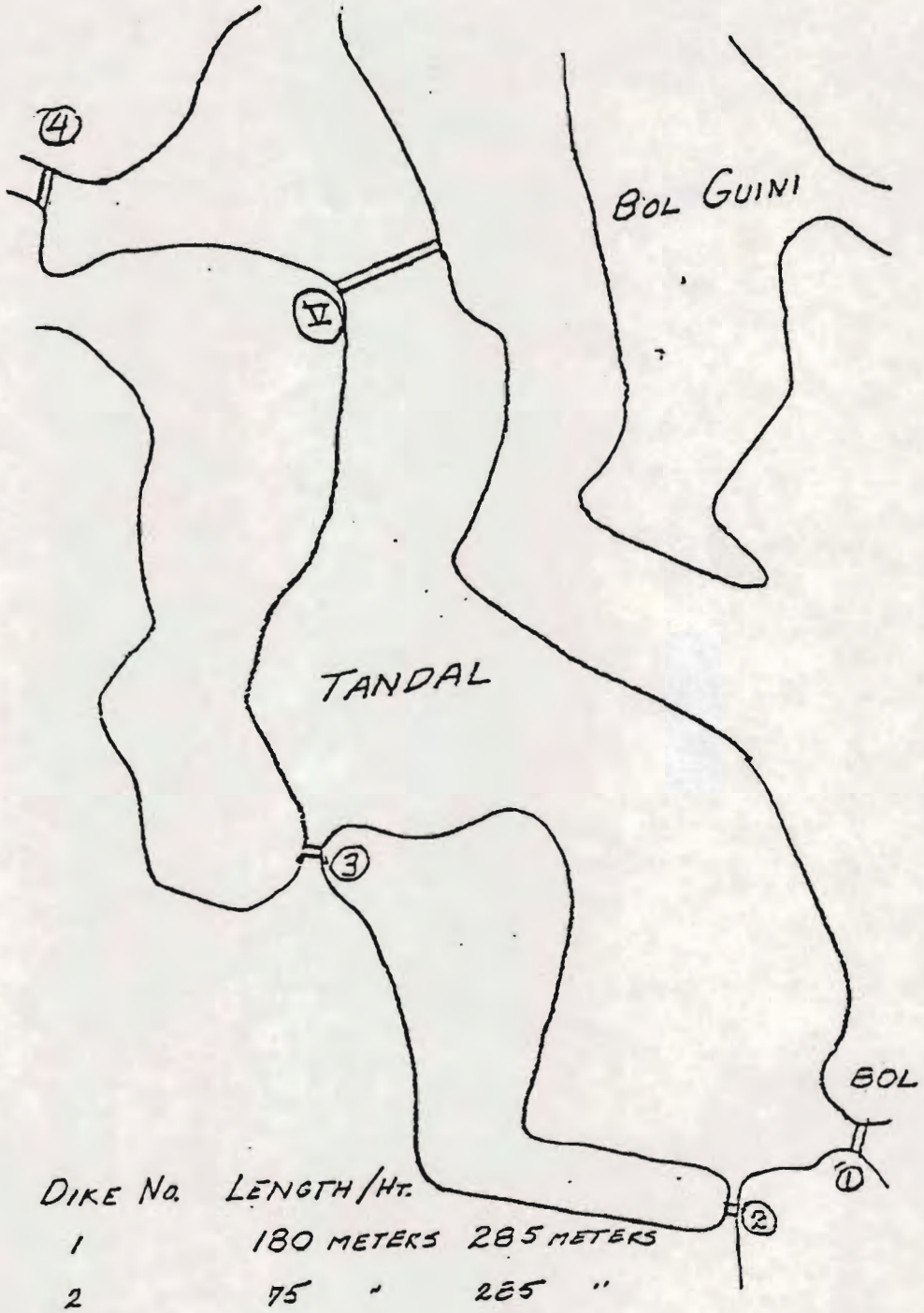


ANNEX B MAP 3.


PRELIMINARY PLAN
TANDAL
BOL GUINI
TANDAL
INLET
INLET
OUTLET
AREA ± 800 ha
PRIMARY CANALS
I 5.2 km
II 4.9 km
DRAINAGE
COLLECTOR 8 km
EXCAVATION
SCALE
0
1
2

← ANNEX 5 PART 3

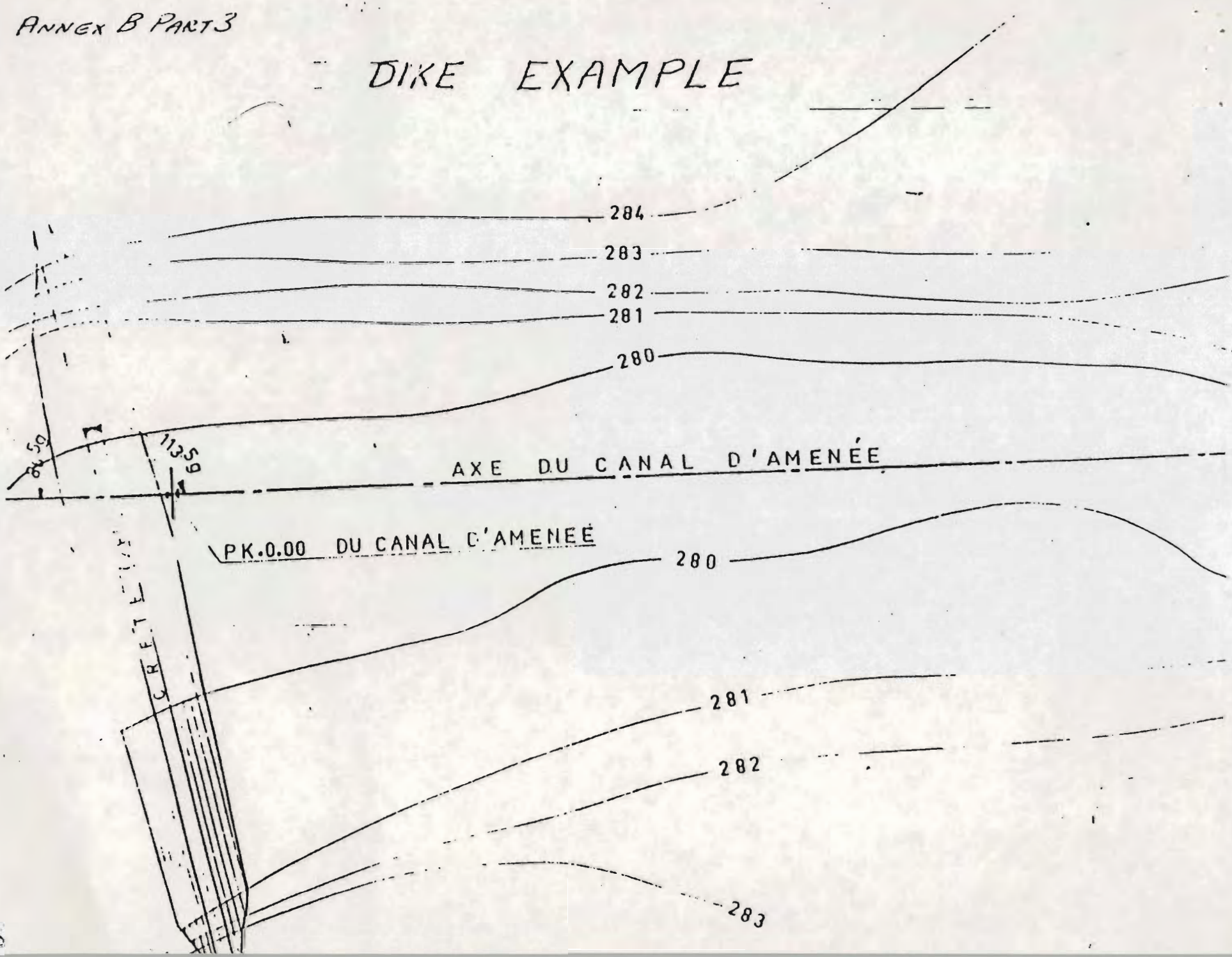
# PROPOSED TANDAL POLDER




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

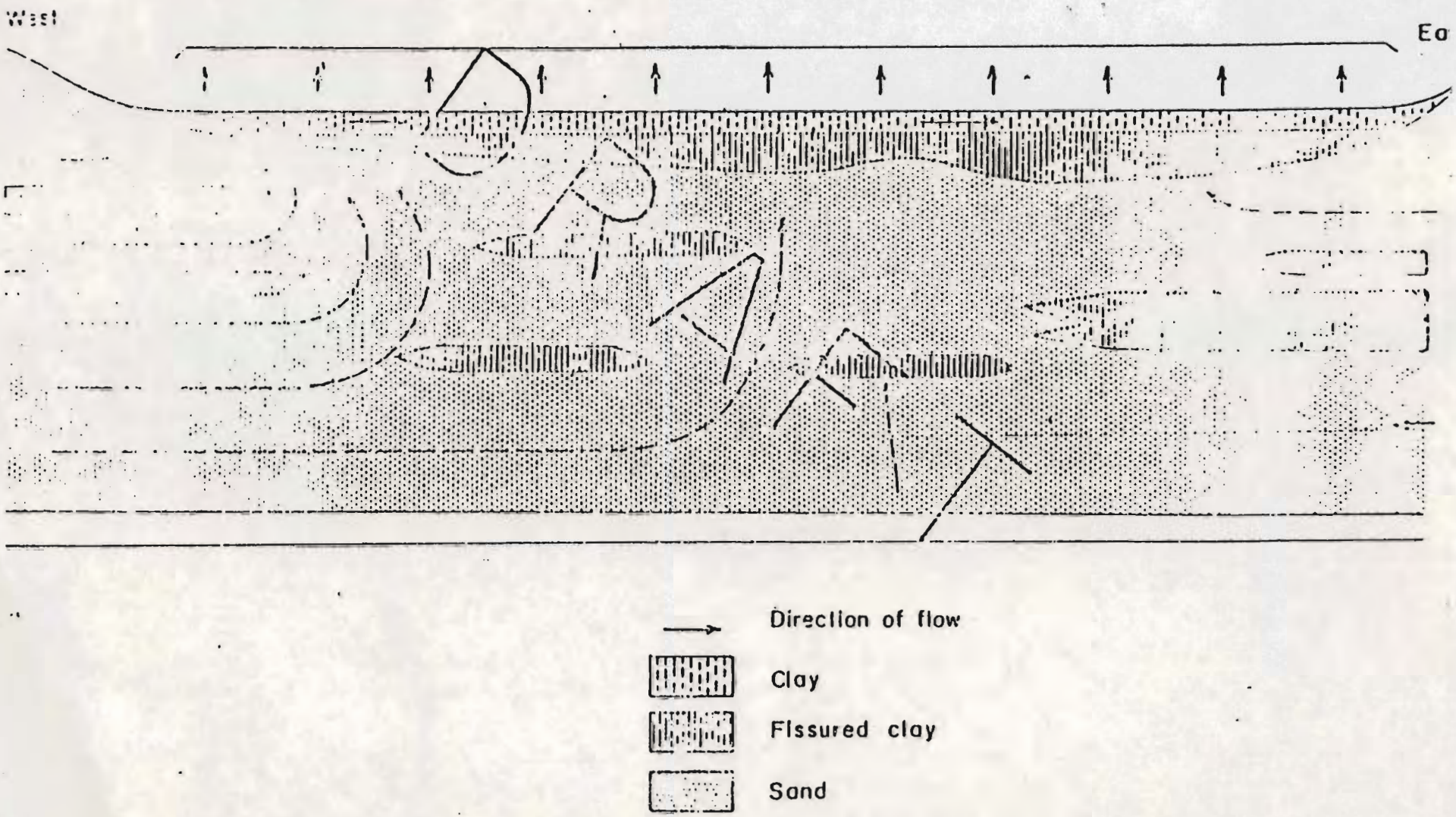
ANNEX B PART 3

# DIKE EXAMPLE



ANNEX B PART 3

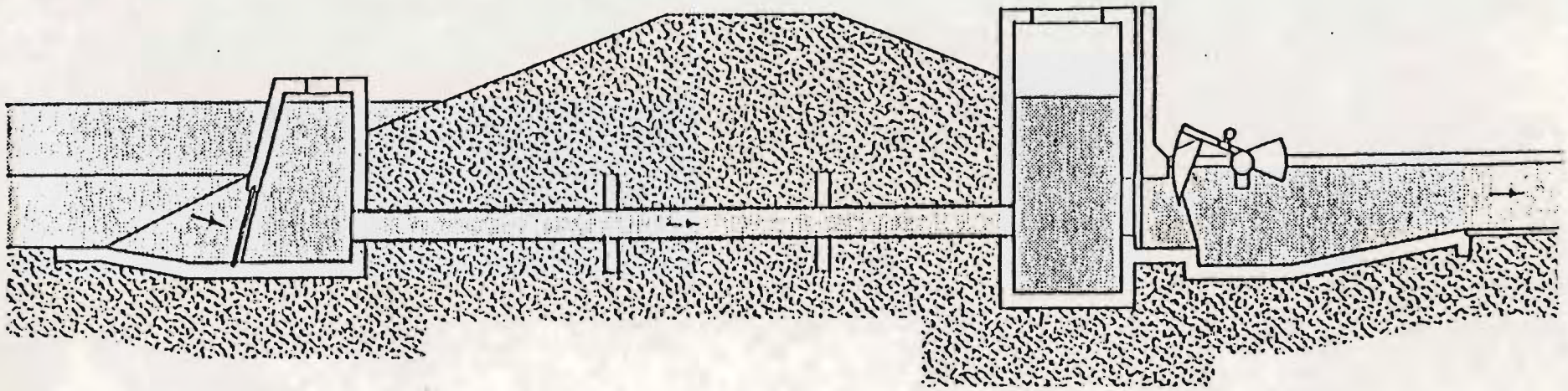
# SCHEMATIC OF POLDER



ANNEX B PART 3

# prise principale

Avec vanne AVIO



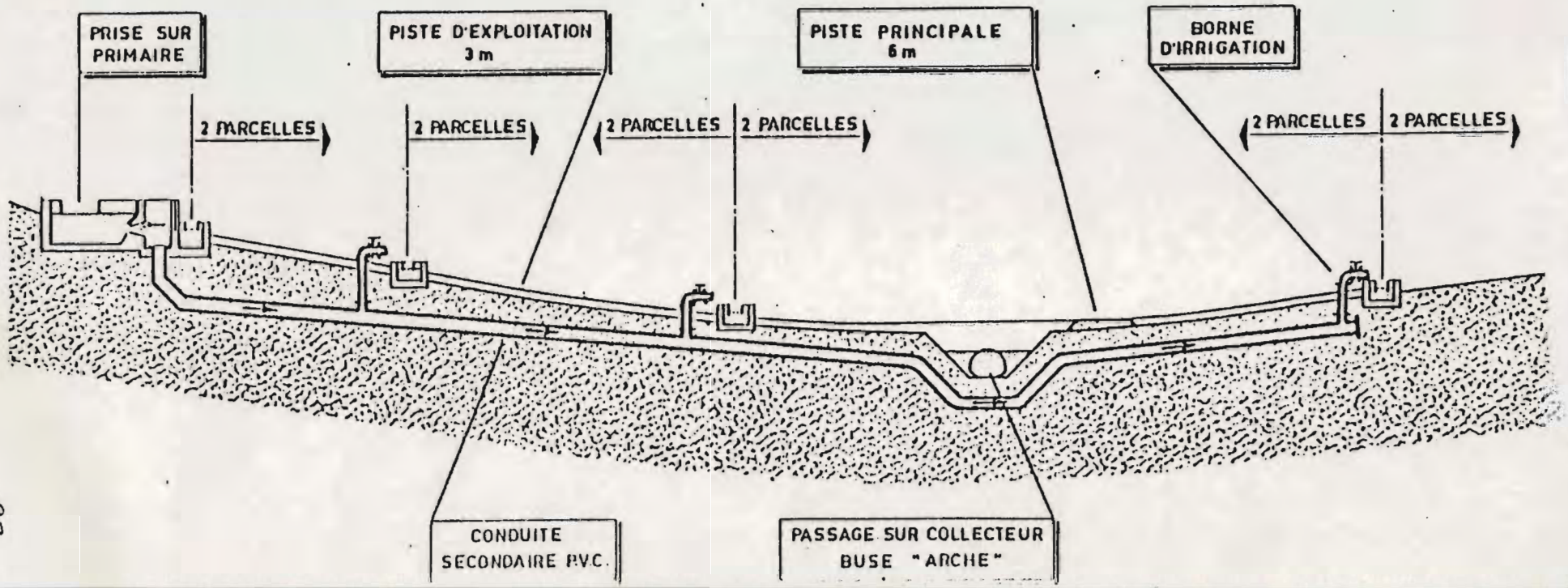
ANNEX B PART 3

SYSTEME TYPE "CALIFORNIEN"

TUYAUX EN POLYCHLORURE DE VINYLE

# principe de distribution

Coupe transversale type d'un Polder



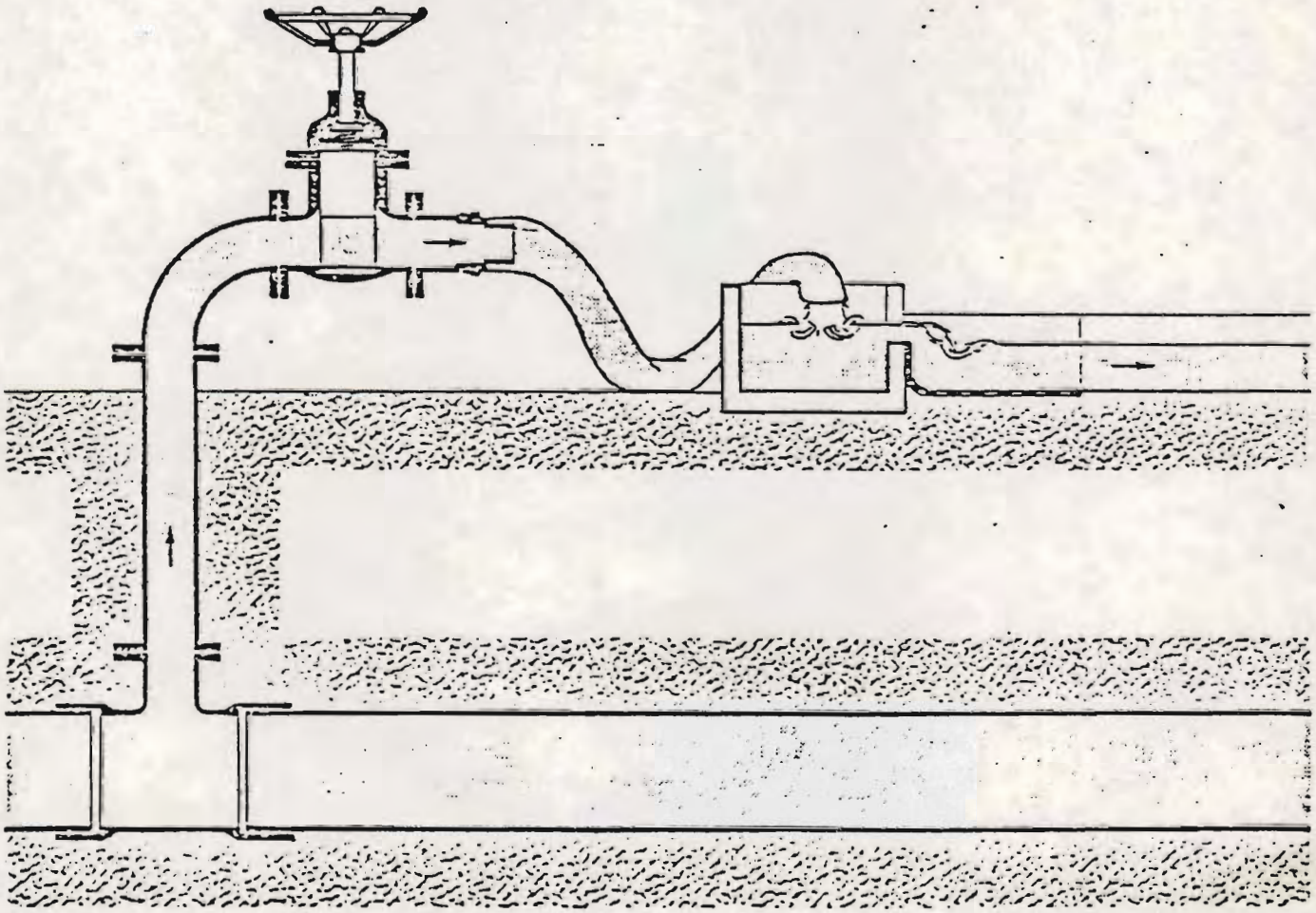
ANNEX B PART 3

SYSTEME TYPE "CALIFORNIEN"

TUYAUX EN POLYCHLORURE DE VINYLE

# borne d'irrigation

Debit 60 l/s



Illustrative Economic Feasibility of Polder Tandal (Phase Two)

Introduction: In determining the economic feasibility of this project is is necessary to do an analysis both in terms of the overall economy and 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) Benefit/Cost and Internal Rate of Return (IRR): 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/]

a) Benefits

For the present project the direct benefits to the economy will be the entire production of wheat and cotton from Tandal polder. Since the land is now under water the entire output of the polder can be attributed to the project. From this benefit one normally deducts the foregone output of the families who will be settleing on the polder. However, for the following reasons no deduction will be made. First, since these are underemployed human resources in the area, the people who replace the settler who has gone to the polder will probably produce as much output as before. Consequently,
the foregone output of one farmer will be compensated by another farmer. Second, the settler on the polder will continue to produce some millet on nearby dunes, and will keep some livestock. Hence, he will not forego the entire value of his prior production. Third, it could be argued that the traditional system of agriculture employed on much of the land in the area is destructive since it leads to eventual salinazition and abandonment of the land. Hence, the true cost of traditional output may be greater than the output itself.

In view of these three factors, the production effects of the polder could be derived from Table I which shows expected output from the polder. (Prices data are considered valid but will be rechecked before phase II of the project begins.) Gross output will consist of CFA 125,000 of wheat and CFA 132,500 in cotton or a total of CFA 257,000 ($1,030) per hectare. Since the yields are conservative (see Annex B, Part 2, Crops and Crop Research Results), one can anticipate an increase to 3,500 kg/ha for both crops by year 10. This would increase output per hectare to

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

TABLE 1

CHAD

LAKE CHAD IRRIGATED AGRICULTURE

Settlement Farmer Production and Income

CFA 250 = $1.00

| | Without Project[a] | | | | Under Project[b] | | | |
|---|---|---|---|---|---|---|---|---|
| | Price | Area | Yield | Value | Price[c] | 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[d] | | | | 32,900 | | | | 282,500 |
| Operating Costs including investment and net credit operations | | | | - | | | | 167,000 |
| | | Net cash flow | | 32,900 | | | | 115,500 |
| | | | | ($ 131) | | | | ($ 462) |

a/ Presently farmers in the area cultivate 1.3 hectares on the dunes and small areas on nearby polders, and raise some livestock.

b/ Under the project farmers will double crop one hectare of the polder (cotton is the rotational crop) and continue to raise millet on the dunes and raise some livestock.

c/ Prices were determined by the commodity pricing department of the World Bank.

d/ 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.

$1,442. Since there will be 800 irrigated hectares, the gross output will be $824,000 by year 4 and increase to $1,153,600 by year 10. It is estimated that the life of the polder will be 30 years. These values are shown in the benefit/cost calculations of Table II.

In addition to the production benefits there will be important secondary benefits. 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 under-privileged northern part of Chad; it would help stabilize the farm community, which otherwise would continue migrating to the south and the towns; it would help reduce the income disparity between the northern and 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 (from cotton) and savings (from wheat). Net foreign exchange earnings would amount to U.S. $2 million annually by 1980 from the World Bank's two polders, and roughly an additional $1.0 million annually from the AID polder by 1985.

(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 contributing to the growth of incomes in the rural sector and a gradual decline in the imports of foodstuffs.

Although no attempt was made to impart a monetary value to these secondary benefits, available tools of economic analysis permit one to quantify the secondary income effects following from the local construction expenditures.

From Budget Table V (Part 3-B) other costs for the project are shown as $5,490,000. It is estimated that about 60% of this total will be for local expenditures. Of this latter amount about one half, or $1.5 million will represent local wage payments over the four year construction period. If data were available on the leakages from the income stream (i.e. savings, hoarding of cash, imports, taxes, etc.) a traditional investment multiplier analysis could be conducted. In the absence of this information the safest approach is to assure that these leakages will be significant

TABLE II

LAKE CHAD IRRIGATED AGRICULTURE

Calculation of Cost Benefit Ratio

($000)

COSTS

| Year | Construction[a] | Production[b] | Settlement O&M [c] | Total | Discount Rate 12% | Present Worth |
|---|---|---|---|---|---|---|
| 1 | 955 | - | - | 955 | .893 | 853 |
| 2 | 930 | - | - | 930 | .797 | 741 |
| 3 | 1,720 | - | - | 1,720 | .712 | 1,225 |
| 4 | 800 | 100 | 120 | 1,020 | .636 | 649 |
| 5 | - | 221 | 237 | 458 | .567 | 260 |
| 6-30 | - | 221 | 237 | 458 | 4.453 | 2,039 |
| | | | | Total Costs..... | | 5,767 |

BENEFITS

| Year | Production | Income | Total | Discount Rate 12% | Present Worth |
|---|---|---|---|---|---|
| 1 | - | 300 | 300 | .893 | 268 |
| 2 | - | 300 | 300 | .797 | 239 |
| 3 | 400 | 500 | 900 | .712 | 641 |
| 4 | 824 | 400 | 1,224 | .636 | 778 |
| 5-9 | 824 | - | 824 | 2. 291 | 1,887 |
| 10-30 | 1,154 | - | 1,154 | 2. 729 | 3,149 |
| | | | | Total Benefits... | 6,962 |

Benefit Cost Ratio: $\frac{\$6,962}{\$5,767} \doteq 1.20$

[a] From Table V, Part 3.B

[b] $277 per farm family (CFA 69,300). See Table III

[c] $296 per farm family (CFA 74,000). See Table III

and that the investment multiplier is low; probably around 2.[a/] With an investment multiplier of 2, the local wage payments of $1.5 million would result in an increase in income of $3.0 million. However, if some of the local workers employed to carry out the project had previously been employed, then a deduction should be made to account for the effects of the foregone output of those workers. Although local rates of under-employment are not known, they are thought to be high; probably close to 50%. On this basis, one should consider about half of the new income generated as replacing the foregone income of local workers. As a result, the income effects are reduced to $1.5 million.

Accepting these income effects as illustrative, and combining them with the production benefits calculated earlier produces the stream of benefits shown in Table II.

b) Costs:

The construction costs of the polder project will amount to $4,405,000 over the four year construction period. (See budget tables in Part 3.B). SODELAC will also have operation and maintenance costs for the polder and irrigation facilities which will amount to $237,000 annually beginning in year 5, the first year of full operation. These expenditures will be paid from the water charges levied on each settler (CFA 74,000 or $296).

Settlement costs are an important element in a project of this nature. To ease the way for settlement by small farmers the World Bank's project includes a Commercial Agricultural Development Section which would be responsible for the first year of operations on all newly developed land, and for the basic cultivation during the following year, which would be the first year of settlement (see Part IV for a fuller discussion). In the second year (i.e. the first year of settlement) the Commercial Section would clear, disc and plant a cotton and wheat crop, thus giving the farmer a better change to settle down and to learn the new techniques that will be demanded of him. Hence, during the first year of cultivation the small farmer will work as a salaried worker on the land he will be farming the second year.

Under the World Bank project the Commercial Section will cost $740,000 - most of which is housing, vehicles and equipment. The running costs of the Section's farm machinery are not included as a project cost since they will be covered by the sale of produce grown on newly developed land. Upon the completion of the two World Bank polders, the remaining usuable life for the Section's equipment would be about 50% and this equipment would be used for the agricultural development of any other polder. Since the proposed AID polder (Tandal) will be ready for cultivation about the time the

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[a/] This implies that half of the wages received by Chadian workers (resulting from local expenditures on this project) will be spent on local consumption goods, and half used for imported goods, savings, taxes, hoarding of cash, etc.

two World Bank polders are completely settled, the Section could move onto Tandal. Since the fixed costs (machinery, buildings, etc.) have already been paid and since the operating costs will be covered by the sale of the first year's output, only expatriate salary costs will be required. These are estimated to be $120,000 for the settlement period and shown as occuring mostly in year 4. This amount will be covered by a donation to SODELAC, probably from the FAC.

Combining the cost and benefit calculations discussed above produces a benefit/cost ratio of 1.20 for the 30 year life of the project. This is an acceptable ratio.

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 about 18%. In other words, at a discount rate of 18% this project just breaks even. That is, it will earn back all the capital and operating costs expended on it and pay us 18% for the use of our money in the meantime.

While this IRR is fully acceptable it would be useful to conduct a sensitivity analysis to determine how changes in costs or benefits effect the IRR. The two most important items in the benefit/cost analysis where we lack experience in making projections are settlement costs and production benefits.[a/] In order to get a feel for how changes in these important variables will affect the profitability of the project, it will first be assumed that output on the polders only reaches 80% of the levels shown in Table II, but that all costs items remain unchanged. Under these assumptions the IRR would fall to about 11%. On the other hand, if benefits remain unchanged and settlement costs rise sharply (from $120,000 in year 4 to $600,000 spread evenly over years 3, 4 and 5) the IRR would only fall to about 15%.

Based on this analysis, the crucial factor in the success of the project becomes the production benefits. Stated differently, if yields fall below 80% of those projected the return on the project becomes marginal. On the other hand, if the yields exceed those projected the returns will be correspondingly greater. Yields used in tables I and II assume that farmers will realize 55-60% of the yields obtained from farmer trials and research results. (See Annex 3). These results seems reasonable if SODELAC can work out an incentive plan which will result in the settling the polders on schedule and the providing of necessary farm inputs on a timely basis. With appropriate changes in its organizational structure (following from the management study) and continued technical assistance, CDO feels that SODELAC will be able to meet these requirements.

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a/ Construction costs are based on recent estimates and include a contingency factor. Production and O&M costs have been worked out on the basis of research trials at Matafo Research Station. Income benefits are very conservative and will flow from the construction phase of the project itself.

When viewed from this angle, is it still a good idea to move ahead with the project? To resolve this question it is necessary to consider if there is any cheaper way to increase Chad's food production by about $1 million per year and at the same time significantly improve the economic and social conditions 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 alternatives suggested include doing nothing, (i.e. selective starvation), relying on occasional food relief operations, or carrying out small deep-well irrigation projects in the northern Sahel. These 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 13,000 tons of food relief to drought-stricken 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 "solutions" are nonstarters, and that Chad must begin a longer run program to increase food production. This project represents such an effort.

The alternative of carrying out small deep well irrigation projects in the northern Sahel would require prohibitively expensive infrastructure investments (mostly roads) while only affecting a very small proportion of the population. Around the Bol area are the water, soils, people and transporation links to make this an economically feasible and cost effective project.

In summary, the foregoing economic analysis of the polder component of the project has shown that an IRR of 18% can be anticipated. This return is most sensitive to changes in output over the life of the project and underscores the importance of timely settlement of the polder and the realization of the projected yields. 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 productive employment to a portion of the rural population.

2) Financial 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.[a] 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.)[b]

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.

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a/ Part 3.D. presents a discussion of the structure of incentives needed to insure timely settlement of the polder and its continued exploitation.

b/ Farm gate prices used by the World Bank are still considered accurate.

# 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 income | 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 2/ | - | - | 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 4/ | - | 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/ | - | 2,500 | - | - | - | - | - | - | 300 |
| Mechanical planting cotton 7/ | - | 1,300 | - | - | - | - | - | - | 200 |
| Mechanical land preparation wheat 8 | - | 4,500 | - | - | - | - | - | - | 600 |
| Mechanical planting wheat 9/ | - | 1,300 | - | - | - | - | - | - | 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 | - | 63,600 | 68,000 | 68,000 | 68,000 | 68,000 | 68,000 | 68,000 | 69,300 |
| Debt Service on Credit Received | | | | | | | | | |
| Farmer's investment 14/ | - | 6,500 | 15,700 | 15,700 | 17,800 | 17,800 | 11,200 | 11,200 | 13,700 |
| Farmer's seasonal requirements 15/ | - | 6,400 | 6,800 | 6,800 | 6,800 | 6,800 | 6,800 | 6,800 | 6,700 |
| Total Debt Service | - | 12,900 | 22,500 | 22,500 | 24,600 | 24,600 | 18,000 | 18,000 | 20,400 |
| Total Outflows prior to Water Charges | - | 100,900 | 142,500 | 107,500 | 117,000 | 109,600 | 103,000 | 145,400 | 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 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Total Man-days worked | 118 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 |
| Net Cash Flow per Man-day worked (CFAF) | 279 | 359 | 290 | 290 | 285 | 285 | 302 | 302 | 297 |

1/ 500 kg/settler.
2/ shared between 3 farmers.
3/ shared between 5 farmers.
4/ 25 kg/ha @ 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/ 8 sprays @ 3 l/spray @ CFAF 1,500/l, including battery cost of sprayer.
11/ 45 kg N + 45 kg P2O5.
12/ using stationary combine 0.3 hour/ha.
13/ 300 kg are consumed by the farmer.
14/ repaid over 5 years @ 10% interest rate.
15/ 10% / year.
16/ CFAF 74,000/ha (OM) and CFAF 56,000/ha (capital).

Source: World Bank.

Before concluding this section it may be helpful to contrast the AID and World Bank projects. The World Bank activity consists of rehabilitating 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 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.

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 | | | | - 32,900 | | | | 167,000 115,500 |
| 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.

ANNEX C

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

### 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.

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

(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 salaries 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.

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 IC). 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 | 25,489 |
| Expenses | | | | | | | | |
| staff salaries | 5,675 | 13,714 | 14,916 | 15,076 | 17,268 | 15,936 | 17,292 | 12,921 |
| taxes | 787 | 1,033 | 851 | 714 | 941 | 1,944 | 1,207 | 2,131 |
| cost of goods | 8,964 | 19,740 | 24,478 | 22,805 | 35,773 | 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 | 43,652 | 35,919 |
| Operating Losses | (25,057) | (30,943) | (37,038) | (22,657) | (55,080) | (55,116) | (12,644) | (10,331) |
| Exceptional Losses or Profits | (40) | (2,503) | 9,793 | (2,423) | (672) | (1,519) | (5,651) | (7,959) |
| Total Losses | (25,097) | (33,446) | (27,245) | (25,080) | (55,752) | (56,635) | (18,295) | (18,290) |
| Cumulated Losses | (25,097) | (58,543) | (85,788) | (110,868) | (166,620) | (223,255) | (241,543) | (259,833) |
| Government Subsidy | 10,000 | 20,000 | 42,000 | 31,000 | 31,000 | 7,740 | 4,000 | 16,000 |
| Cumulative Subsidy | 10,000 | 30,000 | 72,000 | 103,000 | 134,000 | 141,740 | 145,740 | 161,740 |

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

AID 1020-28 (1-72)

# PROJECT DESIGN SUMMARY
## LOGICAL FRAMEWORK

Life of Project:
From FY 1977 to FY 1993
Total U.S. Funding $2,755,000
Date Prepared: June 30, 1977

Project Title & Number: Lake Chad Irrigated Agriculture Phase I (677-0001)

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Program or Sector Goal: The broader objective to which this project contributes:<br><br>To develop the agricultural potential of the polders area of Lake Chad through the exploitation of land and water resources. | Measures of Goal Achievement:<br><br>a. Developed polders receiving SODELAC assistance provided through this project will be producing 4,200 to 5,600 tons of grain annually.<br><br>b. Additional polder development will be underway. | a. SODELAC annual reports. | Assumptions for achieving goal targets:<br><br>Chadian small farmers will be successfully settled in polder areas. |
| Project Purpose:<br><br>a. Strengthen SODELAC as a regional development institution.<br><br>b. To develop and disseminate agricultural production technology for small farmers in and near polder areas.<br><br>c. To decrease incidence of endemic disease morbility in the polders. | Conditions that will indicate purpose has been achieved: End of project status.<br><br>a. SODELAC capable of maintaining existing polder/road infrastructure and of constructing new polders/roads.<br><br>b. At least a 50% acceptance rate of technology among all small farmers on polders.<br><br>c. Targets to be determined by APHA study. | a. SODELAC reports<br><br>b. AID assessments/evaluations.<br><br>c. SODELAC, AID reports. | Assumptions for achieving purpose:<br><br>a. GOC continues support of SODELAC's regional development mandate.<br><br>b. Trained personnel are retained by participating Chadian institutions. |
| Outputs:<br><br>See attached page 2. | Magnitude of Outputs:<br><br>See attached page 2. | See attached page 2. | Assumptions for achieving outputs:<br><br>See attached page 2. |
| Inputs:<br><br>See pp. 42-46 of Project Paper. | Implementation Target (Type and Quantity)<br><br>See pp. 42-46 of Project Paper | | Assumptions for providing inputs: |

AID 1020-25 11-78
SUPPLEMENT I

# PROJECT DESIGN SUMMARY
## LOGICAL FRAMEWORK

Life of Project:
From FY 1977 to FY 1980
Total U.S. Funding
Date Prepared

Project Title & Number: LAKE CHAD IRRIGATED AGRICULTURE (677-0001) Phase I



| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Outputs: (C-1) | Magnitude of Outputs: (C-2) | (C-3) | Assumptions for achieving outputs: (C-4) |
| SODELAC Development | | a. On-site inspections. | a. Project inputs will be provided as planned. |
| 1. Road Maintenance | 1. - 20 40 40 100 | | |
| 2. Dike Maintenance | 2. - 4 12 12 28 | | |
| 3. Drainage Systems Maintenance | 3. All standing water removed. | | |
| 4. Management Study | 4. Study Completed. Recommendations Implemented. | | |
| 5. Trained Personnel On Board | 5. 2 5 6 3 16 | | |
| Research | FY 77 FY 78 FY 79 FY 80 TOTAL | | |
| 1. Wheat trials | 1 5 8 | | |
| 2. Fertilizer and crop rotation | 1 2 2 | | |
| 3. Irrigation trials | 4 8 | | |
| 4. Soil and water research | 2 6 | b. Project reports. | |
| 5. Socio-economic research | First baseline study complete. First follow-up study complete. | | |
| 6. Research facility improvement | Lab completed. | | |
| 7. Extension Agents training | 5 20 20 45 | | |
| Health Activities | | | |
| 1. Epidemiological Study | First study completed. First follow-up study completed. Second follow-up completed. | | |
| 2. Facility improvement | Hospital Training Center | | |
| 3. Paramedical personnel recruitment and training | 6 6 6 18 | | |
| 4. Health Campaigns | Number dependent on study results (see text). | | |
| 5. Wells | 5 8 7 20 | | |

Initial Environmental Examination (I.E.E.)

Project Location: Chad

Project Title: Lake Chad Irrigated Agriculture, Phase I

| Funding: | | |
|---|---|---|
| | FY 77 | $1,065,000 |
| | FY 78 | 570,000 |
| | FY 79 | 670,000 |
| | FY 80 | 450,000 |
| | Total | $2,755,000 |

Life of Project: 4 years

I.E.E. prepared by: Edward Lijewski, AFR/DR

Environmental Action Recommended: Negative Determination

Assistant Administrator's Decision:

Approved_____date_____

Disapproved_____date_____

The subject AID-financed activity, Lake Chad Irrigated Agriculture (Phase I), is comprised principally of technical assistance (personnel and studies), research, commodity procurement related to road and dike maintenance, and improvement of a health services delivery system (with some limited building construction). Phase I elements are complementary to on-going activities in the project area sponsored by other donors. The major element of the proposed AID-financed project scheme, an irrigated agricultural production project in the polder formations, is to be considered for separate review and authorization in Phase II. Phase I activities, while related to and supportive of other donor financed construction and rehabilitation of the irrigation (drainage network of polders the project area, do not include any such construction and/or rehabilitation.)[1]

The major elements of the Phase I project are:

a. The strengthening and equipping of SODELAC's (the Government of Chad's regional development institution for the Lake Chad area)

[1]The polder is a dam/dike that closes the entrance to, and prevents the flooding of a low wadi (marsh area) 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.

capacity to maintain public works infrastructure in the Bol area, including existing roads and polders;

b. agricultural research activities at SODELAC's Matafo, Lake Chad, research station and related extension services to small farmers in the area;

c. public health improvement activities, including studies, training of personnel and limited rehabilitation and construction of public health facilities;

d. special studies to design and establish the feasibility of a Phase II activity.

Identification and Evaluation of Environmental Impacts

a. Strengthening of SODELAC and equipping and training a mobile maintenance brigade

The first element of the strengthening of SODELAC -- a management study of that institution -- will have no environmental impact.

The second element -- training, equipping and operational support of the mobile infrastructure maintenance brigade will have little environmental impact since efforts will be focused on rehabilitation and maintenance of existing dikes and roads. Construction of new dikes and roads by this SODELAC unit while possible at a future time after training has been completed is not a direct output of this project.

There are 28 existing polders and a connecting road network in the Bol area. Identification and scheduling of maintenance activities of these facilities will be made by SODELAC in a work plan to be produced early in the project with the assistance of the management study team. The majority of maintenance activities will not cause any significant disruption of the environment but will involve simple maintenance such as refilling sections of existing earthen dikes, cleaning and repairing irrigation and drainage canals, and resurfacing - regrading dirt roads. However, for all such maintenance - rehabilitation activities which SODELAC plans to undertake, an appraisal of the expected effects on the environment will have been made before initiation of the work to prevent environmental damage.

Bol is in the heart of a potentially rich agricultural production area with a potential of 12,500 cultivable hectares on existing polders. It is certain to become a regional development pole and a center for economic and commercial activity north of the capital. SODELAC, which has primary responsibility for the development of the area, must maintain and 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, it needs additional equipment and financial capability to meet operating

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costs. Overall technical and management capability do not appear to be a major problem.

At present SODELAC has 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 purchased under this project.

AID funds would be used to purchase the additional equipment and pay all of the operating costs of the unit for a period of two years or perhaps longer.

The first step is to make the unit's work plan to carefully select work to be done and to organize the use of available equipment (see below). The work chosen will be examined and surveyed and work orders will be made. Actual dike and road maintenance 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, environmental 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 program as outlined by SODELAC during project life will provide the following:

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.

Appraisals of the impact upon the environment of proposed road, dike and canal maintenance activities on the existing polders will be included in the scope of work for the environmental assessment for a Phase II irrigated agricultural production project. That assessment will be financed under the Special Studies component of this project (Phase I) and will be initiated as soon as possible after Phase I authorization and signing of an agreement. The assessment, in addition to reviewing the environmental impact of any Phase II polder construction, will review the environmental soundness of existing polder and road infrastructure development to determine whether maintenance - rehabilitation of that infrastructure, as outlined above, could be undertaken under AID environmental policies. Where necessary, measures to protect or minimize disruption to and impact upon the environment during such maintenance - rehabilitation will be identified. In the event that maintenance - rehabilitation of an existing polder or road section was determined to be environmentally unsound, e.g., because it would produce irreversible or long-lasting degradation of polder land through accelerated salinization, such work would not be included in SODELAC's approved maintenance brigade work plan.

The assessment will be completed and its findings and recommendations incorporated into the maintenance brigade's organizational policies and procedures before any AID-financed Phase I activities are undertaken by that unit. While needed equipment and commodities will be ordered as soon as possible after the agreement is signed, it will not arrive before the assessment has been completed.

If the assessment identifies the need for a more intensive environmental appraisal of any discrete proposed activity for the maintenance brigade, a covenant in the project agreement will provide for such studies to be undertaken before the maintenance activity can be initiated. The agreement will also provide for prior AID review and concurrence in the work plan approved for the maintenance brigade.

b. Agricultural Research

The principal activities of this component involve research into land and water use systems for the polders and related areas (wadis), the development of agricultural production packages for food and cash crops; and research and data gathering activities of a socio-economic nature. All of these activities will be undertaken under strictly controlled circumstances by SODELAC research personnel, who will include expatriate technical experts provided under the AID-financed project (Phase I).

Of the above elements, only research activities into land and water use could involve environmental disruption on any significant scale. Soil

management work at the Matafo center will include plot-testing the chemical and mechanical means of controlling or reducing salinity/alkalinity and will be closely related to studies to be carried out on low lift pumps for irrigation in the polder areas. For the latter study in particular, in an area to be selected as typical, land will be cleared and wells dug as necessary. A thorough baseline study will be made of all soil, water, and health factors. The operation will be observed, recorded and analysed with respect to factors having ecological, social, economic and technical consequences. Before any such plot-testing is carried out, considerations of its likely impact on the existing environment will be made and measures incorporated into the activity to minimize any negative impact.

Research into development of production packages will be managed under similarly controlled circumstances. Land, up to an area equal to twenty hectares by the end of the project, will be reserved and used for agronomic experiments principally involving seed multiplication and production. Analysis will be made of the most appropriate package of fertilizer, water control and pest control methods for agricultural production on or near the polders. Experiments involving chemical fertilizers and herbicides/pesticides, as is deemed necessary, will be subject to complete and continuing control by the research personnel. No pesticides/herbicides will be financed by this project.

The environmental assessment will carefully review the possible effects of fertilizer and herbicide/pesticide use in polder areas on lake waters resulting from the use of lake water for irrigation and the drainage and return of that water to the lake. Guidelines will be recommended by the assessment for the agricultural research to be undertaken on fertilizer/pesticide/herbicide use in developing production packages for the area's small farmers. Any production package subsequently disseminated to farmers by SODELAC's extension service will be designed to be consistent with AID's environmental policies and distributed under controlled procedures providing for both training of farmers in the use and application of the package and for follow-up monitoring.

c. Strengthening of the Health Delivery System

The sub-activities contemplated under this element involve: An epidemiological survey and support to and upgrading of health personnel and facilities in the Bol area. The latter will involve epidemiological monitoring, rehabilitation/construction and partial equipping of health-medical buildings, support for the establishment of a paramedic-rural health system, and selective interventions designed to control endemic diseases in the Bol area.

Specific rehabilitation/construction planned includes:

1. Painting and structural repairs for the medical center at Bol;

2. construction of a three room health education and MCH center at Bol; and

3. purchase of microscopes and staining agents for the medical centers and surrounding dispensaries.

Q

Of the above, only the construction of the three room health education center at Bol might involve environmental impact. However, the scope of construction is limited, and provision for assessing and minimizing any negative environmental impact will be incorporated into planning and approval of final designs and initiation of construction itself. The building will incorporate sanitary water supply and sewage disposal facilities.

A significant health benefit to be produced by the Phase I activity is a reduction in the risk of contracting schistosomiasis in the Bol area. An AID-financed study on health conditions in the area indicates a low incidence of schistosomiasis with the principal breeding areas for the snail vectors being those polder irrigation and drainage canals which have become overgrown and clogged with vegetation. The mobile maintenance brigade, as part of its regular work program, will maintain those canals to eliminate or reduce the endemic risk of contracting schistosomiasis in the project area.

d. Special Studies - Phase II

This element involves technical-engineering review, sociological-economic assessments, and a full scale Environmental Assessment as established in Reg. 16 of an irrigated agricultural production project to be identified as part of Phase II. Accordingly, there will be no direct impact upon the environment from this element.

Conclusion

Overall, the project has been determined to have no or little environmental impact. Where negative environmental impact will or can occur, it will be identified and measures needed to prevent or minimize those effects will be followed. For the adoption of new farming techniques by small farmers, the project provides for research, training, and control at all levels to prevent damage to or pollution of project areas or the participants themselves through improper use of technology packages.

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 research component of the project will also seek to reduce the present deterioration of soils and water and to reclaim land previously damaged and now abandoned.

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

The project will have a neutral to favorable impact upon the ecosystem, the endemic disease level of the local population, and health, social, transportation and communication services. The changes that might produce

these effects are: The alteration of flooding patterns; the use of modern farming methods; the maintenance or rehabilitation of infrastructure; and the improvement of health services. 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 development in the project area on the ecosystem and community services structure and to improve it. Agriculture research will 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 for endemic diseases in the polders.

IMPACT IDENTIFICATION AND EVALUATION FORM

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

[1] See explanatory notes for this form

[2] Use the following 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 | N |
| 3. Other factors<br>Fishing | N |
| E. Cultural | |
| 1. Altering physical symbols | N |
| 2. Dilution of cultural traditions | N |
| 3. Other factors | - |
| F. Socioeconomic | |
| 1. Changes in economic/employment patterns | L |
| 2. Changes in population | L |
| 3. Changes in cultural patterns | L-U |
| 4. Other factors | |
| G. Health | |
| 1. Changing a natural environment | L |
| 2. Eliminating an ecosystem element | L |
| 3. Other factors<br>Possible creation of vector habitats | L-M |

H. General

| | |
|---|---|
| 1. International impacts | N |
| 2. Controversial impacts | N |
| 3. Larger Program impacts | N |
| 4. Other factors | |
| I. Other possible impacts: | - |

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) FY 77funding was provided under the Foreign Disaster Assistance Act of 1974.

   (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, 1962; see Fed. Register, Vol 38, No. 174, Part III, Sept. 10, 1973)?

   N/A (Phase One)

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 further strengthened with training in necessary skills. Further, SODELAC will engage in further training activities.

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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 Executive 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

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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 ...nist-Bloc countries, contrary to ... best interests of the U.S.? — Yes

4. FAA Sec. 635(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 |

LAKE CHAD IRRIGATED AGRICULTURE, PROJECT 677-0001.

611 E CERTIFICATION

I, John A. Lundgren, principal AID Officer in the Republic of Chad, do hereby certify that in my judgment the Republic of Chad through its representative, SODELAC, will have the financial capability and the human resource capability to implement, maintain, and utilize effectively subject project. This certification takes into consideration the requirements placed on the Republic of Chad to maintain and utilize other projects previously financed or assisted by the United States.

This judgment is based on the fact that (1) the Government of Chad has given a high priority to the production of food as an essential element of its development plan; and (2) past performance in maintaining and utilizing assistance provided under other AID projects.

John A. Lundgren
Country Development Officer
N'Djamena.

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. <u>Polder Development</u>

2. <u>Development of SODELAC as a regional development institution</u>

   a) Management study

   b) Equipping and operating a mobile maintenance brigade

   c) Participant Training

3. <u>Research</u>

   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 [illegible] 77

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

.../...

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l'on y adjoint une certaine somme pour formation à l'étranger de cadres SODELAC et imprévus, un total de 250 millions de F CFA me paraît soutenable. Cette somme correspond d'ailleurs sensiblement à la participation de l'USAID telle qu'elle avait été prévue au sein du groupement IDA/USAID/F.C (rapport IDA/ en date du 16 Octobre 1976 N° 920 - a - C.D) Nous pourrons rattacher à ce point l'appui de l'ORSTOM à la station de MATAFO pour la recherche pédologique (45 millions au maximum).

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

La SODELAC a évidemment une vocation pour le développement de l'ensemble de la Préfecture du Lac. Dans ce cadre, l'équipement d'une unité 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 prévue en première phase (environ 970 millions) est suffisant pour aménager 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, BLRIM et vraisemblablement MAIDI. 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 les délais 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 agréeront. 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

HAMOUGUE GUIDINGAR.

ANNEX I

## Request for Waiver FAA Section 110(a)

## 25% Host Country Contribution

As described in the body of the PP, this project is designed to provide complementary, supportive inputs to certain already initiated efforts to develop improved irrigated agriculture practices in the Bol Polders area of Lake Chad, and to establish the feasibility of a full scale irrigated agriculture production program for Phase II funding review. Given the multi-donor involvement in the irrigated agriculture experiments in the Bol area, total investment in polder development over the life of the Phase I activity is substantial, approaching $16 million.

As proposed in the PP for Phase I, AID financing would be $2,755,000 with Government of Chad's contribution $400,000. Thus, the total direct contributions for Phase I amount to $3,155,000 with the Government of Chad's (GOC's) contribution representing about 13% of the total, and composed exclusively of local currency.

The AID financing will principally cover foreign exchange costs of technical assistance and commodities, and operating costs of the expanded activities of SODELAC's infrastructure maintenance, and agricultural research units. The GOC contribution will cover personnel expenses for existing personnel to be assigned to the project.

While at the present time the GOC is unable to assume a larger share of total project costs, the project has been designed so that, if successful, the principal implementing unit - SODELAC - would generate revenues on an increasing basis over time from the provision of development services to project participants. Those revenues would absorb an increasing share of SODELAC's costs of operation as AID assistance is terminated. Therefore, the GOC contribution will be an increasing one with an objective of assuming a proportionately larger share of project costs.

The Mission believes a waiver of the Section 110(a) provision is justified in this case on the following grounds:

1. Country Commitment. The GOC has repeatedly noted the high priority it assigns to efforts to develop the agricultural production potential of the Lake Chad litoral and waters in order to increase national food production self-sufficiency and to improve the incomes and standard of living of the area's small farmers. The GOC has demonstrated this commitment by maintaining a firm level of financial support to SODELAC, the unit responsible for development of the area, in spite of many other competing internal demands for shares of its limited resources. GOC support to the project, within the means available to it, is substantial.

2. Financial Constraint. Chad, one of the Sahelian countries on the UNCTAD list of relatively less developed countries (RLDC), has a very limited financial resource base which has not yet recovered from the effects of the recent severe Sahel drought. Chad's development needs are large and can only be met by substantial foreign donor support of the major element of development project costs. Chad's balance of payments situation is critical and not expected to improve significantly in the short run. Government budgetary resources are fully committed with limited potential for significant increases in internal resource availabilities in the short term.

3. Nature of the Project. As described above, the GOC through SODELAC will be assuming a larger share of certain project operating costs over time. Withholding approval of the project until a 25% contribution might be possible would be counterproductive as the elements of the project have been designed to produce benefits for the area's target group to increase production and productivity and thereby the ability to pay increasing shares of the costs of such services. Therefore, the sooner the project is undertaken, the earlier the area and its population will be progressing towards self-sufficiency.

# ILLUSTRATIVE SCOPE OF WORK FOR ALTERNATIVES AND ENGINEERING ANALYSIS, SOCIO-ECONOMIC ANALYSIS, AND ENVIRONMENTAL ASSESSMENT, OF THE LAKE CHAD IRRIGATED AGRICULTURAL PROJECT, PHASE II

## I. Introduction:

This project proposes to develop additional irrigated agricultural production in or near polder formations of the Bol area of Lake Chad using modern and/or improved traditional irrigation and drainage techniques. Two polders ( 1200 ha. ) are under development with IDA-FAC financing. Crops being raised in the area on dry land are millet and grass; the existing, traditional wadis and polders produce millet, wheat, corn, and vegetables principally. The IDA-FAC polders will produce wheat and cotton principally. Project objectives include bringing to the area's agricultural practices the advantages of protection against periodic droughts and uncertain groundwater levels that are harmful to soils and crops, and multiple cropping. If a cost-effective, modern irrigation project is successful, replication over an area of more than 100,000 ha. is potentially feasible.

This project is part of AID's development strategy in the Sahel to develop available water resources. The Executive Committee for Project Review ( ECPR ) of the Africa Bureau in AID/W found three areas needed further study and clarification before a Phase II proposal could be reviewed for approval: viz., engineering, social soundness, and environmental impact. These studies are considered part of Phase I of the project and the studies must satisfactorily answer outstanding issues identified below.

## II. Objectives:

### A. Alternatives and Cost-Effectiveness Analysis -- Engineering Design Appropriateness:

1. Design alternatives for an irrigated agriculture project should be reviewed to determine the lowest cost, most effective alternative considering protection of ecology, management and maintenance, and productivity.

2. Verification must be made that designs are adequate.

3. Cost estimates must be reviewed to verify satisfaction of requirements of 611 (a) of FAA.

4. Hydrological data should be reviewed to assure supply of water and safety from flooding.

5. Determination must be made that maintenance requirements are adequately provided for.

B. Socio-Economic Study:

1. Update sociological-anthropological appraisal to determine human and cultural constraints to proposed project's success, and to design measures to be used to overcome such constraints.

2. Review relationship with costs which will be reviewed as per para A and settlement costs, and possibility of benefits being reduced by sociological or settlement related expenses or problems.

3. Analyse availability of education and health services.

4. Determine full scope of benefits of project, multiplier effects, including industrialization, transportation, etc.

C. Environmental Assessment:

1. The environmental effects on the area caused by construction and increased population will be significant. What will be the adverse and beneficial effects? All polders ,old and new, will be examined, as will pro-road maintenance activities.

2. Effects of return seepage water on lake waters ( and on fishing ) must be determined:

a. resulting from farming methods (e.g., use of fert./chemicals)
b. resulting from population increases and concentrations

3. Impact of soil and water use methods on:

a. salting /alkalinization
b. health hazards

4. Health data in the project area and peripheral areas must be collected and assembled to determine:

a. the magnitude of present tropical disease problems with particular attention to malaria and shistosomiasis;

b. the magnitude of present diseases caused by poor sanitation standards;

c. the nature and extent of public health services presently operating in the project area;

d. the nature of preventive medicine and sanitation infra-

structure presently in place including methods, types, prevalence of and uses of household water supply, human waste disposal, and solid waste disposal;

e. water quality and vector habitats in the project area;

f. social habits and attitudes among villagers in the project area relating to health and sanitation.

The assessment must propose and evaluate options for alleviating any potentially adverse environmental impact of the proposed project on public health. This analysis should include consideration of:

1. Investment and recurring cost, taking into account the potential effect of such costs on the overall viability of project design;

2. Institutional support required during and after AID participation in the project and its capacity and willingness to provide this support;

3. Likelihood of change in villagers' perceptions and attitudes in their health and sanitation practices, and extent of cooperation called for on their part;

4. Replicability of project design in other areas where irrigated development is contemplated.

Furnish recommendations concerning:

1. Whether the overall project may proceed in a manner which will not adversely affect health conditions, if so;

2. Which of the health component design options identified is the most technically, financially and socially feasible and should be adopted, and provide project design for that option.

3. Means of monitoring and evaluating the environmental impact of the proposed project on public health during implementation and expansion phases of the project.

## III. Report Content

The report should determine the major areas of environmental impact likely to result from the recommended Phase II activity and team members should interrelate their analyses, conclusions, and recommendations so as to arrive at an integrated report.

The analysis should consider the positive and negative effects, the primary and secondary consequences and the long and short term effects of the activity; alternatives, including "no activity", should be considered given benefits, costs and risks of alternatives. Adverse environmental effects that can not be avoided should be considered and responded to by positive correction measures to be taken and weighed against benefits that will result.

Considerations should include but not be limited to: (a) resource linkages, e.g. relationship to national resources, (b) physical aspects, effects on geographic location ( Sahel ), (c) socio-economic aspects, e.g. effects on cultural relationships, traditions and values, etc., (d) public health aspects, e.g. effects on health, sanitation, etc., (e) economic costs and benefits, (f) adverse effects versus benefits, and (g) short-term versus long-term benefits.

## IV. Scope of Work

The contract team will work closely with and/or coordinate with officials of AID/Washington, CDO/Chad, SODELAC, ORSTOM, and GDC.

The team will evaluate the following:

### A. Engineering Analysis:

1. Design alternatives for the proposed project will be analysed for;

   a. safety of design,
   b. protection of ecology and environment,
   c. cost effectiveness,
   d. soundness of design adaptability related to prior experience in the area,
   e. problems of maintenance and management of water distribution to farmers,
   f. efficiency of water use - losses in distribution, etc.

### B. Socio-Cultural, Socio-Economic Feasibility

1. This area of analysis has three distinct but related aspects:

   a. to determine the compatibility of the project with the socio-cultural environment in which it is to be introduced;

   b. to assess the likelihood that new practices or institutions introduced among the initial project target population will be diffused among other groups;

   c. To assess the social impact or distribution of benefits and burdens among different groups, both within the initial project population and beyond.

2. Assess Socio-cultural feasibility taking into account values, beliefs, social structure, allocation of time, motivation and organization of the target group.

a. Develop "minimum participator profiles" of the potential target group participant. Identify those who will not participate and any who will be adversely affected.

b. Identify social, political and/or religious obstacles to project implementation.

c. Determine preferred methods for communicating with potential and actual project participants. Design communication strategy, mechanism and define content of communications.

3. Assess the Potential of the Project or Important Individual Elements of it for Replication by Other Members of the Target Group.

4. Social Consequences and Benefit Incidence

a. Assess the distribution of benefits and burdens produced by the project considering, e.g., access to resources and opportunities (viz., land, capital, credit, education, markets, etc.); employment generated (and the ability of the target group to respond to new requirements of new agricultural practices); displacement, migration and "urbanization" effects; changes in power and participation.

(For more complete definition of these terms, AID Handbook 3 (Project Assistance) appendix 5A -Social Soundness Analysis- should be consulted).

C. Physical Environment

1. Non-renewable natural resources related to the project areas.

2. Other natural resources

a. Using data available, determine present environmental conditions in the basin. This determination should include, but not be limited to, the following areas:

(1) Identify by type and estimate the population of the various wildlife species in the area. Note especially if any of these animals are on the international or local endangered species lists;

(2) Identify the major plant species in the project area. Note any plants, or plant diseases which could be a threat to expanded agriculture within the area.

(3) Identify proposed sites to be used for dike fill material and road maintenance-grading materials. Assess adequacy of environmental protection measures proposed to control exploitation of these materials.

(4) Locate and analyse the existing fishing in project areas and determine the extent of the fishing industry within these areas.

b. Determination of effects of an irrigated project proposal.

(1) Consider effects on public health, surface and groundwater, fishing, natural resources, etc., resulting from water and land use.

(2) Wherever water supply systems are to be established, ensure that the impacts resulting to these areas are studied. This would concern health maintenance problems and costs, and replicability.

c. Prepare guidelines and terms of reference for proposed project to:

(1) Ensure that wherever pesticides, fertilizers, or other agricultural chemicals are proposed, the potential environmental impacts of these chemicals resulting from direct application and runoff are analyzed.

(2) Prepare proposals for minimizing possible adverse public health, and environmental effects of, irrigation and settlement.

(3) Ensure project is ecologically sound. Terms of reference for the project should consider cropping, soil use, drainage, health, etc.

D. Human Environment

1. Public Health

a. Collect and organize all data pertaining to public health in the Bol polders area; this is to be presented on an area basis (dunes, village, polder, etc.)

(1) Tabulate communicable disease statistics with emphasis on vector borne and agriculturally related diseases such as schistosomiasis, malaria, trypanosomiasis, onchocerciasis, dracontiasis, hookworm and other intestinal parasitic infections.

(2) Present and propose public health and preventive medicine infrastructure including methodologies.

(3) Present types, prevalence of and uses of domestic water supply, human waste disposal and solid waste (refuse).

(4) Collect, chart and present data on chemical and bacteriological water quality of the area.

b. Through interview, secondary data review and observations assess the present governmental institutional capabilities in public health and communicable disease control programs.

(1) Make detailed assessments of capabilities for the control and prevention of the further dissemination of malaria, schistosomiasis and other vector borne diseases.

(2) Recommend areas of institutional change of additions which would improve existing programs.

c. Based on the data analysis and observations make recommendations on the following:

(1) Possible or potential modifications of the project or deleterious effects which the project may produce, in the areas of public health.

(2) Possible or potential institutional modifications that may be required to monitor, lessen and/or eliminate deleterious public health hazards which may result from or be increased due to project activities.

E. Animal Health

Data on animal health is to be collected and organized in a manner similar to that cited above for human health. Special attention is to be given to data on typanosomiasis. Recommendations as outlined in item c. above are to be made for this area of study.

V. Personnel and Manpower Requirements

| | | | |
|---|---|---|---|
| 1. | (1) Civil/Environmental Engineer-team leader, knowledgeable and experienced in studying integrated/complex ecosystems, public health, and agricultural development practices. | | 90 days |
| 2. | (1) Hydrologist/geologist | | 30 days |
| 3. | (1) Aquatic Biologist/chemist | | 30 days |
| 4. | (1) Entomologist/Ecologist | | 60 days |
| 5. | (2) Epidemiologist/Public Health Specialist (should include animal diseases) | each | 60 days |
| 6. | Agronomist/soils specialist | | 30 days |
| 7. | (1) Sociologist/Anthropologist should have experience in rural/tribal societies and ability to perform demographic analyses | | 60 days |

| | | |
|---|---|---|
| 8. | Sanitary Engineer | 30 days |
| 9. | Water Resource (Civil) engineer | 30 days |
| 10. | Economist (Agricultural development specialist) | 60 days |
| | TOTAL | 18 person months |

Field efforts in this study are estimated to require NTE of two (2) months. Final report 90 days after initiation of study.

Cost Estimate - 18 person months

25 work days/month average

$185/day average

| | |
|---|---|
| 18 x 25 x $185 | 83,250 |
| + 75% | |
| Per diem - 18 x 30 x 50 | 27,000 |
| Travel - 10 x 17 (International, US) | 17,000 |
| 10 x 200 (In country) | 2,000 |
| Excess Baggage | 1,000 |
| Sub-total | $130,250 |

Other Direct Costs

| | |
|---|---|
| Physicals - 10 x 50 | 500 |
| Passports, visas, shots - 10 x 50 | 500 |
| Telephone, etc. | 1,000 |
| Report reproduction, secretarial, etc. | 10,000 |
| Workmans' compensation, insurance, etc. 20% | 16,650 |
| Sub-total | 28,650 |
| Grand Total | $158,900 |
| Rounded to | $160,000 |

VI. Briefings and Reports

A. Prior to departure for Chad, the entire contract team will assemble in Washington D.C. for one day briefing by AID/W Africa Bureau and SER/ENGR Personnel.

B. Routine, periodic progress reports will not be required. Reports of any significant findings, problems, serious delays, or unforseen circumstances which may seriously hinder or effect the outcome of the team's activities or of the total project must be reported to the responsible AID offices/bureaus when and if they occur.

C. Prior to departure from Chad, the contract team will brief CDO/Chad and others designated, such as SODELAC, and present a draft of field findings for review and comments.

D. Within 10 days after return to the U.S. the team leader will again go to Washington for debriefing by Africa Bureau and SER/ENGR personnel and present a draft of the final report for comments.

E. A final report shall be prepared and submitted no later than thirty (30) days after completion of field work in Chad. This report shall contain all findings, pertinent data, recommendations and project designs required. The draft report is to be in a format conforming to sections 1500.7 and 1500.8 of the Council on Environmental Quality Guidelines described in the Code of Federal Regulations, Title 40, Chaper V, Part 1500 (38 Fed. Reg. 20550-20562, August 1, 1973) and conforming to procedures set forth in AID regulation 16 as published in the Federal Register, Vo. 41, No. 127, Wednesday, June 30, 1976.

The final report is to be submitted to AID/W within twenty (20) days after the Contractor is debriefed and receives comments on modifications of the final report. The final report is to be prepared in a format which may be presented to and accepted by the Council of Environmental Quality. The final report shall incorporate all data, maps, findings, recommendations and project design resulting from the team effort, as well as AID review comments and/or modifications of the draft report. Twenty-five (25) copies of the final report shall be submitted to AFR/DR and five (5) copies submitted to SER/ENGR.

ANNEX K

## 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.