688-0213
PD-AAG-832 (1)
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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: MALI

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 688-0213

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

7. PROJECT TITLE (Maximum 40 characters): ACTION BLE

8. ESTIMATED FY OF PROJECT COMPLETION: FY 82

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 78; B. QUARTER 4 (Enter 1, 2, 3, or 4); C. FINAL FY 81

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	953	548	1501	2869	1557	4426
(GRANT)	(953)	(548)	(1501)	(2869)	(1557)	(4426)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY	—	137	137	—	768	768
OTHER DONOR(S) FAC	—	—	—	400	—	400
TOTALS	953	685	1638	3269	2325	5594

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 78 F. GRANT	E. 1ST FY 78 G. LOAN	H. 2ND FY 79 I. GRANT	H. 2ND FY 79 J. LOAN	K. 3RD FY 80 L. GRANT	K. 3RD FY 80 M. LOAN
(1) SH	070	073	—	1501	—	1649	—	1159	—
(2)									
(3)									
(4)									
TOTALS				1501	—	1649	—	1159	—

A. APPROPRIATION	N. 4TH FY 81 O. GRANT	N. 4TH FY 81 P. LOAN	Q. 5TH FY — R. GRANT	Q. 5TH FY — S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) SH	117	—			4426.	
(2)						
(3)						
(4)						
TOTALS	117	—			4426	

12. IN-DEPTH EVALUATION SCHEDULED: MM 03 YY 80

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

2 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Ronald D. Lee

TITLE: Mission Director

DATE SIGNED: MM 04 DD 26 YY 78

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

AID 1330-4 (3-78)

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT IDENTIFICATION DOCUMENT FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete)

PID

2. DOCUMENT CODE: 1

3. COUNTRY/ENTITY: MALI

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 DIGITS): 688-XXXX

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

7. PROJECT TITLE (MAXIMUM 40 CHARACTERS): ACTION BLÉ

8. PROPOSED NEXT DOCUMENT: A. 2 (2 = PRP, 3 = PP); B. DATE (MM YY): 12 76

9. ESTIMATED FY OF AUTHORIZATION/OBLIGATION: a. INITIAL FY 78; b. FINAL FY 80

10. ESTIMATED COSTS ($000 OR EQUIVALENT, $1 = 450)

FUNDING SOURCE	LIFE OF PROJECT
A. AID APPROPRIATED	3930
B. OTHER U.S. 1.	
B. OTHER U.S. 2.	
C. HOST COUNTRY	1087
D. OTHER DONOR(S)	
TOTAL	5017

11. PROPOSED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. FIRST FY 78 F. GRANT	E. FIRST FY 78 G. LOAN	LIFE OF PROJECT H. GRANT	LIFE OF PROJECT I. LOAN
(1) FN	110	073		1,178		3,930	
(2)							
(3)							
(4)							
			TOTAL	1,178		3,930	

12. SECONDARY TECHNICAL CODES (maximum six codes of three positions each)

084 | 071 | 072 | 064 | 032

13. SPECIAL CONCERNS CODES (MAXIMUM SIX CODES OF FOUR POSITIONS EACH)

BF | BR | COOP

14. SECONDARY PURPOSE CODE

15. PROJECT GOAL (MAXIMUM 240 CHARACTERS)

To reduce chronic cereal deficit in 5th and 6th regions of Mali.

16. PROJECT PURPOSE (MAXIMUM 480 CHARACTERS)

To produce cereals, with emphasis on wheat, using farmer managed irrigation schemes on a cooperative basis in the Diré subsector of Mali's 6th Region under the direction of the parastatal organization Action Blé.

17. PLANNING RESOURCE REQUIREMENTS (staff/funds)

Irrigation engineer (8 weeks), sociologist (8 weeks), Project design officer (4 weeks) agricultural economist (8 weeks), Irrigation Agronomist (4 weeks)

18. ORIGINATING OFFICE CLEARANCE

Signature: E.G. Ruoff

Title: Acting/Country Development Officer

Date Signed: MM 06 DD 25 YY 76

19. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-2 (3-76)

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Part 1.B. SUMMARY

Grantee: The Government of the Republic of Mali

Amount : $4,426,000

Life of Project : Four Years

Purpose : Increase wheat and sorghum production in a manner which maximizes benefits to the small producer.

Design Team

David Delgado, USAID/Bamako
Etien Asmon, Irrigation Engineer
Randall Stelly, Agricultural Economist
Torrey Lyons, Agronomist
Richard Downs, Anthropologist
Kenneth Casavant, Transport Economist

Recommendations

It is recommended that the sum of $ 4,426,000 life of project costs be authorized during FY 1978 for a grant to the Government of the Republic of Mali for a four year project to increase cereal production.

It is further recommended that : A source/origin waiver from Geographic Code 000 to Geographic Code 935 be granted to permit the purchase of motor vehicles, mobylettes, and urea, the total of which will not exceed $281,000. Requests for waivers are detailed in the procurement package found in the annex.

Part I. C.

Description of the Project: Action Blé will assist approximately 2,400 small farmers to increase cereal production in Mali's VI Region through the provision of (1) small irrigation pumps; (2) agricultural inputs (fuel, lubricants, fertilizers, hand tools) furnished on short-term credit; (3) a more competent, better trained Action Blé management. A pricing policy established by the GRM as a covenant of this project will provide a strong production incentive.

Farmers will be provided short-term credit for agricultural inputs through a special revolving credit fund managed by Action Blé. They will also be provided with small (4 HP) pumps on a 5-year credit basis managed through the same fund. These pumps, capable of irrigating a minimum of 4 hectares each, will take water from a nearby branch of the Niger River and lift it into a simple, gravity-fed irrigation system constructed by the farmers themselves. This series of small pumps, which will irrigate 2,420 hectares of wheat will also permit supplementary irrigation of rain-fed sorghum on an equal area, as well as create possibilities for pulse or forage production. Each pump will be jointly owned, operated, and maintained by a group of about 4 farmers cultivating about 1 hectare each, with assistance from the cadres of Action Blé mechanics.

The Action Blé staff will be increased and will receive additional training to better supervise the production activities of farmers in eight villages in the Diré area. A mechanical supervision unit, a credit and marketing unit, and a training unit will be created under this project to support more fully the farmer cooperators.

Organizational Responsibility: The responsibility and supervision of the project will rest with the Director and staff of Action Blé - Diré. "Actions", similar in structure but smaller than "operations", are parastatal organizations responsible for development within geographic, or crop-specific areas.[1]

Action Blé has a young, eager, but small staff, designed originally to support production needs on the "pilot perimeter", a contiguous area of 300 hectares. AID support to the project, however, will bring some 2,400 hectares of wheat and sorghum into production, through small irrigated perimeters, necessitating village and sub-village level management units (secteurs and secteurs de base), mechanics, and additional extension staff. These management units will be created and staffed with an adequate number of trained, mobile personnel.

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[1] "Operations" are essentially regional agricultural development administrations, parastatal in nature and financially autonomous. Operations have been granted the "financial and administrative autonomy in order to coordinate and utilize rationally all the means necessary to execute rural development programs." (Art. #2 of Ord. 22 of the Military Committee of National Liberation, March 24, 1972.) This autonomy thus permits them to seek direct foreign donor financial assistance. Many "Operations" receive self-generated support through ad valorem levies on crops produced and marketed under their auspices. At present, three "Operations" receive no direct national budget support.

Conceived originally as crop-or-geographically-specific agricultural development projects, focused on export crop production, "Operations" are now considered to be the vehicles for introducing "integrated development". Farm-to-market road networks, functional literacy, village potable water supplies and human and animal health measures are examples of their new directions.

Extension activities will be focused upon the groups of four or five farmers sharing the use of the irrigation pumps. This grouping will greatly facilitate the exchange of ideas and transfer of information between technician and farmer. Additionally, in each participating village a group of elected village leaders known as the Commission des Paysans will assist Action Blé in the extension/supervision activities of this project. The Action will work through this and other village leadership to arrive at a just allocation of land following traditional land use patterns. This will ensure a permanent right of usufruct to participating farmers.

Input-Output Linkage: The inputs to be provided under this project include: (1) pumps for irrigation; (2) a credit fund for seeds, fertilizer, etc.; (3) training in extension education, management, economics, and marketing; (4) a larger Action Blé staff; (5) 8 village level input warehouses, a repair shop and staff housing; (6) vehicles and 2 motorized boats; and (7) foreign technical assistance. These inputs are either in direct support of the farmers' activities or facilitate the task of those who support the farmer. Each is clearly an indispensable part of the support system necessary to achieve the project purpose...."wheat and sorghum production increased in a manner which maximizes benefits to the small producer".

End of Project Status: By the end of the project there will be 2,420 hectares of irrigated wheat, of which 2220 hectares will be double-cropped with sorghum and 500 hectares triple-cropped by including legumes or forage. At a conservative yield estimate of 2.5 tons per hectare for wheat and 1.5 tons per hectare for sorghum, more than 9,000 metric

tons of cereals will be produced annually. The sorghum alone will reduce the grain deficit of the 6th Region by almost 20%. The total value of production after deducting all amortization and cash costs by the end of the project will be $1.23 million per year.

Part I. D. **SUMMARY FINDINGS**

This section summarizes conclusions supported by observations and findings of the PP team, the 1975 SCET study, and other pertinent technical analyses of the project area.

Action Ble is a remarkably low-cost, labor-intensive cereal production project utilizing an environmentally sound technology which is both economical and appropriate for use by small farmers. It takes advantage of a uniquely favorable combination of: (i) an irrigated wheat production tradition dating back centuries; (ii) ideal soils and temperatures; (iii) an assured supply of irrigation; and (iv) a growing demand for cereals in a grain deficit region.

The technology to be extended under this project has already been successfully introduced and its adoption is assured by a population eager for the kind of assistance proposed. Agronomic conditions are considered near perfect and wheat yield will be limited only by the genetic potential of the varieties used, water management, and fertilizer availability.

The purchase and installation of small pumps along the banks of the river is considered economical and appropriate. Animal driven "flow pumps" capable of irrigating up to four hectares each will be tested as well.

Free market prices in the project area are necessary to maintain the production incentive.

There are adequate storage and transportation facilities to support this phase of the project.

The return on labor of participating farmers after payment of cash costs and equipment amortization and operation is almost double the returns of traditional production methods. Farm prices paid will be sufficient to cover operational cost of the Action Blé management and guarantee its continued operation upon the termination of AID financing.

This project utilizes a technology largely existent in the project area and a management capability deemed suitable for successful project implementation.

This project meets all applicable statutory criteria (Annex XX). A 611(e) certification is found in Annex XV of this project paper.

Part I. E. PROJECT ISSUES

Identifiable issues include:

(i) managerial capability for successful implementation of this project;

(ii) likelihood of an agreement to permit free market forces to prevail in the case of wheat and sorghum; and

(iii) effect of pricing on non-particpating farmers.

Discussion

(i) The agressive young staff of Action Ble is presently not large enough nor mobile enough to manage AID's planned inputs. Well staffed and organized for the supervision of the large irrigated perimeter, it will have to be increased slightly and deployed in village-level management units in order to provide adequate technical assistance to the small, farmer-managed irrigated perimeters. Staff mobility and training are planned for the project.

(ii) Mechanical irrigation is expensive and reasonable returns on labor are critical to the success of this project if increases in farm income are to be realized. Several frank discussions were held with high level officials of the GRM on ways to assure or maintain the existing production incentives. While they do not establish official pricing policies, they were very supportive of the economic arguments proposed. They reported that an inter-ministerial price policy review for all major crops is near completion. Although no wheat (or sorghum, for that matter) is presently being marketed through

official channels, these officials are very confident that the official price of 62 MF/kg for wheat will increase as a result of this review.

The GRM, through the state-owned enterprise OPAM, is not in a financial position to support a floor price for wheat. The Ministry of Rural Development is cognizant of the fact that diesel pump irrigation will be expensive to the producer. Moreover, they are cognizant of the economics of continued and increasing flour importation which cost the GRM $7.8 million in foreign exchange last year alone. If milled locally, the value of wheat to be produced in Dire, as a result of this project, would save approximately $1.8 million in foreign exchange. Accordingly, it is in the GRM's best interest to encourage expansion of local wheat production. The GRM has already developed plans for the establishment of a flour mill. A condition precedent that a contract be signed for the construction of this facility will assure that an outlet exists to purchase wheat as it is produced by project farmers.

The PP team is confident, and has received repeated assurances that every effort will be made to accomodate Action Ble's project purpose: increased wheat production in a manner which maximizes benefits to the small producer. The project agreement will include a covenant that no "quotas" or other market interventions be imposed in the project area, thus allowing free market prices to prevail. Wheat produced in Diré , delivered to Bamako, less transportation, handling and production levies, should therefore bring prices roughly equivalent to world market prices for imported wheat delivered to Bamako's mill.

In summary, the PP team is of the opinion that there is every reason to believe that the GRM will accept a covenant to allow free market prices to prevail in the Diré area, and that the prices, as a result of an assured market outlet, will permit increased investment in irrigated grain production.

(iii) A full discussion of prices and production incentives is presented on page 72. The conclusion of the design team is that a drop in wheat prices due to surplus grain production as a result of this project will not adversely affect the very few non-participating farmers. Projected drops in sorghum prices will be small and are not expected in the near future due to a high and growing demand for cereals in nearby deficit areas. Since most farmers do not sell, but buy grain, a slight drop in price would be welcome.

Part II. PROJECT BACKGROUND AND DETAILED DESCRIPTION

A. Background:

Grain production deficits in most of the 6th Region have long been a problem. The area around Diré, however, has been identified with significant potential for irrigated crop production although the introduction of wheat culture in this region is linked to Moroccan influence traced back to the 15th century.[1]

The recent history of efforts to develop the "Plain of Diré" begins in 1921 with the establishment of a large (3-4,000 hectare), private irrigation system by the French C.I.C.O.N.I.G.[2] Agricultural production efforts were concentrated upon cotton, although some peasants were given small, individual plots for the growing of wheat. The C.I.C.O.N.I.G. system failed 25 years later due to a combination of factors including low world market prices for cotton, politics in post-war France and high cost, increasingly scarce fuel (firewood) for the large, steam-driven irrigation pumps.

In the late 1950s a group of retired civil servants established the "Cooperative of Diré" and purchased and installed a pump capable of irrigating 150 hectares of wheat land in the former C.I.C.O.N.I.G. perimeter. The cooperative continued to function for 13 years.

In 1962 the Centre d'Animation Rurale, (rural training center) at Dire put back into production another small part of the former perimeter

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[1] Seydoux, L. and P. Damien, "Development Integré de la Zone Diré-Goundam" p. 31, 1970.

[2] Compagnie Indigene du Coton du Niger.

on land adjacent to the Center. A Russian made pump was installed at an existing pump site and operated for approximately six years.

In 1974, the GRM, concerned by the growing need to increase grain shipment to the 6th Region and faced with large import requirements for cereals, focused its efforts on maximizing grain production in this region. It was determined that the development of the "Plain of Diré" could contribute significantly to increased food production for the region. Thus, the GRM's 5 Year Plan (1974-1978) included the "Experimental Perimeter of Diré" designed for 300 hectares, of which 270 hectares would be distributed to local farmers and 30 reserved for experimentation with wheat, sugarcane and forage production.[1]

French financial assistance for this pilot perimeter was secured in June of 1975 for the development of the 300 hectare irrigation system, the purchase of pumps, office equipment and supplies, vehicles, housing and technical assistance.[2] A second tranche of funding (approximately $500,000) was secured when cost overruns threatened the completion of the project. Another major investment in the Dire area is the solar energy powered SOFRETES heat exchange irrigation pump. This pump, to be installed by 1979, is the world's largest such installation. It will be used both to irrigate 50-60 hectares of the "experimental perimeter" and to supply water to the planned tourist complex slated for development in the early 1980s.

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[1] Plan Quinquennal 1974-1978 "Perimetre Experimental de Diré" August 1974.

[2] FAC project 206/CD/74/VI/B/13, "Mise en Valeur de la Plaine de Diré" June 1974.

FAC also financed the 3 volume feasibility study conducted in 1975 by the French firm SCET International. The study encompassed the entire Diré Plain (95,000 hectares in all) and examined, in the following priority, the suitability of (1) sugar cane, wheat, and vegetable production; (2) the establishment of a flour and sugar mill; (3) forage production; and (4) a feedlot.

The SCET study did not focus on the potential of small farm irrigation units but limited its study primarily to the engineering/economic feasibility of the rehabilitation of the large irrigated perimeter. It placed major emphasis on agricultural diversification and related agri-business development. Irrigation, as projected in the SCET study, would be done through the provision of large diesel pumps, much as in the manner of the former C.I.C.O.N.I.G. investment. Producers would lease land on a three year basis from Action Ble.

The SCET study summarizes wheat production potential: "The development of wheat in the study zone should not encounter particular difficulties... and could reach yields in the order of 4 tons/hectare."[1]

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[1] SCET, International "Schema d'Amenagement de la Plaine de Diré" Republique du Mali, 1975, p. 77.

Part 2.B. DETAILED DESCRIPTION

The goal of the project is "increased food grain production which will contribute toward Mali's acheivement of self-sufficiency in food".

The project purpose is to demonstrate that wheat and sorghum production can be increased under irrigation in the Dire area in a manner which will maximize benefits to the small producer.

The end-of-project status will show 2,420 hectares under irrigated wheat production, all 2420 hectares will also be targeted for double-cropping with sorghum. Five hundred hectares will be triple-cropped with a legume such as cowpeas. This would provide an annual wheat harvest of 6,050 MT, of which 5,350 would be marketed to a flour mill to be established in Bamako, as well as 3,630 MT of sorghum which will help diminish the grain deficit in the 6th Region. The income of about 2,400 participating farmers will rise from the present $266 to about $510 .

In the Diré and Goundam cercles there exist over 12,000 ha of plains potentially suitable for wheat production (Diagram 2), in addition to the 4,000 hectares plain around Diré which had been the site of the CICONIG cotton and wheat project. Much of this area presents the topographical characteristics of (i) banks rising steeply about 4 meters from the Niger River and especially from the Marigot (river branch) of FARABONGO, one of its important channels, and (ii) almost perfectly smooth plains sloping gently inland from the top of this embankment (Diagram 3). This topographic situation presents an outstanding opportunity for the installation of small pumps along the river bank in order to lift the water to the top of the embankment and allow it to run inland through simple, farmer-constructed and operated gravity irrigation systems.

Along the Niger River and especially along the FARABONGO arm (which is deeper than the main channel and assures water availability even in years of extremely low flows),over 48 Km of such steep banks have been identified in the Diré and Goundam cercles. Considering a 500-meter-wide strip along the river - a distance which is within easy reach of small pumps - an area of at least 2220 ha is available for year-around irrigation by small pumps. (Diagram 2). To this was added an area of 200 ha adjoining the marigot de Bourem, although this channel carries water only during the flood season (which corresponds to the wheat growing season), because of the outstanding fertility of the soils in that location (Diagram 2).

Thus the total area of this subproject has been defined as 2420 ha of wheat production, all of which will be followed by sorghum and possibly also with legumes, such as cowpeas. This is only a fraction of the area suitable for small-pump irrigation in the vicinity of Diré; thus land availability is not viewed as a constraint for project expansion. This project should be seen as only the first phase of a major, multilateral development effort in the northern Niger delta. AID's assistance to the project is modest but of sufficient scale to (i) demonstrate the economics of small pump irrigation; (ii) develop the managerial capability of the technical staff; and (iii) gather research data (agronomic, economic and social) to support an expanded project. The PP team is of the opinion that there will be no difficulty in securing funding of a second and larger phase if the present project meets its objectives.

The typical 4-ha farm unit will extend for 160 m along the water course and for 250 m inland. Thus a 250-meter green strip will be created along the river. Later a second tier of farms will be formed, widening the green strip to 500 m (Diagram 3). Alternatively, the farmers could shift cultivation to the second tier, letting the first one follow, thus obviating the need for fertilizer (Annex I, p. 9).

The 2420 ha area will be irrigated by two methods: (i) 2000 ha will be irrigated by 500 small (about 4 HP), low-head (5-15 m lift) portable diesel pumps. Each pump will irrigate at least 4 ha and will be jointly owened and operated

by about 4 farmers cultivating about 1 ha each (Annex II); (ii) An area of 420 ha will be irrigated by 105 animal-driven pumps (activated by oxen or donkeys) of the Pakistani type known as a "flow pump" (Annex VI.), which will also irrigate at least 4 ha each. This area will constitute a pilot project for the introduction to Mali of this type of pump which is likely to be much more economical in purchase and operation, and also to eliminate dependence on costly fuel. Spare parts for these pumps can be manufactured in Diré.

The following schedule is proposed for the installation of pumps:

	1st Project Year	2nd P. Y.	3rd P. Y.	Total
Diesel pumps	150	175	175	500
Animal-driven pumps	5	50	50	105
Total	155	225	225	605

The exact proportion between the two types of pumps; however, will be adjusted according to experience gathered during project life with the two types.

All pumps will be sold to the farmers on credit, at terms which reflect their real cost and assure the permanence of the operation.

Along with credit for the pumps, the project will provide credit for fuel supplies, fertilizers, improved seeds, hand tools and other production inputs at 8% per annum. Action Ble's provision of pump repair services, extension and marketing assistance are project operating expenses.

The project will assure marketing of the products at prices which will give the farmers sufficient incentive to produce. At the same time, the project will institute a levy which will meet the expenses of "Action Blé" activities to the extent necessary for guaranteeing its self-sufficiency at the end of the project.

The project may be regarded as the first phase of a larger irrigation development based on the principle of small pumps owened and operated by small groups of farmers. If it is found feasible to extend the range of such pumps to 1 Km from the water courses (possibly through the use of plastic canal linings), the area irrigated by small pumps could be doubled to about 5000 ha. Moreover, additional areas with topography suitable for small pumps (steep river banks and inland-sloping plains) might be identified at other locations along the Niger River.

The project will also provide the institutional infrastructure for the possible introduction of solar pumps. If solar pumps would become economical in the late 1980's as is currently projected, they could be plugged in to replace the diesel pumps as these are worn out after about 5 years of service (see Solar Pump Economics in the Annex).

FAC will provide funding for an extension/on-farm irrigation advisor to be stationed in Diré beginning in September 1978. Discussions with the FAC have led to an agreement that the technician will be made available to assist the AID-financed project area as needed. This relationship will be included in

the scope of work soon to be signed between the GRM and the SCET international.

Part III. A

I. Agronomic Aspects

Summary:

The detailed agronomic analysis is found in Annex ..I.. This summary highlights the findings of the team agronomist.

Objectives of this project include not only augmenting wheat and sorghum production by increasing hectarage under cultivation, but also includes increasing farmer's income, yields per hectare. While some short-strawed wheat varities have the genetic yield potential of 8-9 tons/hectare, the farmers in the Diré area are presently averaging about 2.5 tons/hectare. Increasing actual yield toward the potential is a question of overcoming constraints and avoiding conditions which would limit this potential. A full discussion of possible agronomic constraints and limiting factors is found in the Annex. These factors can be categorized into two groups: (i) physical conditions; and (ii) farm management practices.

Physical Conditions

On the physical side, the Diré area offers nearly ideal agronomic conditions for wheat production. (1) The temperature and light for wheat production are all but perfect. (2) The Niger River supplies unlimited water. (3) There is an ample area of adequate soil. In fact, some farmers experienced decreased production in first year wheat crops due to over-fertility of the soil. However, later year crops will need fertilizers and the recommendations in the Annex are projected to

maintain yields at about 2.5 ton/hectare. Fertilizer recommendations are also given for 3.5 tons/hectare. (4) Surprisingly, there are no wheat diseases at present and pests, such as birds, rats, and insects are easily controlled. (5) Weeds at this point are not a problem.

Farm Management Practices

The farm management practices side of the situation is more complex but nonetheless equally promising. Wheat is a traditional crop in the area,by some accounts it has grown for over 5 centuries. A small research program has been very active since its inception in 1975. Local farmers have proven their competence and capability in good farm management practices over the years. Only two present agricultural practices (relating to tillage and seeding) seem to act as a constraint on production. Separate annexes to this paper address these constraints and concrete proposals are put forth to help overcome these limitations. For example, a seeding device is diagramed which might make an improvement in the present seeding practices.

An integrated research/extension effort is proposed to deal with present and future constraints in either the physical or farm management areas. Although research may seem to address the physical problems and extension the farm management concerns, it is a basic premise of this project paper that research and extension should be integrated into a single function . Research, which must take place on-station as well as on-farm, should feed into extension efforts. Conversely, extension work should

provide direction and feedback into research efforts.

A suggested research/extension program includes the following areas of concern. (1) Varieties. Variety trials should be run for the evaluation, selection, and original seed increase not only for wheat but especially for sorghum, cowpeas, and other crops deemed important for the project area. Variety trials should be a precursor to a seed multiplication program. Enough seed of a collectively chosen variety should be produced to totally supply villages in order to replace local stock. This will minimize the traditional practice of mixing seed and thus limit the dilution of the good genetic qualities of the improved varieties.
(2) Water Management. As in any irrigation project, careful water management is of the utmost importance. Irrigation timing has been well worked out by local farmers but some work might be needed in irrigation on heavy soils and for use of plastic in irrigation canals. (3) Tilling and Seeding Methods. Present methods may not be optimal and work on the influence of tillage depth and seeding practices on production, the evaluation of improved tools, equipment, and techniques is necessary. (4) Fertilizer Practices. Efforts in this area should be based on the farmers economic welfare and not on maximum yield. Examination of the nature and optimum levels of nutrients to be applied (including local organic fertilizer) is needed. (5) Rotation. Rotation provides economic and biologic-flexibility to many production problems and optimizes the use of land and other resources. Therefore, it has the potential of being an important area for research concern. Sorghum, the clear choice for a second crop, can be grown during the

short rainy season with some supplemental irrigation. Sorghum is a traditional crop of major importance in Malian agriculture. Cowpeas, a legume, has many advantages for being included in a 3 crop rotation. Other crops should be investigated. Work in intercroppin and relay cropping is also recommended.

A "set-aside" policy should be looked into where the land area alloted to one pump is twice the irrigation capacity of the pump, ie. 8 hectares instead of the 4-hectare "module". This would reduce fertilizer inputs and raise farmers net income per labor day. (6) Crop Protection. Although the various pests and weeds do not presently pose a problem in the field the situation should be closely monitored as production increases. Crop storage protection is a chronic problem in Mali and improved storage techniques should be developed and implemented.

In summary, constraints of both a physical and farm management nature seem to be minimal. An integrated research and extension component will help alleviate these present constraints and be flexible to future problems which might arise.

3. A. TECHNICAL ANALYSIS

II. Pumping Considerations

The technical details of the pumping installations are considered more fully in Annex . VI. The present section highlights some of the more important aspects of that Annex.

1. Due to the short irrigation canals and not excessively permeable soil, irrigation efficiency will be at least 72%. At this efficiency, 8,000 m^3/ha of water are adequate for wheat (this agrees with current field experience), and 4,200 m^3/ha are sufficient for sorghum, which grows during the rainy season.

2. The maximal pumping heads (during a 20-year drought) would be 4.50 m for wheat and 6.00 m for sorghum.

3. For the above heads and discharges, a 4 HP diesel pump could irrigate up to about 5.5 ha. In the project design, each 4 HP diesel pump is expected to irrigate 4 ha (2,000 ha will be irrigated with 500 pumps), which allows an ample margin for less-than-optimal operation. In practice, the 500 pumps might well irrigate 2,500 ha or more.

4. The existing pilot installation of diesel pumps might be improved upon by using 4 HP, low-head (5-15 m)

pumps with a larger capacity than the present pumps (50 - 80 m^3/ha), equipped with an 80-mm delivery pipe. A trench should be excavated from the water's edge part of the way to the brim of the embankment and the pump placed at the end of the trench (Diag. 4), for savings on both pipe purchase costs and friction losses.

5. A <u>sine qua non</u> for project success is that the diesel pumps selected be appropriate for project conditions. The pumps must have a robust construction, slow motor speed, ability to undergo several overhauls, a record of satisfactory utilization by small farmers in the tropics, and a satisfactory spare-part supply system. Since there is no assurance that there exist U.S.-made pumps which meet these requirements, the procurement of the pumps should be done by an international bid (Annex XVIII). This will not exclude a U.S. manufacturer, if (but only if) he produces the pump which is best suited to project conditions.

6. To ease the spare-parts problem, all 500 pumps will be of the same model, and every pump will come equipped with a spare part kit worth 50% of the pump purchase cost, which will contain the spare parts necessary for a 5-year operation. The project will provide 8 itinerant

mechanics for small repairs and preventive maintenance, and a central workshop for major repairs. To assure fuel provision, one year's fuel supply will be shipped in during the flood season and be stocked at village level.

7. Conditions in the project area appear very suitable for the introduction of modern, efficient animal-driven pumps of the Pakistani type, known as flow pumps (Diag. 5). These can irrigate under project conditions up to 4 hectares, cost less than half as much to purchase and operate as do diesel pumps of equal capacity, have a much longer life span, and all spare parts can be manufactured at Dire. The project will provide a pilot installation of 105 such pumps to irrigate 420 ha. This will make possible at a later stage the fabrication of such pumps in Mali.

PROVISION FOR PUMP REPLACEMENT

The pumps to be used in this project have a projected useful life of five years. Not all of the planned 500 pumps, however, will have to be replaced after five years since the specifications for these pumps call for a design which permits overhauling and refitting, which can be done in most cases at a cost estimated to be 50% of the initial purchase price. To assure that the pumps will be maintained in good working order, eight mechanics will be hired by the project to train farmers in routine maintenance and operation procedures. A pump repair shop, another project input, will assure that the timely upkeep of these pumps and replacement of used parts is done properly. Proceeds from principal and interest payments (8% p.a.) on these pumps will be set aside in a special interest earning account to serve as a credit source for eventual replacement of the original pumps.

Part 3. A.

III Environmental Analysis :

The nature, scope, and magnitude of potential environmental impacts have been carefully examined by the project team. The initial Environmental Examination is found in the Annex IX. The conclusion that a negative determination is called for, is, after further analysis, still valid.

IV. Transportation

The transportation aspects are more fully considered in Annex X . The main conclusions and recommendations of that annex are discussed here.

1. The ability of the existing transportation system to serve any increased demand for transportation services generated by Action Blé is largely dependent on the timing, volume, and direction of this new traffic.

2. The Senegal-Mali Railroad is severely constrained in operational capacity. Any internal change in Malian production and consumption which will decrease the pressure on the system would be beneficial.

3. Water navigation on the Niger River continues to be the primary access route for products moving in the 6th and 7th Regions. The existing capacity of the Compagnie Malienne de Navigation (CMN) is completely utilized on down-river movements (Koulikoro-Timbuktu-Gao) during the short navigation season, but substantial up-river capacity does exist. Pirogues, ranging in size from 1 ton to 30 ton capacities also carry passengers and freight on the river, but account for only 10 to 15% of total river traffic.

4. Total truck capacity in Mali appears to be reasonable, but not uniformly distributed throughout the country. Truckers are reluctant to go onto poorer roads, and only recently have the rates been adjusted to encourage this movement. It is still doubtful that these rates will

induce movement on the poorer, unpaved or even improved roads in the project area. Diré is accessible by road only during the dry season.

5. CMN rates from Koulikoro to Diré are only 20% of the truck charges, 8,354 MF/MT compared to 47,290 MF (Table 2 in annex). Pirogue rates are about 50% higher than the CMN rates, while truck-pirogue combined rates fall between the truck and CMN rates.

6. Constraints on the transportation system are related to the seasonal movements and physical capacity, both for river and road. Any further down-river traffic will necessitate investment in more barge capacity. On the other hand, the existing unutilized backhaul capacity (25,000-30,000 MT/year) is more than adequate to handle project wheat shipments to Bamako (about 5,000 MT/year). Port facilities along the river appear adequate. Thus the Action Blé project does not require additional investments in transportation infrastructure.

7. Construction costs of an all-weather road to Diré are prohibitive. Thus practically all project inputs and products will move by river.

8. Traffic generated by Action Ble will be a substitute for cereals imported into the area, thus decreasing the demand for transportation rather than increasing the pressure on the already strained system. This not only makes capacity available for other traffic important for Mali, but will also result in significant transportation savings - on the order of $ 93/MT of wheat consumed in Bamako which is produced in Diré and substitutes wheat imported from abroad. Over 70% of these savings are in foreign exchange.

9. Any flour mill constructed in Mali should be located near Bamako. Processing costs would be higher, management and communication more difficult, and logistical support non-existent if the mill were located in Diré. Also, much of the wheat in the near future would have to be imported, further increasing the desirability of Bamako as a location site. If decentralization of industry is desired, the mill could be located at the Koulikoro railhead (60 kilometers from Bamako).

Part III. B. FINANCIAL ANALYSIS AND PLAN

Conclusions set forth in this section are based upon detailed analyses which are summarized in Annex I.

It is apparent that there exists suitable financial incentive to attract the participation of small farmers. Income projections based upon conservative yield estimates of 2.5 tons per hectare (Tables 5, 6, 7 and 8 of Annex I) indicate an almost doubling of farm income derived from wheat/sorghum production after payment of all costs.

1. Present Annual Income

	Wheat[1]	Millet[2]
Labor-days	194	200
Cash Costs	8,500 MF	600 MF
Gross Revenue	93,750 MF	48,000 MF
NET REVENUE	85,250 MF	47,400 MF
NET REVENUE	($171)	($95)
Total Annual REVENUE	$266	

[1] Projected for a .5 hectare field (see page 19, Annex I).

[2] Sorghum, is not presently being planted in the immediate area where pumps will be installed. Millet production costs, yields, and returns are essentially the same as for sorghum. Finger millet, more drought tolerant than sorghum, is included in this annual income table as a basis for comparison of returns to participating farmers.

2. Projected Annual Income per Hectare

	Wheat	Sorghum
Labor-days	261	226
Cash Costs	128,238 MF	19,386 MF
Gross Revenue	312,500 MF	90,000 MF
NET REVENUE	184,262 MF	70,614 MF
NET REVENUE	$369	$141
Total Annual Revenue	$ 510	

Any yield increases above these projections will substantially increase annual farm income. The agronomy section indicates that yields of 3.5 tons/hectare for wheat and 4-5 tons/hectare of sorghum are not out of the reach of the Diré farmers. Projected net income at these levels: $958. (See Tables in Annex I).

Recurrent Budget Analysis

The following budget summary is based upon a detailed analysis of salaries and other project expenses for one year of Action Ble operations. These figures represent costs to be assumed by Action Ble and the GRM upon termination of AID financing to this project.

A. Special allowances for GRM personnel	18,180
B. GRM salaries	56,280
C. Office supplies	7,000
D. Vehicle maintenance/repair	22,500
E. Extension activities	4,000
TOTAL	$107,710

It is planned that the 10 MF/kilo of wheat levy be utilized to defray recurrent budget costs upon termination of AID financing of this project. At production estimates for the end of project the total available for budget support would be $121,000 (2,420 x 2.5 x $.02), which would be more than adequate to guarantee self-financing of Action Blé.

Action Blé will deposit in a special interest bearing account all proceeds from the 10 MF/kg levy on wheat. At the end of project years 2, 3, and 4, these funds will be used to defray annual operating expenses.

REVENUE FROM WHEAT LEVY

	Est. Production (MT)	Value of Levy ($20/MT)
Year 1	1,550	$ 31,000
2	3,800	76,000
3	6,050	121,000
4	6,050	121,000
Total Revenue		$ 349,000

Life of Project Shared Operating Expense Budget

Year	Total Operating Expense	% Support AID	% Support GRM	Cost AID	Cost GRM
	$			$	$
1	41.480	100	0	41,480	-
2	51,430	80	20	41,144	10,286
3	51,430	50	50	25,715	25,715
4	51,430	0	100	-	51,430
TOTAL	$195,770			$108,339	$ 87,421

PROJECT BUDGET SUMMARY

	Component	Total	OBLIGATIONS FY 79	FY 80	FY 81	FY 82
I. Technical Assistance		360,000	60,000	140,000	100,000	60,000
1. Sociologist a/	40,000					
2. On-Site Project Analyst b/	160,000					
3. TDY Technical Assistance c/	200,000					
II. Participant Training d/		225,200	101,800	84,800	39,000	-
1. U.S. (78 pm)	132,000					
2. In-Country (297 pm)	53,000					
3. Third Country (27 pm)	40,200					
III. Commodities d/		1,487,800	554,800	466,500	466,500	-
IV. Other Costs d/		1,000,839	326,080	454,394	199,365	21,000
1. Construction	348,000					
2. Action Research & Evaluation	166,000					
3. Credit Fund	378,500					
4. Operating Expenses e/	108,339					
TOTAL		3,073,839	1,042,680	1,145,294	804,865	81,000
Contigency (20%)		614,768	208,536	229,059	160,973	16,200
Inflation (20%)		737,721	250,243	274,871	193,168	19,440
PROJECT TOTAL		4,426,328	1,501,459	1,649,224	1,159,006	116,640

a/ Graduate student research grant.
b/ Personal Services Contract, local hire.
c/ Expertise in agronomy, credit and marketing, pest control, and on-farm irrigation.
d/ See Detailed Budget Sheet.
e/ Represents A.I.D.'s portion of operating expenses to be shared with GRM as detailed on preceding page.

DETAILED BUDGET ANALYSIS: II. PARTICIPANT TRAINING

(U.S. $000's)

	Total # Person Months	Cost/pm	(000's) Total cost		OBLIGATIONS FY 79	FY 80	FY 81	FY82	Total
U.S.									
U.S. Academic									
Ag. Ext. Education (1 participant)	18	$1,666/pm	30		18	12			
Ag. Credit & Marketing (2 participants	36		60		18	30	12		
Ag. Econ/Agribusiness (1 participant)	18		30	120	18	12			
U.S. Non-Acad.									
On-farm Water Mgmt. (2 participants)	3	$2,000/pm	6			6			
Mid-west Observational (2 participants)	3		6	12	6				
In-Country									
Long Term									
Diesel Mechanics (8 participants)	240	$ 150/pm	36	36	12	12	12		

	Total # Person Months	Cost/pm	(000's) Total cost		OBLIGATIONS FY 79	FY 80	FY 81	FY 82	Total
Short Term									
Accounting (3 participants)	21	$ 570/pm	12		8	4			
Bus. Administration (1 participant)	6	$ 666/pm	4		4				
Health (24 participants)	12		1	17	1				
Third Country									
Long Term									
None									
Short Term									
Research Farm Mgmt. (1 participant) (Mexico & CIMMYT)	7	$1,200/pm	8,400		8,400				
Agronomic Production (2 participants)	14	$1,200/pm	16,800		8,400	8,400			
Observational Tour (4 participants)	6	$2,500/pm	15,000				15		
	385pm		225,200	402	$101,800	84.4	39	0	

DETAILED BUDGET ANALYSIS: III. COMMODITIES

	Quantity	Unit Price	Cost	OBLIGATIONS (000s U.S.) FY 79	FY 80	FY 81	FY 82
Vehicles			$ 132,000	$132,000			
Boat w/motor	2	2,500	5,000	5			
Light Vehicle (passenger)	1	10,000	10,000	10			
Truck (10-ton)	1	45,000	45,000	45			
4-Wheel Vehicle	4	15,000	60,000	60			
Mobilettes	24	500	12,000	12			
Pumps[a/]			$1,320,000	$ 387	$466,500	$466,500	
4-HP Diesel Pumps[b/]	500	2,260	1,130,000	339	395,500	395,500	
Flow Pumps (pilot)[c/]	5	6,000	30,000	30			
Flow Pumps	100	1,000	100,000		50	50	
Fuel Barrels (4/pump)	2,000	30	60,000	18	21	21	
Generators							
Small, Gasoline Powered Emergency Use	2	1,000	2,000	2,000			
Repair Shop Equipment[d/]			23,440	23,400			
Maintenance Crew							
Tool Kits[e/]	10	150	1,500	1,500			
Office Equipment[f/]			8,860	8,860			
TOTAL			$1,487,800	$554,800	$466,500	$466,500	

a/ Pumps will be extended on strict credit terms. They are not included in the revolving credit fund which detail short-term credit requirements only.
b/ With suction pipes, delivery pipes, spare parts kits, delivered Dire.
c/ Includes air freight shipment and technical assistance installation.
d/ See detailed Equipment List page 40 .
e/ Includes two extra kits.
f/ See Office Equipment List page 39 .

DETAILED BUDGET ANALYSIS: COMMODITIES

	Quantity	Unit Price	Total
OFFICE EQUIPMENT			
1. Duplicating Machine	1	2,000	2,000
2. Typewriters	4	500	2,000
3. Desks (metal)	5	130	650
4. Tables	6	75	450
5. Chairs	30	20	600
6. Safes	4	490	1,960
7. Filing Cabinets (metal)	6	100	600
8. Calculators (desk top, battery operated)	6	100	600
TOTAL			8,860

REPAIR SHOP EQUIPMENT LIST

Description	Quantity	Unit Price	Cost
1. Metal Lathe, 3/4 HP motor, 115/230 volt with misc. bits	1	4,500	4,500
2. Drill Press (15", variable speed, bench model)	1	1,800	1,800
3. Hvy. Duty Bench Grinder (w/8" alum oxide wheels)	1	450	450
4. Eletrical Generator (7 KW)	1	2,500	2,500
5. Arc Welder (295 AMP AC dual range)	1	350	350
Rods, fluxes, etc.			300
6. Oxyacetylene Welder (2 stage regulator)	1	450	450
7. Rods, Tanks, Cylinder Holders and Gas			400
8. Gas-fired Shop Forge	1	650	650
9. Work-benches	2	200	400
10. Tool Chests	2	160	320
11. Shallow Drawer Small Parts Drawer	3	100	300
12. Tool Cart and Cabinet 635 pc. set (Sears)	1	2,500	2,500
13 Hand Truck	1	200	200
14. Pipe Cutters, Threaders, and Fitting Equipment	1	800	800
15. Metal Shears (Bench Model)	1	400	400
16. Large, Circular Vise	2	50	100
17. Swivel-base Utility Vise	2	90	180
18. Flange Spreader	1	350	350
19. Flange Jacks	1 pair	200	200
20. Manual, Stone Grinder	1	75	75
21. Wire-wheel Brushes (8" asst'd)	40	20	800

	Quantity	Unit Price	Cost
22. Aluminum Welding Clamps	4	95	380
23. Hand Tools			
A. Pliers	Asst.		175
B. Screwdrivers	2 sets	50	100
C. Files/Rasps	100	3	300
D. Hammers	Asst.		200
E. Adjustable wrenches (4"-16")	2	60	120
24. Tap & Die Set (STD & Metric)	1	200	200
25. Asst. Sheet Metal Stakes			400
26. Spark Proof Drum Wrench	3	30	90
27. Anvil (Wrought-iron, 100 lbs)	1	350	350
28. Block & Tackle	1	150	150
29. Lubricant Dispenser & Lubricants	1	250	250
30. Work Gloves, Hoods, Goggles, & Other Safety Equipment			200
31. Misc. Supplies (Sheet metal, pipes, etc)			2,500
			23,440

DETAILED BUDGET ANALYSIS: IV. OTHER COSTS CONSTRUCTION

	Quantity	Unit Price	Total	OBLIGATION FY 79
1. Staff Housing (including water & electrical connections)	2	15,000	30,000	
2. Pump Repair Shop (including water & electrical connections)	1	20,000	20,000	
3. Cement Floors for Temporary Grain Shortage	12	1,000	12,000	
4. Roofing Material, Doors & Windows for 8 Extension Offices, 8 extensionists Lodgings and 8 Village Level Input Warehouses	24	1,500	36,000	
Total			98,000	98,000
				OBLIGATION FY 80
5. Grain Storage facility	1	250,000	250,000	$ 250,000

DETAILED BUDGET ANALYSIS: OTHER COSTS

ACTION RESEARCH AND EVALUATION[1]

Activity Areas	Total	By Component	FY 79 US - GRM	FY 80 US - GRM	FY 81 US - GRM	FY 82 US - GRM
Environmental	22				12	
A. Windbreaks & Reforestation		12				
B. Triple Cropping & Crop Rotation		10				10
Social						
Malian Sociologist Support	16		4	4	4	4
Agronomic						
A. On-Farm Testing	28					
1. Varieties		7			7	
2. Fertilizer		7			7	
B. Crop Protection						
1. Bird Control		7		7		
2. On-Farm Storage		7				7
Economics	30					
A. Base Line Data for Evaluation		15	15			
B. Market and Pricing		15		15		
Appropriate Technology	45					
A. Animal Traction		15			15	
B. Small Farm Implements[2]		20		20		
C. Other		10			10	
Women in Development[3]	25				25	
	166		19	46	80	21

1. See detailed description.
2. Foot treadle threshers.
3. Gasoline powered grain mills.

DETAILED BUDGET ANALYSIS: IV OTHER COSTS

REVOLVING CREDIT FUND

	QUANTITY	UNIT PRICE	TOTAL	FY 1979	FY 1980	FY 1981	FY 1982
A. Diesel Fuel (1 year supply)	800 liters/pump	$ .36/liter	$ 424,800	$ 43,200	$ 93,600	$144,000	$144,000
B. Lubricants	25 liters/pump	$1.20/liter	44,250	4,500	9,750	15,000	15,000
C. Certified Wheat Seeds	100 kg/ha	$ .34/kilo	82,300	21,100	30,600	30,600	--
D. Fertilizers[1/]			221,000	11,000	37,000	75,000	98,000
E. Wheel barrows	605	$60.00	36,300	9,300	13,500	13,500	--
F. Hand Tools (picks, shovels, sickles)	2,420	$40.00	96,800	24,800	36,000	36,000	--
G. Wheel Assemblies (for donkey carts)	150	$150.00	22,500	5,700	8,400	8,400	--
H. Storage Sacks	1 bag/50 kg		225,600	48,000	56,000	56,000	65,600
			$1,153,550	$167,600	$284,850	$378,500	$322,600
TOTAL CREDIT REQUIREMENTS			$1,153,550	$167,600	$284,850	$378,500	$322,600
NET CREDIT REQUIREMENTS[2/]			$ 378,500	$167,600	$117,250	$ 93,650	--

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1/ Includes wheat and sorghum needs.
See Credit Fund Requirements for Fertilizer.

2/ Assumes 100% repayment. Interest rate of 8% p.a., principal and interest earnings from pump loans will assure viability of revolving fund through 1987.

CREDIT FUND REQUIREMENTS-FERTILIZER

YEAR	HECTARES PLANTED	TOTAL FERTILIZER COST (000's MF)
Year 1 (600 total ha)	*600 ha at 9,185 MF	5,511
Year 2 (1,300 total ha)	600 ha at 18,955	11,370
	*700 ha at 9,185	6,426
Year 3 (2,000 total ha)	600 ha at 21,650	12,990
	700 ha at 18,955	13,269
	*700 ha at 9,185	6,426
Year 4 (2,420 total ha)	600 ha at 29,815	17,889
	700 ha at 21,650	15,155
	700 ha at 18,955	13,269
	*420 ha at 9,185	3,858
	Total fertilizer cost for 4 years =	106,163

(* newly introduced into production that year)

DETAILED BUDGET ANALYSIS: IV OTHER COSTS

OPERATING EXPENSES

	TOTAL	OBLIGATIONS FY 79	FY 80	FY 81	FY 82
A. OFFICE EXPENSES (Office supplies, communications, fuel for generators)	$ 25,000	$ 4,000	$ 7,000	$ 7,000	$ 7,000
B. EXTENSION EXPENSES (Field days, materials, training)	14,000	2,000	4,000	4,000	4,000
C. VEHICLE OPERATION					
4 wheel drive vehicle, 3, 17,500 km/year at $.22/km ($.36/mile)	48,000	12,000	12,000	12,000	12,000
Light vehicle, 1, 17,500 km/year at $.11/km ($.18/mile)	11,450	2,000	3,150	3,150	3,150
Truck, 10 ton, 1, 15,000 km/year at $.44/km ($.72/mile)	22,800	3,000	6,600	6,600	6,600
Mobilettes					
Motor boat fuel and oil	1,800	300	500	500	500
D. SPECIAL ALLOWANCES FOR GRM PERSONNEL	72,720	18,180	18,180	18,180	18,180
	$195,770	$ 41,480	$ 51,430	$ 51,430	$ 51,430
AID Portion of Operating Expenses	$108,339	$ 41,480	$ 41,144	$ 25,715	—

RECURRENT BUDGET ANALYSIS

	Number of Personnel	Annual GRM Costs	Annual AID Supplements
Director	1	2,160	960
Section Chiefs	6	10,080	4,320
Sector Chiefs	3	3,600	2,160
Mechanics	8	9,600	2,880
Research Asst.	1	1,200	360
Credit & Marketing Asst.	1	1,200	360
Supply Mgr., Budget & Accounting	3	3,240	1,080
Extension Agents (*moniteurs*)	12	11,520	2,880
Asst. Extension Agents (*encadreurs*)	12	8,640	2,220
Secretaries	2	1,440	240
Chauffeurs	2	1,200	240
Laborers and Guards	4	2,400	480
TOTAL	55		
TOTAL ANNUAL COSTS		56,280	18,180
Life of Project Costs		225,120	72,720

ACTION RESEARCH AND EVALUATION

The introduction of new technology on a wide scale in a discrete geographic area offers the unique oportunity to conduct action research. Many of the planned interventions in this project will hopefully have significant and lasting effects on crop production patterns such as rotational irrigation, relay cropping, etc., price policies, the environment, women in development, or appropriate technology. The Research and Evaluation component of this project will provide modest research funds to GRM research organizations to assist them design, implement, and document research activities which demonstrate applicability in the Action Blé project. The purpose will be to initiate research on several questions which were raised during the process of the PP on-site visit, ie., (i) trees most suitable for windbreaks; (ii) advisability of windbreaks; (iii) legumes most easily adapted and adopted in the Diré area; (iv) animal traction economics; (v) suitability of small-farm machinery; and (vi) potential uses of solar powered irrigation units.

A.R.E. funds will be disbursed by the Director of the Project only after appropriate review of the research design by the AID project manager and the GRM's Institut d'Economie Rurale, and upon their written approval of the research itself.

detailed sociological analysis is contained in Annex XI. A summary of major observations and conclusions in that annex are presented here.

1. The immediate project goal of expanding the production of wheat and other grains in the Diré area to satisfy the needs of the region and ultimately to reduce national dependence on the importation of wheat flour is technically reasonable because of climatic and soil conditions and the permanent availability of water.

2. At the same time it should prove feasible because there is a tradition of wheat cultivation under irrigation in the region and the people are eager for the kind of assistance proposed. Furthermore, the organization of the project on the basis of production units limited to four hectares promises to encourage individual concern and initiative while avoiding the problems of management, heavy capital investments, proletarianization of labor, and unequal distribution of benefits that are the usual consequences of large-scale irrigation projects.

3. The project should also result in important nutritional and economic benefits to a region that has a serious food shortage and depends almost entirely on the sale of wheat for its cash income.

4. The population of the area concerned is dense, entirely rural, and homogeneous in that it belongs almost exclusively to a single ethnic group, the Sonrai, whose villages are moreover linked to each other by a common heritage and ties of kinship.

The society is marked by a hierarcny of five classes (rich, upper, middle, lower middle, and slave) and five cast groups. The three first classes constitute the nobility, who have traditionally controlled land and political power. The emancipation of the slaves and attempts at land reform under the French and since independence have modified the traditional structure to a certain extent, but tradition remains strong.

The villages are governed by hereditary chiefs and elected councils of notables. Villages may also be divided into wards or quarters from which the councillors are chosen. People are further distributed into numerous age groups, each with its own chief, and extended, patriarchial families, which latter form the basic economic and social units of the society.

Subsistence is almost entirely based on agriculture. Most fields are said to be owner-cultivated, but sharecropping, rental, and wage labor also occur.

The area is further characterized by a low degree of literacy and poor health conditions (schistosomiasis, malaria, dysentery, tuberculosis, leprosy, and malnutrition are endemic).

5. The <u>impact</u> of the project on the <u>physical environment</u> should derive primarily from the increased human and animal population pressures on the land that would result from a rise in food production and economic welfare, rather than from the agronomic interventions themselves.

The <u>impact</u> on the <u>social environment</u> could be varied: (i) increase in general economic welfare; (ii) more even distribution of land and income; (iii) changing patterns of political control; (iv) a change in

the material basis of extended families; (v) increased commerce; and (vi) improved health of the population.

6. The ultimate goal of the project should be to create what has been termed a "sustained yield tropical agroecosystem" capable of maintaining the population of the region in good health at a reasonable standard of living without deterioration of the physical environment.

7. The project should be socially sound on the basis of the following operational conditions and recommendations:

a. Fair minimum prices for grains should be established.

b. The producers should pay the real costs of inputs and credit.

c. The credit agreements signed with participating farmers should clearly specify the repayment conditions, guarantee mutual responsibility within the group organized around each pump, and provide tenure security.

d. There should be some form of insurance against disasters or crop failures beyond the producers' control during the life of the project.

e. Necessary materials and mechanical services must be available in advance.

f. Close cooperation between research and extension activities is essential.

g. Close cooperation and mutual trust must obtain between the villages and Action Blé. Agreement on land allocation would be crucial. A functional literacy program would be helpful in improving communication.

h. The project must be implemented at a slow enough pace to avoid supply problems or drastic price fluctuations and to allow flexibility to profit from experience and to adapt to change or resistance to change.

i. The presence of social anthropologists throughout the life of the project will be necessary to ensure adequate knowledge of social reactions to the project and of the changes it provokes as a basis for developing the "sustained yield tropical agro-ecosystem" referred to above.

j. The precise role of women is difficult to determine in this Muslim culture. Recommendations for their participation in this program are presented in Annex XII.

Introduction:

Wheat has been grown in the Diré area for many centuries. The climate and soil conditions are ideal and a ready, nearby market exists at remunerative prices. This project plans to expand the area under cultivation through the introduction of small diesel pumps, owned and operated by farmers cultivating four hectare production "modules". Full farm services (extension, credit and marketing assistance) are planned to increase farm family income on a 2,420 hectare strip of land along the Niger river.

At present, approximately 150 hectares of wheat are being grown, of which less than 50 hectares are irrigated by mechanical means. Yield is estimated at 2.5 tons/hectare. All wheat is marketed and consumed locally (much of it marketed by merchants in Timbuktu). Local demand through increased availability and lower prices is expected to rise to 1000 tons annually.

This section highlights observations and conclusions reached about the economic viability of wheat and sorghum production in the Diré area. It is the opinion of the PP team that the project is very viable for many reasons. Benefits of this project which can be quantified have been included in the internal economic return calculation on page 74 . Other benefits not used in the calculation are described in the following pages.

Summary of Project Benefits:

Upon termination of AID financing of this project it is anticipated that:

(i) the value of cereals produced will be more than 2 million dollars annually;

(ii) The regional grain deficit will be reduced by 17-20% (3,500 tons of sorghum and 700 tons of wheat);

(iii) wheat produced in the Diré area and milled in Bamako will save about 1.8 million dollars annually in foreign exchange (5,300 MT x $346 CIF Mali border);

(iv) employment opportunities will increase and will support approximately 20,000 people (1/5th of the population of the Cercle of Diré);

(v) net annual farm income will rise by 92%; and

(vi) new technology introduced through Action Blé will make significant contributions to improve farm productivity.

Observations and Recommendations:

1. At the official price, irrigated agriculture (mechanical pumping and distribution of water) is not economical; cash costs cannot be covered at the government price of 62 MF/kilo for wheat and 36 MF/kilo for sorghum.

2. The grain deficit in the sixth Region is sizable and will continue well after the termination of AID financing of this project.

3. The combined grain deficits (sixth and seventh Regions) will prevent sudden or dramatic downward shifts in producer prices assuming free market prices prevail.

4. It is strongly recommended that an agreement be signed between AID and the GRM guaranteeing that:

(i) no quota system or other official price interventions be applied for sorghum and wheat produced in the project area;

(ii) a flour mill will be built in or around Bamako;

(iii) a production levy on wheat produced in the project area be extracted to finance operating costs and other expenses of Action Blé.

5. It is highly recommended that official marketing practices for sorghum be discouraged.

Comparative Wheat Prices:

The official price to the wheat grower of 62,000 MF/MT ($124) is unrealistically low in comparison to both world prices and existing Diré prices. SOMIEX statistics show that in early 1978 the price of wheat flour from France and the USSR delivered to Bamako was over 50% higher ($188/MT). As for Diré prices, wheat prices are normally 50-60% higher than other grains, and even though they fluctuate widely during the season, they are consistently and significantly above the officially stated price. For example, the price in the Diré market on February 23, 1978 was 200 MF/kg -- $400/MT!

National Wheat and Wheat Flour Marketing

At present, there is no export to Bamako of Diré-grown wheat. Flour is imported by SOMIEX[1/], the government owned enterprise, and a private merchant who produces biscuits and macaroni products. In 1977, flour imports were on the order of 22,000 tons, half coming from France and the rest from the Soviet Union. Thus, a major project benefit will be in terms of reducing Mali's wheat imports, which are far in excess of the 6,000 tons expected from the project.

1/ SOMIEX - Société Malienne d'Imports et Exports. The SOMIEX mark-up is 30%, i.e. 1 kilo retails for 233 MF.

Wheat Flour Imports

Year	Volume (tons)
1972	9,188
1973	23,977
1974	27,027
1975	17,000
1976	(Data not available)
1977	22,000

Source: Banque Centrale du Mali to 1975; 1977 figure from SOMIEX and private importer.

The average import price (CIF Bamako) was 180 MF/kg, for a total value of 3.96 billion MF; this is equivalent to $360/ton or $7.9 million for 1977 alone.

Trade Deficits

Trade deficits are chronic as the following table shows (in billion Mali francs):

	1972	1973	1974	1975
Exports +	33.4	34.2	41.2	41.8
Imports -	42.0	58.0	89.1	82.0
Trade Balance	-8.6	-23.8	-47.9	-40.2

Source: Banque Centrale du Mali, reported in International Monetary Fund Staff report 1/77.

During 1976, Mali's imports and exports of merchandise amounted to 96.0 billion MF and 58.2 billion MF respectively, for a deficit of 35.8 billion MF. Imports of wheat flour represented slightly more than 4% of all these imports and 11% of the resulting deficit.

The 6,000 tons of wheat to be produced by the project, of which about 5,300 tons will be exported from the Sixth Region, will reduce wheat imports by about 24% calculated at existing levels. This amount will save the GRM approximately $1.8 million in precious foreign exchange.

Increased Wheat Consumption

Mali's principal private importer of wheat flour expressed great confidence concerning increased flour consumption in Mali. Statistics of the FAO support this confidence. FAO estimates and projections of food requirments in Mali indicate that the 22,000 MT wheat flour imports will increase to 25,000 MT in 1980; 30,000MT in 1985; and 36,000 MT in 1990.[4/]

There are several reasons for this increase in flour consumption;

(i) Increased migration to larger cities and urban centers where flour and bakery products are readily available;

[4/] FAO, "Prospective Study for Agricultural Developments in Countries of the Sahelian Zone (1975-1990)", Rome, 1976

(ii) Living standards in Mali are improving and increases in purchasing power are influencing a higher consumption of these products; and

(iii) Comsumption habits of Malians are changing as the pace of life in the urban areas increases. More and more Malians prefer bread, biscuits and macaroni to cornmeal, sorghum or millet, since wheat flour products are faster and more efficient to prepare and serve.

Thus, in the face of growing consumer demand for flour and a favorable agricultural/pricing climate for wheat production, there is every reason to be optimistic about the success of a well-planned, well-organized irrigated wheat production project in Diré.

Cereal Deficits

A second major benefit coming from local increases in sorghum production will be to reduce somewhat the serious cereal deficit in the Sixth and Seventh Regions. The following table o population and consumption figures illustrate the magnitude of this deficit.

	Region (Population)	Consumption[1]	Production[2]	OPAM[3]	Merchants[4]
1.	Diré (100,000)	14,000	10,000	1,500	2,500
2.	Rest of VI Region (260,000)	36,000	15,000	4,750	16,250
3.	VII Region (340,000)	47,500	16,000	10,000	21,500

The production/consumption figures in the above table represent the best available estimates of the grain situation in the VI and VII Regions. The table suggests that production in both regions combined accounts for only about 42% of their estimated grain consumption. OPAM normally imports about 17% of the required grain.

If the figures are accurate, Diré is not far from reaching self-sufficiency in cereals. The output of the project will permit Diré farmers to continue but increase the volume of their exports to Timbuktu and Rharous where grain deficits are serious. The net effect of this strong demand in nearby urban centers will support the existing sorghum prices.

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[1] 140 Kg/person (nomad population brings down the FAO nation-wide estimate by about 40 Kg).

[2] This is an estimate of production in normal years, such as 1975-76. This includes perhaps 10-15% in the secondary grains (cram-cram, fonio, and nunyfar); most of which grow wild but which are seen on the local markets in significant quantities.

[3] This represents OPAM grain imports into the area in a normal year. In 1977, for instance, the quantities were down 50-70%. Source: OPAM Statistics in Timbuktu and Gao.

[4] This represents grain brought into the area by merchants; the mode of transportation is both small boats (pirogues) and trucks, and most comes from the V Region, a surplus grain production area. These estimates are based upon what remains for consumption needs after subtracting local production and OPAM imports.

COST OF IMPORTED GRAIN

The 3,500 tons of sorghum to be produced by this project will contribute to reducing the cereal deficit and costs associated with importing grain from the Vth Region (Mopti area). Regional consumers ultimately pay for high shipping and handling costs (approximately $20/MT). Thus another benefit of this project will be the 3,500 tons locally produced which will not have to be imported...a savings of about $73,000 annually ($20.00 x 3,600 MT).

The United States, too, is a major beneficiary. The table below, composed from AID/Bamako's cable file, shows that the cost of shipping 10,000 tons to Mali this year for emergency relief (over half of which is going to the VI-VII Regions) is approximately $3,500,000 or $3,325,000 for the 9,500 tons wheat/sorghum to be produced by this project - this is grain that would not have had to be shipped to Mali this year had this irrigated project been in operation:

4,000 tons corn	$ 440,000 FOB
6,000 tons sorghum	$ 618,000 FOB
Ocean Freight (10,000 tons)	$1,000,000
Inland Freight Dakar/Abidjan ports to Bamako and to interior centers	$1,500,000
TOTAL	$3,558,000

MARKETING IN THE VI REGION

Most of the cereals grown in the sixth region are not marketed. Nationwide, only about 15% of grains produced are marketed, and this estimate is reduced by half in the sixth region in view of the large deficit which exists. It is estimated, therefore, that less than 2,000 tons of cereals marketed in all of the sixth region are produced locally.

The official cereal purchasing agency in Mali is the Office des Produits Agricole Malienne (OPAM) which is a state enterprise with a monopoly on domestic cereals marketing at all levels (including sales to consumers). To date OPAM has dealt only with millet, sorghum and rice. It was not until 1976 that OPAM announced its first official price for wheat. In 1977, it was raised from 55 MF/kg to 62 MF/kg. OPAM has yet to buy its first grain of wheat, and, in general, does not purchase in the VI Region since it is very much a grain deficit area.

The problem with the marketing of grains through OPAM is less of marketing efficiency (though this plays an important part in areas where grain transportation costs are significant) than one of official pricing and "quotas". OPAM is generally ill-equipped to transport grain the required distances between production sites and consumer markets. Government pressure to purchase grain at low prices for retail in the Bamako market is often blamed for the quota system.

WHEAT MARKETING

OPAM is the only officially recognized grain dealer. It is clear, however, that unassisted, with the existing market, OPAM will not be able to purchase much grain of any kind. First, OPAM has been solely an importer of grain into the region and is administratively under-staffed to purchase cereal. Secondly, they will not purchase much grain since parallel market prices are much higher than OPAM can pay.(It is anticipated, for example, that sorghum prices will hit 200MF/kg in July of 1978; OPAM offers the official price of 36 MF/kg.) With a high-priced commodity such as wheat, with only one major future outlet (the flour mill to be established in Bamako), it is felt that free market forces will maintain wheat at a level suitable to sustain existing production incentives.

SORGHUM MARKETING

Theoretically, an increase in production equal to 15% of annual production in the 6th Region would exert a mild, but downward pressure on prices. However, in this region, and especially with

sorghum, prices are unlikely to fall significantly or soon due to strong consumer demand throughout the 6th region. As shown on page 60, the present grain deficit is estimated at 25,000 tons. An increase in production of 3,500 is not significant in terms of price pressure since so little of the local production is actually marketed. Diré traditionally supplies Timbuktu and Rharous with millet and sorghum. Cereal production in Timbuktu is expected to increase only slightly and in Rharous not at all, and the demand will remain constant. Additionally, any production not consumed in the 6th region would naturally "flow" to the 7th at almost equal prices since it is cheaper to ship grain from Diré than from Mopti. The more immediate effect of the production increases will be to reduce imports from the fifth region.

The fact that the grain deficit is so large as to block a major downward movement in sorghum prices has an additional side benefit: farmers outside the irrigated project area are not likely to suffer significantly from falling prices and may, since they purchase grain annually, benefit from reduced prices.

OTHER BENEFITS

EMPLOYMENT

Employment benefits as a result of this project will be significant. This is a project where almost 2,400 hectares of new land are being opened to cultivation. With a ratio of one farmer per hectare, employment opportunities will be opened up to about 2,400 persons.

This contribution to employment is extremely important to the VI Region because, as stated in the Mali Agricultural Sector Assessment (p. 21), there are certain zones in Mali "where land is the limiting factor and a major constraint to increasing agricultural production. There is not enough cultivable land for the existing population, resulting in under-employment and unemployment in the region. These zones are Lacustre and the VI Region". Assuming 8-9 persons per farm family, 20,000 persons in the VI Region will have a new land base for being supported by agriculture.

APPROPRIATE TECHNOLOGY

Finally, in view of the fact that the project calls for the installation of many oxen driven pumps and the testing of other small farm equipment, it is quite possible that their viability will become so evident that many farmers outside the project will obtain them as well. If so, the benefits of the project to farmers outside the project could ultimately be very great indeed.

OTHER CONSIDERATIONS

AGRICULTURAL CREDIT

There is no formal credit system, as such, available to farmers in the area for crop production items. The few loans that do take place are furnished by either the village chief and his brother who also owns a store, or by the grain merchants in Diré who will

sell salt, sugar, spices, etc., and cloth to be repaid with grain delivered at harvest.

SCAER is not operating in the area, although according to its Director it plans to open one store in Diré and one in Goundam this year. However, while SCAER is the state agency with a quasi-monopoly on distribution of farm implements, fertilizer and pesticides, and provides in-kind, short-term production credit of one year and medium-term credit for tools, repairs, equipment, etc., it evidently has not been a great success to date in reaching a large number of independent farmers. According to reports on their operations, the following are some major shortcomings:

1. To date some 90 percent of loans have been through the "Operations" and, although it reportedly has 30 other stores over the country, the activities there are limited.
2. The evident inability of SCAER to deliver inputs (fertilizer, etc.) on time: there are reports of up to 10-14 months delay in delivery of crop production items.
3. Delivery of damaged goods, wet fertilizer and torn bags, etc.
4. Shortages on the quantity ordered and promised.
5. Transportation problems - inability to move supplies to the villages.
6. Serious financial difficulties, with a reported deficit of 600 million MF in 1975. The income from interest is negligible - they pay 7.5% interest on borrowed capital from

the Central Bank and try to operate on a 3.5 % gross margin, which is not sufficient.

In view of the above it is suggested that the Action Ble project provide for credit to participating farmers and arrange for purchase, delivery and insurance.

CREDIT

Two types of agricultural credit are programmed for this project. Short term production credit of up to one year will be extended, in kind, for seeds, fertilizers, fuel and small farm implements. Medium term credit will be extended, also in kind, for a period of up to five years to cover small diesel pumps and larger agricultural implements (threshers, plows, etc). Farm plans and budgets for short term credit will be developed by the extension agent with each farmer. The budget will specify the quantity and timing of the application of all recommended inputs as well as repayment responsibilities. Credit for pumps and larger implements will be extended along similar lines with each farmer signing a billet a ordres specifying joint and several liability for the executed note. Applications for credit will be reviewed and approved by the village commission des paysans who will help assure that the terms of the agreements are respected. Credit terms will include an interest rate of 8% per annum, with payments due upon harvest. Farmers will deliver their grain to the nearest of 8 village extension offices. The value of their outstanding credit will be determined and the balance will be paid to them in cash. Farmers will also have the option of repaying in cash.

Loan delivery costs in small farmer credit programs in other countries have often been high. This has not been the case in Mali. In the Action Ble project, local village groups will act as screening committees and loan supervisors. Farm plans and budgets, as mentioned above, will be developed by extension agents as part of their job. The

area to be covered by the project is small, facilitating loan supervision.

Loans will be non-collateralized to permit full access by all area farmers to Action Ble's production credit. Small downpayments, however, will be used to the maximum extent possible and will be waivered only upon a solid justification. Loans will be co-signed and all signers will assume responsibility for loan repayment.

Repayment problems will be minimized since most of the wheat will be marketed through or with the assistance of Action Ble. Farmers will rely on Action Ble for agricultural inputs and are thus expected to maintain current accounts.

An 8% interest rate is considered slightly subsidized, but this is the maximum interest rate acceptable at this time to the GRM for small farmer credit. Farmers will pay the full price of inputs and farm implements under the proposed credit program.

Loan default is not anticipated to be a major concern due to the highly profitable nature of irrigated wheat production and peer pressure to repay.

Principal and interest payments for short and medium term credit will be placed in special interest earning accounts to assure availability of funding for continuation of the credit program.

STORAGE CAPACITY

Since the wheat harvest is in February-March and river transportation does not begin operation until August-September, for wheat not sold at harvest at least six months storage will be required. Finding adequate storage in the area does not appear to be an immediate or pressing problem. OPAM has just completed a new 2,000 ton security stock warehouse which, in addition to an older 4,000 ton warehouse, gives it a total capcity of 6,000 tons in Dire. (OPAM also owns a 3,000 ton facility in Goundam, and two new 1,200 ton security warehouses in Timbuctu.) In addition to these facilities, private merchants in the area can store an estimated minimum of 500-600 tons of grain in their stores.

It is anticipated that during the initial stages of the project, Action Ble will store the wheat in OPAM's facilities in Dire. If the GRM does, in fact, begin to fill the warehouses with security grain stocks and the volume of production in the project area increases beyond the available OPAM storage space, Action Ble will have to give serious consideration to constructing its own wheat storage facilities because storage rental costs are high. OPAM statistics show that a typical 200 tons storage facility costs OPAM about 75,000 MF ($150) per month. The cost of storing grain in rented warehouses in Bamako averages about the same —— 375 MF per ton per month, with an average storage-time being five months.

Construction estimates for warehouse facilities are based upon the figures supplied in the Senegal Grain Storage project with adjustments for Diré conditions. Four warehouses with a combined storage capacity of 2,000 metric tons (each 30'X60'X15') can be constructed in Diré for approximately $ 250,000. This sum has been included in the budget to assure that funds are available for construction of these facilities, as needed, to augment existing OPAM and private storage. Prior to the obligation of funds for this purpose, preliminary plans and cost estimates will be prepared and reviewed in compliance with Section 611(a), if it is determined that storage facilities will actually be needed. A decision will be made in project year 2.

IMPACT ON FARMERS OUTSIDE THE PROJECT

A major economic factor to be considered is the effect of increased production on farmers who are not participating in the project. Normally, in a project located in an area where only certain farmers will benefit, there exists the potentially serious problem of falling prices which adversely effect other farmers. The situation in Diré is different for several principal reasons: (i) an estimated 57% of the project produce (5,350 tons wheat) will never enter the local (Sixth region) market; (ii) the high cereal deficits in the VI/VII Regions (about 55-60,000 tons) will not be reduced significantly by the estimated 3,500 tons sorghum and 700 tons wheat entering the market; hence consumer demand will continue to be very strong and effectively prevent prices from falling significantly in Diré; and (iii) possibly most important of all, very few of the farmers in the VI Region are presently producing a surplus, and, hence, low farm prices are not a big concern. It is estimated that less than 1,000 tons of grain produced in the cercle of Diré is marketed. Indeed, because so many farmers in the VI/VII Regions fail to produce enough to even meet their family needs, farmers there appear to be more concerned about prices becoming too high than vice versa -- because they buy much more grain than they sell. A slight drop in sorghum prices would probably benefit the farmers outside the project more than harm them. For those farmers in the project area they will become concerned about falling market prices only to the extent that they market their grain.

ECONOMIC RETURNS

Calculations in this section are based upon projections from the aggregation of individual farm units producing wheat and sorghum at 135 MF/Kilo for wheat and 60 MF/Kilo for sorghum. The choice of the wheat price is based upon the world market price which is felt to be a truer measure of the value of wheat production than the prevailing domestic price. Both the wheat and sorghum prices are felt to be conservative farm gate prices. A sensitivity analysis of the wheat price was performed and indicated a viable internal economic returns even at a price of 100 MF/Kg[1].

(See Table III, p75)

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1. (90 MF to producer, 10 MF to Action Blé)

INTERNAL ECONOMIC RETURN

I. Benefits

A. Crop Production

1980	620 ha. wheat x 2.5 x $ .27/Kg[1]	= $418,500	1980
	620 ha. sorghum x 1.5 x $ .12/Kg	= $111,600	
		$530,100	
1981	1520 ha. wheat x 2.5 x $.27/Kg =	1,026,000	
	1520 ha. sorghum x 1.5 x $.12/Kg =	273,600	1981
		$1,299,600	
1982	2420 ha. wheat x 2.5 x $.27/Kg =	1,633,500	
	2420 ha. sorghum x 1.5 x $.12/Kg =	435,600	
		$2,069,100	1982
1983	Identical calculations	$2,069,100	1983
1984	Identical calculations	$2,069,100	1984

B. Miscellaneous Benefits

1. Total transportation savings on grains (sorghum) shipped from the V Region at estimated $20./ton.

   1980 18,600

   1981 45,600

   1982 72,600

   1983 72,600

   1984 72,600

2. Total salvage value [2] as final year.

   Benefit $316,900

1. $.25 to farmer and $.02 to Action Ble
2. Salvage value calculations based upon useful pump life of 5 year for diesels and 15 years for flow pumps

II. Costs[3]

A. USAID Costs excluding Credit Fund.

1979	$1,037,766
1980	879,010
1981	843,332
1982	163,932
1983	0

B. Revolving Credit Fund[4]

1979	$201,120
1980	341,820
1981	454,200
1982	387,120
1983	0

C. GRM Costs

1979	$ 56,300
1980	56,300
1981	56,300
1982	56,300
1983	132,000[5]
1984	132,000

3. All costs include contingency.
4. Full value of inputs not net credit needs.
5. Assuming GRM picks up special allowances or increases salaries.

D. FAC Costs[6]

1981	$100,000
1982	100,000
1983	100,000
1984	100,000

6. Proposed technical assistance at estimated $100,000/year for 4 years.
The full cost of technical assistance has been charged as a project cost although in practice only 30-40% of these costs should be so allocated.

Table .I..

SUMMARY OF BENEFITS/COSTS

	Total Benefits	Total Costs
1979	0	1,295,266
1980	548,700	1,277,130
1981	1,345,460	1,453,832
1982	2,141,700	707,352
1983	2,141,700	232,000
1984	2,458,600	232,000

Table .II..

COMPARING GROSS BENEFITS TO GROSS COSTS

Year	Gross Costs	D.F.=12%	Present Worth	Gross Benefits	D.F.=12%	Present Worth
1979	1,295	.893	1156	0		0
1980	1,277	.797	1018	549		438
1981	1,454	.712	1035	1,345		958
1982	707	.636	450	2,142		1,362
1983	232	.567	132	2,142		1,215
1984	232	.507	118	2,459		1,247
Total	5,197	4.112	2,869	8,137		5,220

$$\text{Benefit cost Ratio @ 12\%} = \frac{5,220}{2,869} = 1.8$$

Net present worth @ 12% = $2,351

Table III.

COMPUTATION OF INTERNAL ECONOMIC RETURN

Year	Gross Costs	Gross Benefits	Discounted Costs	Discounted Benefits	D.F. at 30%
1979	1,295	0	996	0	.769
1980	1,277	549	756	325	.592
1981	1,454	1,345	662	612	.455
1982	707	2,142	247	749	.350
1983	232	2,142	62	576	.269
1984	232	2,459	48	509	.207
	5,197	8,137	2,771	2,771	2.642

SENSITIVITY ANALYSIS

Internal Economic Return at stated Wheat Prices.[1]

	U.S. $27	U.S. $23	U.S. $20
Internal Economic Return	30%	22.5%	17%

1. Sorghum price deemed insensitive therefore held constant.

Part IV. IMPLEMENTATION PLANNING

A. ADMINISTRATIVE ARRANGEMENTS

Legal Base of Action Blé

By means of Ordinance No. 22, issued on 3/24/72, the President of Mali has created within the Ministry of Rural Development the rural development operations. The rural development operations are defined as organisms of technical character, possessing financial and administrative autonomy, whose purpose is to coordinate and utilize nationally the means necessary for rural development programs. Decree No. 33 established the by-laws of rural development operations, and specifically authorized them to engage in research, augmentation of rural production, and marketing of agricultural products. Over 20 operations and actions (smaller-scale organisms of the same type) exist at present.

Within this legal framework, "Action Blé Diré" was established on 1/28/1976 by Arrêté (ministerial order) No. 269. Its zone of action is those parts of the Diré and Goundam cercles which are near the Niger River system (appropriate for pump irrigation).

Administrative Capacity

The GRM will continue to manage the project with the following core staff. Necessary additions to this staff and a re-organized staffing pattern are detailed in this section.

Director (agronomist)

Chief of Technical Division

Chief of Finance and Personnel

3 Section Chiefs (Extension, Research, and Irrigation)

1 Accountant

1 Agricultural Supply Manager

3 Secteur Chiefs (agric. technicians)

2 Sub-Secteur Agents (agric. monitors)

2 Sub-Secteur Encadreurs (trained on the job)

1 Pump Operator

1 Secretary

2 Chauffeurs

2 Guards

10 Laborers

31 TOTAL

Action Blé's professional staff has been trained in Mali and abroad and has performed exceptionally well in its 2 years of operation. The director has demonstrated very good planning, and under his direction the present emphasis on village level irrigation management was begun. Project activities have been well coordinated and reporting has been timely.

The Action's staff is presently too small to supervise adequately the major new thrust of this project. Cognizant of this fact, it was the staff that recommended reorganization to effect village level management.

The requirements for managing the extension of technology and the supervision of the application of inputs have been carefully considered by the Action Blé staff and the PP team, and the new staffing pattern reflects these considerations.

B. REORGANIZATION

It was agreed that reorganizing the present staff would provide a more responsive management. Originally, the director had 2 divisions (the Technical Division and the Finance and Administration Division) which were sub-divided into sections, secteurs and sub-secteurs. The proposed organizational chart on the next page replaces the former divisions with six sections reporting directly to the Director. Three of these sections are new, designed to support (i) credit and marketing functions; (ii) small pump operation and maintenance; and (iii) the training needs of the moniteurs and encadreurs.

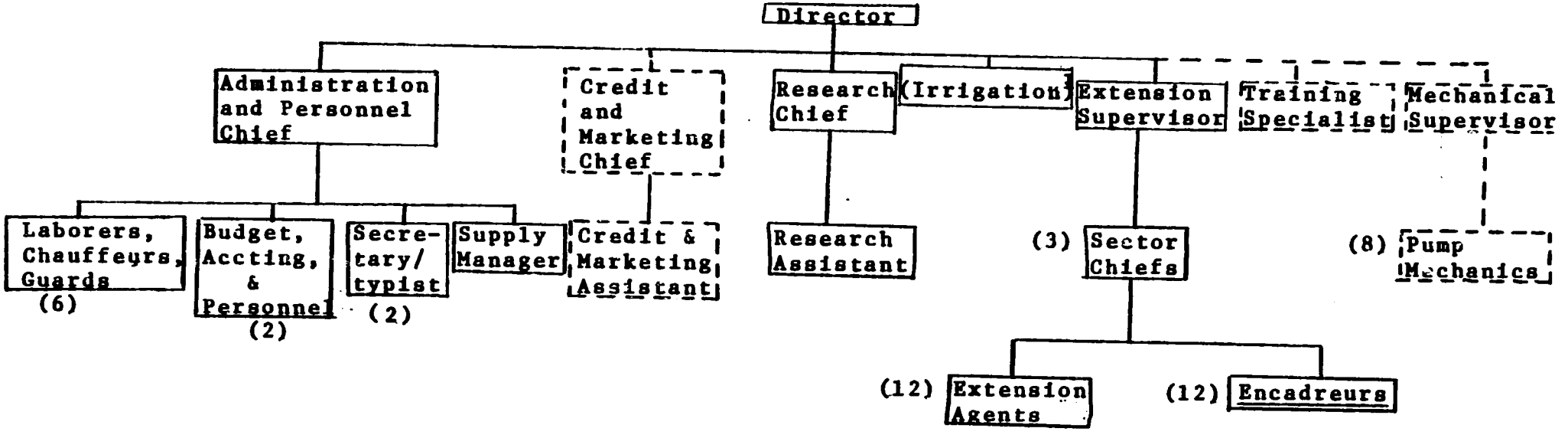
Credit and Marketing Section: It is strongly felt that the overall ability to (i) successfully extend production credit on a timely basis; (ii) recover loans promptly; and (iii) assist farmers with the marketing of their grain, will be critical to the success of the project.

These tasks will be the responsibility of the proposed Credit and Marketing Section. This Section will be staffed by two people who will receive academic training in the United States in agricultural economics, marketing and agri-business management, (see participant training budget for details).

Mechanical Supervision and Maintenance Section: This Section will supplant most of the functions of the existing Irrigation Unit and, in addition, will assume responsibility for management and supervision of (i) the pump and vehicle repair shop, and (ii) the pump mechanics assigned to each village. Eight mechanics will be employed on contract basis for a period of three years. Additionally, diesel mechanic in-country training for eight village youths will guarantee replacements for the contract employees upon the end of their contracts.

PROPOSED ORGANIZATIONAL CHART

ACTION BLE - DIRE



Existing positions

Postions to be created

1. Existing - to be supplanted by mechanical supervisor

Training Section: This Section is necessary to support the extension personnel. The linkage between training, extension and research will be further strengthened through a program of research farm training for each extension agent. This short-term training will prepare him for the on-farm (multi-locational) testing planned for later in the project. The training specialist will receive short-term, U.S. non-academic training for this position. (For further participant training see Participant Training Budget and Summary, page 36).

C. EXTENSION ACTIVITIES

Each extension agent will be responsible for 50 groups of 4 farmers each, organized around 50 pumps, in subjects related to irrigation management and agricultural practices. Each extension agent will be assisted by one encadreur (a literate local person, trained by Action Blé), who will perform the logistical functions such as fuel and input supplies and accounting. This gives altogether a 1:100 ratio of field agents to farmers. This high ratio is possible because of the grouping of 4 farmers around each pump. Every group will choose a spokesman, through whom the project personnel will interact with the extension supervisor through 3 sector chiefs responsible for the three sectors of the project - the Diré/Douta, Bourem and Kessoubibi areas (Diag. 2). Extension activities of the Action Blé agents will also be carried out with the "Commission des Paysans" - a locally elected, village supervisory council.

D. EXPATRIATE TECHNICAL ASSISTANCE

Given the complex logistics involved in this project, the geographic isolation of Diré and the need for close coordination between Action Blé Diré and Bamako management, it is recommended that an on-site project analyst

be assigned to Action Blé headquarters. An anthropologist is also recommended for this project.

This technical assistance has been included in the budget and suggested scopesof work are attached in Annex XIV.

OTHER ORGANIZATIONS

A. OPAM:

At present OPAM has no purchasing role in the Diré area and limits its operation to the distribution and storage of imported grain (from the V Region during normal years). The establishment of a buffer stock is planned during calendar year 1978. An excess sotrage capacity exists at OPAM's level and an agreement for central storage will be a project input.

B. SCAER:

Agricultural inputs are made available to government operations through the Service du Crédit Agricole et de l'Equipement Rural (SCAER). This government organization imports and transports these inputs to Operations and Actions all over the country. SCAER is capable of handling the purchase of all the input requirements of Action Blé assuming adequate advances are made to assure timely delivery. SCAER is planning to open 2 stores in the VI Region (in Goundam and Diré) in 1978.

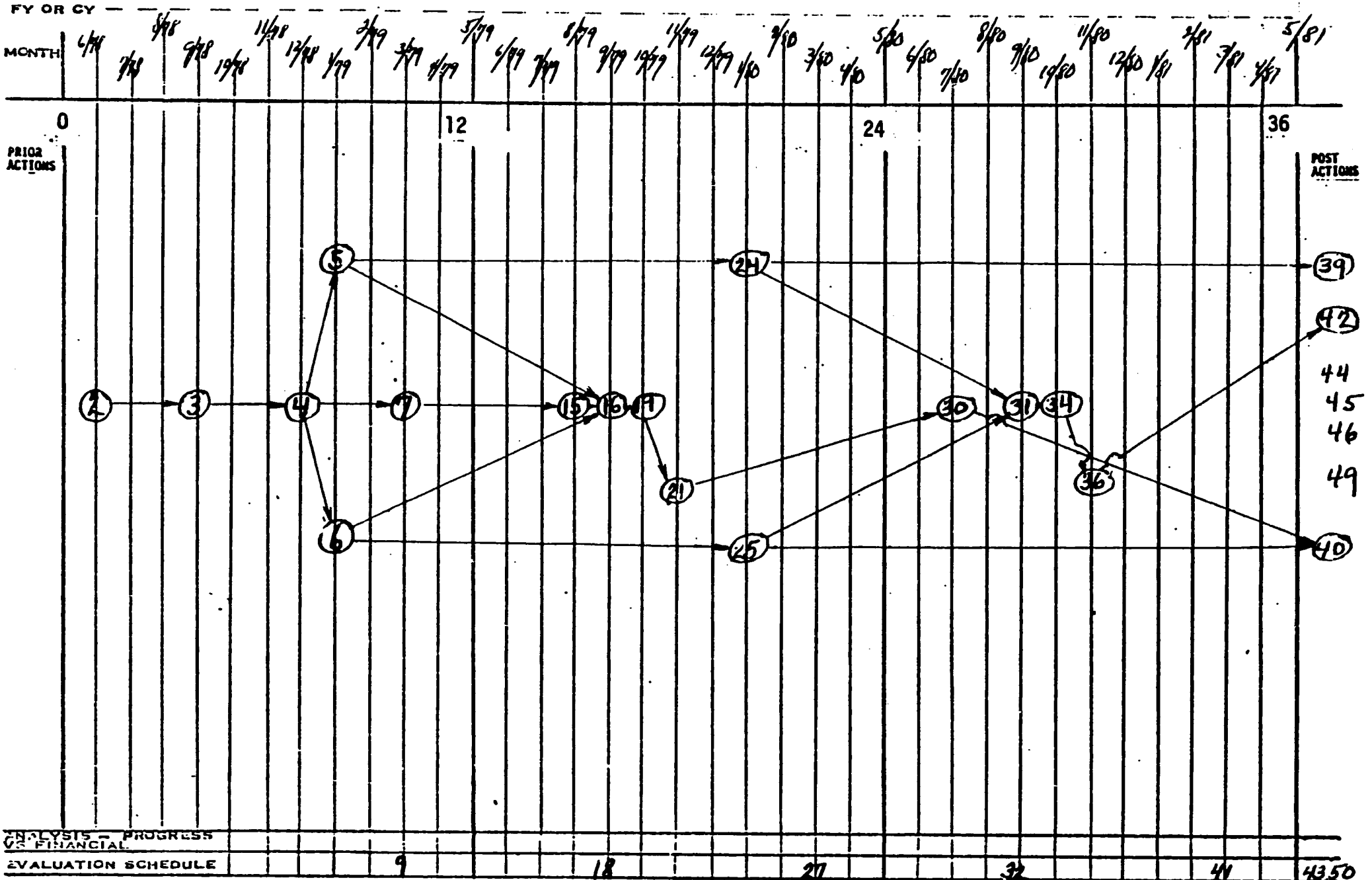
C. SCET INTERNATIONAL:

Under FAC financing this consulting firm, which performed the 1975 feasibility study, will provide 48 man-months of technical assistance to this project.

Part IV. B. IMPLEMENTATION PLAN

The following section presents the implementation schedule agreed upon in collaboration with the Director of the Action Blé project. PPT events and times are the current best estimates available. This schedule is linked directly with the wheat crop season and river transportation availability. It is recommended that this network be revised and possibly detailed at least annually in collaboration with project management staff.

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	ORIGINAL / REVISION #	APPROVED
MALI	688-0213	ACTION B/6	3/30/78	☒ ORIGINAL	



CRITICAL PERFORMANCE INDICATOR (CPI) NETWORK

Part IV. B.

IMPLEMENTATION SCHEDULE

Event Number	Activity Description
1.	PP submitted AID/W (Apr. 78)
*2.	PP approved (June 78)
*3.	Proag. signed (Sept. 78)
*4.	CP's met (Dec. 78)
*5.	PIO/C's issued for pumps ~~instal~~. (Jan. 79)
*6.	Credit advanced for purchase of inputs and fuel for crop year 1979 (Jan. 79)
*7.	Project analyst at site (Mar. 79)
8.	Construction of repair shop and local housing begins (Mar. 79)
*9.	AID project mgmt. "in-house" evaluation (Mar. 79)
10.	3rd country participants (2 to CIMMYT) leave for training (April 79)
11.	8 local youths begin diesel mech, training (May 79)
12.	In-country business administration and accountant training begins (May 79)
13.	Anthropologist at-site (June 79)
14.	Action Ble senior staffing complete (June 79)
*15.	8 Contract mechanics on-board (Aug. 79)
*16.	155 pumps and fuel and inputs delivered in Mopti (Sept. 79)
17.	U.S. academic training begins (Sept. 79)
*18.	Second semi-annual "in-house evaluation conducted (Sept. 79)
*19.	155 pumps installed and fuel delivered by (mid Oct. 79)

Event Number	Activity Description
20	Seeds and inputs supplied to farmers (Nov. 79)
*21.	Planting of 620 ha completed by (30 Nov. 79)
22.	2 participants from CIMMYT return (Nov. 79)
23.	In-country business administration and accountin trainees return (Dec. 79)
*24.	PIO/C's issued for pumps.
*25.	Credit advanced for inputs and fuel for crop year 1980 (Jan. 80)
26.	Harvest of 620 ha (Mar. 80)
*27.	1st Joint Evaluation (Mar. 80)
28.	Research farm management participant leaves for CIMMYT (April 80)
29.	In-country business administration and accounting training begins (May 80)
*30.	Loan repayment cycle ends (July 80)
*31.	175 pumps, fuel, and inputs delivered in Mopti (Sept. 80)
*32.	Third semi-annual "in-house" evaluation conducted (Sept. 80)
33.	U.S. academic training credit and marketing (1 participant) begins (Sept. 80)
*34.	175 pumps installed and fuel delivered by (15 Oct. 80)
35.	Seeds and inputs supplied to farmers (Nov. 80)
*36.	Planting 1520 ha, completed by (30 Nov. 80)
37.	Research farm management trainee returns (NOv. 80
38.	In-country business administration and accounting training ends (Dec. 80)
*39.	PIO/C's issued for pumps (Jan. 81)
*40.	Credit advanced for inputs and fuel for crop year 1981 (Jan. 81)
41.	Harvest of 1520 ha (Mar. 81)

Event Number	Activity Description
*42.	Second Joint Evaluation (Mar. 81)
*43.	Loan repayment cycle ends (July 81)
*44.	4th semi-annual "in-house" evaluation conducted (Sept. 81)
*45.	175 pumps, fuel, and inputs delivered in Mopti (Sept. 81)
*46.	175 pumps installed and fuel delivered (Oct. 81)
*47.	Planting 2420 ha completed (Nov. 81)
48.	Harvest 2420 ha (Mar. 81)
49.	Last U.S. participant returns (Mar. 82)
*50.	End of project
*51.	Post-project Evaluation (Mar. 82)

Project evaluations are regularly scheduled at 12 months' intervals beginning 18 months after the satisfaction of the conditions precedent to disbursement of the project agreement. As can be seen by the implementation schedule, a full project year will be lost because of delays in providing the irrigation pumps. It would be a waste of time and money, and a drain on management efforts to evaluate a project which will have admittedly accomplishe little by that time. During the 18 months' delay, however, staff will be recruited and training will begin. The project site analyst and anthropologist should be fully "settled in" to the project. Valuable base line data will have been gathered and during the 18 months' period validated by these two expatriate personnel.

The annual evaluation after this initial start-up phase should be conducted with REDSO/WA or AID/W assistance, GRM representatives and possibly an "outside source" (i.e. Malian private firm or American contract firm). The composition of the team should include an economist, a wheat agronomist and a marketing specialist. Social reviews can be completed through the on-going social analysis.

Baseline Data

Insufficient data exists in the project area and funding for the recommended baseline data collection is included in the budget.

Periodic Data Collection

The site analyst will be responsible for developing an MIS for this project which will reflect quarterly changes in the baseline data base as well as monthly status of cropping progress. (See proposed scope of work for on-site analyst.)

Semi-Annual Reviews

Semi-annual reviews of the project will be jointly conducted by the AID project manager and a counterpart from the Ministry of Rural Development. This review should be informal yet designed to encourage exchanges of opinion between management in Bamako and the project site. The Director of Action Blé, with the assistance of the project analyst, will be responsible for presenting the review of accomplishments to date and summarizing problems encountered. Reviews should be conducted in Diré upon the completion of the harvesting or marketing cycle of wheat (mid-March) and prior to the next campaign in mid or late September. The findings of this review should be filed for the regularly scheduled annual joint evaluations.

Final Evaluation

A post-facto evaluation is highly recommended for this project. This evaluation should reflect an "end-of-project status" report based upon initial targets set by the project management as well as include reset targets based upon actual experience. A thoroughly prepared evaluation design should be submitted to AID and the GRM, and the post-facto evaluation should be conducted by "outsiders" with full Malian support and collaboration. The evaluation should benefit greatly from the social research conducted by the resident anthropologist and the project analyst. It should focus attention upon: (i) the returns to participating farmers; (ii) the price policy and its effect on production; (iii) the management performance of AID and Action Blé; and (iv) cereal production in the VI Region in general.

Part IV. D. **CONDITIONS AND COVENANTS**

See final covenants and conditions in PAF II section of authorization package.

HOST COUNTRY CONTRIBUTIONS

GRM Support	Total	Costs ($000's) FY-79	FY-80	FY-81	FY-82
Accion Ble salaries	225	56.3	56.3	56.3	56.3
Beneficiaries					
Construction Labor 8 officies ¢1,500 8 input warehouses $3,500 8 houses for extension agent $2,500 12 cement floor for storage $500	60	15	22.5	22.5	—
Land Preparation 2,420 ha at 40 days/ha @ $1/day	97	25	36	36	—
Digging 605 pump inlets, 50m^3 ea. @ $1/m^3	30.4	7.8	11.3	11.3	—
Installation labor of 605 pumps @ $10/pump	6.2	1.6	2.3	2.3	—
10 MF/Kg levy into Action Ble operating fund	349	31	76	121	121
Total Host Country Contribution	767.6	136.7	204.4	249.4	177.3

ANNEX I

AGRONOMIC ASPECTS

Conditions for irrigated wheat production in the VI Region are uniquely favorable:

1. An ideal temperature regime exists during November, December, January, and February;
2. There are no dessicating harmattan[1] winds during this period;
3. There is unlimited water for irrigation from the Niger River;
4. There is an ample area of adequate soil;
5. Land development will be accomplished with local resources;
6. Wheat is a traditional crop;
7. An ongoing wheat research program has been under way for 3 years;
8. The feasibility of small pumps has already been demonstrated;
9. This is a grain deficit area within a wheat deficient country;
10. The project plan, which envisages many small production units, each with its own pump, permits flexibility and feedback into continuing development, resulting in a far greater probability of success than a grand scheme which would be derailed by a single error at a single point.

The Action Blé program has conducted a wheat research and extension program at Diré for the past 3 years. In 1977-78 season the research program comprised 1/2 hectare and farmers grew wheat on 24.5 hectares. Yields in variety trials reached 4.5 tons per hectare and grower yields are estimated up to 3 tons per ha. with an average this year of 2-2.5 tons per ha. At Bourem 4 pumps of the type specified in the project are irrigating

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[1] Arabic for "Killer heat".

approximately 15 ha. of wheat which looks excellent and will probably produce 2.5 tons per ha. From the air en route from Tombouctou to Diré, approximately 35 ha. under calabesse irrigation were observed.

Traditionally the agriculture in the project area is based on the annual ebb and flow of the Niger River. There are five basic types of culture in the region: (1) rainfall in sand (finger millet); (2) advancing or receding flood water from river channels (rice and sorghum); (3) receding water in ponds and lakes filled from river overflow (rice and sorghum); (4) capillary fringe from water table in lakes and ponds (rice and sorghum); and (5) irrigation (wheat, maize, barley, and vegetable gardens).

In systems (2), (3), and (4) which depend on the annual cycle of the Niger, unusual endemic adaptations have been developed: floating rice in which stem elongation keeps pace with the rising water and which is harvested from boats; and sorghum established in moisture from receding flood water which becomes dormant under following conditions of moisture stress to be revived and rapidly complete development when moisture is restored by rain and rising flood water. Sorghum yields under this system are 700-800 kg/ha.

Traditional irrigation depends on a calabesse for bailing water out of small dug channels or for carrying water from ponds or the river. This is an inefficient use of human energy and often results in an inadequate moisture supply for the crop. Traditional wheat yield is estimated at 1,500 kg/ha.

Basically the project supplies and distributes water, aided by improved cultural practices. Water will be supplied by means of 500 small mechanical (4 HP) pumps, and 105 animal driven pumps each supplying 4 hectares,

2,420 hectares in all. The pumps will deliver water to the crest of the river bank, a 1 to 6 meter lift and 20 to 50 meters from the water's edge depending on topography and river level. Each 4 ha. area supplied by a single pump will comprise a single production unit. Little land shaping and clearing will be needed except for leveling termite mounds (which is not a wasted effort, as this material is high in nutrients).

The soil along the river tends to be favorable for wheat and there is far more land than the planned 2,420 ha. Therefore, only the areas with the most favorable topography and soil will be chosen. The most common textural classes are sandy clay loam, clay loam, and sandy clay. Heavy-textured soil must be absolutely avoided because of extremely low infiltration rates with resulting problems of scalding, waterlogging, and soil salinity. The present surplus land area builds in flexibility for modifying land use systems both for more favorable results and for correcting unforeseen agronomic or environmental problems which may appear (see "Soil and Water", page 25).

AGRONOMIC PRACTICES

WHEAT

Water Management: Reliability of water supply is the primary issue. Present irrigation techniques within the field are satisfactory. However, with pumped water there is a tendency to apply an excess amount, especially on heavy soil. Some modification of technique is necessary on these soils (see Research section).

Fertilizer: Farmers are not presently using chemical fertilizers and in this they are correct. During the first crop year the nitrogen status is

above the optimum level for the weak strawed varieties now being used, and yield is lost as a result of lodging. With the traditional varieties, when wheat follows wheat, nitrogen status tends to be optimum in the second year. In the third year some fertilizer is needed, and the need becomes acute in successive years of cropping. Phosphate is needed as well as nitrogen but there is no evidence that other nutrients are limiting production. Most crops do not respond to potash in Mali. This was shown to be true with wheat in fertilizer trials conducted at Dire.

Given the farmers experience of yield loss due to excess soil fertility, recommendations of chemical fertilizer must be: (i) based on accurate information, (ii) reflect the farmers interest, and (iii) be presented via demonstrations on farms. Manure is now being used but only a small proportion of that being produced is applied as fertilizer. It is not collected from fields or bedding areas. The small amount used is obtained from corrals. Research evaluation is needed, followed by an extension program to promote the most favorable use of this resource (see Research program).

Tillage Practices: At present the only soil preparation in the project area is shallow hoeing. In general, succeeding levels of input are: (1) deeper manual tillage with a hoe or other hand tool; (2) animal power; (3) small power tillers; (4) tractor power. Rototillers have replaced human power and supplemented animal power at a surprising rate in some developing countries; however, mechanical power is beyond the time span of this project. Modification of present techniques may permit savings in energy as well as yield increases. Switching to animal power tillage has consistently resulted in yield increases in Mali.[2]

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[2] Mali Agricultural Sector Assessment, Univ. of Michigan Center for Research on Econ. Development, Dec. 15, 1976, p. 75.

Varieties: Except within the Action Blé project at Diré, farmers are using traditional varieties. Alkama Tjirey, the most popular, is limited to the 2.5 ton yield class by weak straw. Newer varieties are: (1) Florence Aurore, with excellent grain quality but susceptible to bird loss due to its awnless ("beardless") character, in the 3 ton class, and (2) Hindi Tosson, bird repellant because of bristly awns, in the 4 ton class. Many newer varieties with still greater potential are available. The Action Blé program at Diré has completed the third year of collection, evaluation, multiplication and introduction of wheat varieties. This effort should proceed as rapidly as possible. However, results of the program will be seriousl handicapped unless the tradition of varietal mixing can be overcome. This must be changed and will require convincing demonstrations of the advantages of improved varieties as well as a sufficient seed supply to saturate local communities when the change is made. If only a dribble of new germplasm is supplied, it is destined to be diluted to insignificance in the local gene pool. Seed mixes are not intrinsically undesirable as long as favorable components dominate the mix. In choice of variety, yield reliability and local acceptance for consumption must be given high priority. (See Suggested Seed Multiplication Program)

Seeding Technique: The weakest link in the chain of production practices is the traditional seeding technique. It is probably based on rice culture which preceeded that of wheat in this area. Seed is broadcast over the surface of small basins which are then flooded. The seed is then trampled into the mud. In clay soils the result is loss of stand by asphixiation,

scalding, and entrapment of plants as the mud dries and hardens. In addition to clay content, over-application of water is involved. The constant observation of poor stands in low areas indicates that the problem is correlated with depth of water applied. A seeding device proposed in this project paper may eliminate the problem of stand establishment and result in improvement in weed control, fertilizer efficiency, and soil structure (see "Proposed Wheat Seeding Device").

Crop Protection: Losses from birds probably exceed that from all other pests combined. Among farmers, loss varies tremendously and is closely related to vigilance, even though a great variety of techniques are used. This indicates that present methods afford reasonable protection if adequately pursued. Wheat ripens during a period of minimum food supply for birds and this suggests that as more wheat is grown in the area, in the short run, a percent loss will decrease. But control must be an important part of the research program and should be cooperative with the OCLALAV project.

Rats are reported to be a serious problem, probably cyclic, and a study of control methods has been proposed. This may be more important than it appears. As agricultural productivity in the area increases, so does food and habitat for rats, and the rat is an extremely adaptive and clever adversary.

At present, most of the loss from insects is caused by termites, both in the field and in stored grain. Termite mounds are as high as 10 feet and a prominent feature of the landscape. Termite control must receive high priority in both research and extension and low cost methods must be found. In this effort, cooperation of the program of Research and Development of Integrated Pest Management for Basic Crops in the Sahel will be very helpful. The few examples of stem maggot observed are not considered

a threat.

Wheat disease problems are not important at the present and none are expected. The dry atmospheric conditions prevent most leaf diseases, and more and more resistance is being built into the new varieties. No soil-born diseases were observed, in spite of the poor soil conditions in some areas. Because of the apparent paucity of soil-born insects and diseases, and the "Island" nature of the project, it is recommended that no potted plants be brought into the project area as this might introduce new soil-born insects and fungi.

Surprisingly few weed species were observed in wheat fields. There were: (1) a wild dill; (2) Portulaca sp.; (3) nut sedge (Cypurs.); and (4) and (5) two grass species. Wild dill is the usual dominant weed species but does not reach high levels of population density until the third consecutive year of wheat. The first weed invaders of newly irrigated land should be eradicated to prevent seed production. This is important in the extension program. "A weed killed in time may prevent nine million". Vigilance should be maintained against potentially damaging species such as wild oats, nut sedge in new areas, and parasitic witch-weed (*Striga*).

The Environment and Crop Protection: As new environments proliferate as a result of this project, theory predicts epidemics of new pests, especially in introduced crops and varieties. However, the situation in this project does not conform to the classical scenario (D. H. Janzen). The site is not surrounded by an intense ecosystem such as tropical lowlands. The new environment will be an island within a relatively barren ecosystem. It would seem that the Niger River is an isthmus connecting this island with very active ecosystems of Africa. However, observation does bear this out.

At Diré, the shore of the river appears as barren as the desert. In spite of a long but intermittent history of irrigation, only one weed species appears to be an invader and does not reach damaging population density until the third consecutive year of wheat.

Wheat production is protected against problems related to ecosystem instability by the adaptability of the plant itself. In no other crop have genes of adaptation been concentrated in new varieties to the extent they have been in many of the new varieties of wheat. "Miracle wheats" are not miracles, only the result of a simple strategy that proved to be correct.

Environmental protection also results from the vast space involved. This provides a surplus of productive land to switch to if unforeseen problems arise. It also provides flexibility in management and reduces the intensity of operations required. Starting in limited areas and expanding provides a probing wedge of change to guide the way - a wedge which can be withdrawn and redirected on a more favorable course with minimal agronomic and environmental consequences.

Rotation: The simplest rotation is wheat each year. The next step in increasing the intensity of land use is the addition of sorghum during rainy season, supplemented by irrigation. The final step is the addition of a third crop. A promising example of a 3-crop rotation is:

Wheat	15 November to 1 March
Cowpeas	15 March to 1 July
Sorghum	15 July to 15 October

Inclusion of cowpeas has many advantages: (1) it is a traditional crop, which enhances acceptance; (2) it increases protein in local diets; (3) it supplies both human and livestock food; (4) it provides livestock food at the low point of the supply cycle; (5) being a legume, it increases rather than decreases the soil nitrogen level; and (6) it introduces a broad-leaf crop in the rotation, which tends to interrupt buildup of grass-plant pathogens. The advantages of sorghum are that it is traditional, well adapted, and potentially high yielding.

Flexibility of rotations can be increased by intercropping or relay cropping. The former is growing two crops at one time and the latter is seeding a second crop into the field before harvest of the original crop, thus gaining time in development and maturity of the second crop. Both of these techniques are important in rotations involving wheat in China and the sub-continent.

Rotations and Environmental Impact: Rotations provide economic and biologic flexibility as well as the best solution to many production problems, i.e. infestations by weeds, diseases and insects. Rotation is also the means of intensifying land use. What is the most appropriate level of exploitation? Perhaps it would be prudent to establish a set-aside policy in which the land area alloted to one pump is twice the irrigation capacity of the pump. This would result in fallow of half of the land; therefore, in one-half the average use intensity. A set-aside policy would reduce fertilizer inputs, prevent most production problems (including unforeseen results of

irrigation), and provide a cushion against population increase and harmful environmental impact. Thus a set-aside policy would give the project the efficiency of increased land use intensity without the environmental risk.

Test sites of continuous high-intensity farming should be set up to reveal problems and consequences, develop solutions, and provide lead time for effecting changes indicated. Perhaps communities should be permitted to opt for the set-aside system or full land use. There is no economic cost of a set-aside system in communities with sufficient suitable public land. Neither is there a loss of land use, merely a changed pattern which protects and increases productivity. Under the set-aside option, the field nearer to the river and the one farther away (Diag. 3) would be irrigated by the same pump on alternate years; the other pump would be similarly placed elsewhere, so that no reduction of total project area would result.

Under a continuous wheat-sorghum rotation with improved varieties and practices, net income was calculated at $958.00. Under the set-aside system, by utilizing the traditional principal of biologic restoration of soil fertility, net income was $1,028 (see Crop Budget E). The calculated difference was due to lower fertilizer requirement.

Research/Extension: In principle and practice, (1) allocation of research resources must reflect the urgency of questions to be answered; (2) research and extension is a single function; (3) on-farm trials are as important as on-station trials; and (4) the value of a research program is measured by its value to the farmers it serves.

It follows that: (1) in any cooperative research effort, control of the research program must rest with the project in order to insure efficient resource allocation; (2) research personnel must be involved in planning, observation, and interpretation of off-station trials; likewise, extension personnel must be involved in planning, observation, and interpretation of on-station research; (3) on-farm trials should be as simple as possible, but must be carefully conducted if they are to provide valid information and feedback to the on-station research program, and (4) on-farm trials and demonstrations must be well-executed if they are to be helpful to farmers.

The project will enlist the cooperation of the Direction National de Recherche Agricole (DNRA), and the relevant international agricultural centers, i.e. CIMMYT for wheat, ICRISAT for sorghum and millet, and IITA for legumes. In addition to technical guidance and seed of improved varieties, these international centers also provide very effective training programs for agricultural technicians.

Research program suggestions: (for more detail see "Suggested Research Program for Wheat, Sorghum and Pulses", page 40).

1. Varieties: evaluation, selection, and original seed increase of those chosen for use.
2. Water management, including drainage.
3. Tillage and seeding methods.
4. Fertilization practices.
5. Rotations:
   a. date of seeding of different varieties of the crops used in the rotations.

b. economic and biologic evaluation of recommended and promising rotations.

6. Crop protection:

a. bird control;

b. rat control;

c. insects, both in field and stored grain;

d. diseases;

e. weed control.

7. As new opportunities and problems arise, allot research effort in proportion to their importance.

Of the crops involved in the present research program, wheat technology is at a far higher level than the others and a successful package of practices has been established. Modern technology for irrigated sorghum does not exist in the project area, and this technology is totally different from the highly adapted local practices; therefore, the research/extension requirement is equivalent to that of introducing a new crop. This work should start as soon as possible. Experience with cowpeas and other legumes is also urgently needed. In addition to chick peas which are already being tested at Diré, other legumes which might be tested are peanuts, pigeon peas, and bombara groundnuts. With any new crops or varieties, local acceptance is an important consideration.

The present wheat program of Action Blé at Diré consists of varietal evaluation (288 varieties), selection and seed increase of promising varieties; a date of seeding trial; a method of irrigation trial; a timing and number of irrigation trial; and a fertilizer trial. The varietal work

is in cooperation with the National School of Agriculture in Montpellier and COMMYT. Work in maize consists of a variety trial in cooperation with IRAT. Work in legumes consists of a chick pea varietal trial from ICRISAT and forage legumes from Montpellier. There has been no work in sorghum but sorghum trials will be seeded in July 1978.

3.5 TONS/HECTARE BY END-OF-PROJECT

(Expected Farmer Average in the 1980s)

Present varieties have a genetic yield potential of 8 to 9 tons per hectare. Obtaining this yield is a matter of avoiding conditions which limit this potential. What are these factors which may be limiting in the project area?

1. Water: supply is unlimited, local management is good.
2. Temperature regime: near perfect.
3. Light regime: excellent-full sunlight.
4. Mineral nutrition: fertilizer program will compensate for any soil deficiencies.
5. Pests, insects, and diseases:
   a. diseases: none at present;
   b. insects: termites, controllable;
   c. birds: controllable through vigilance;
   d. rats; cyclic, controllable; community effort may be needed;
   e. weeds: easily controlled at present;
6. Soil: texture and structure: variable; soil must be carefully selected. Fortunately, wheat tolerates a wide range of soil conditions.
7. Cultural practices:
   a. Tillage: should be improved, yet with present manual methods 4 ton yields are being obtained on the experiment station;

b. Seeding technique: traditional method is unfavorable in clay soils and must be modified, yet does not limit yield on soil with normal infiltration rates.

8. Capable farmers: the farmers in the project area pride themselves in being brave and hard-working (Annex XI). So far they have lived up to their reputation, considering the risk they have taken in incurring considerable indebtedness for an unknown technology (pumps) and the careful irrigation they have been practicing.

In conclusion: the present yields are estimated at 2.5 MT/ha, and end-of-project status assumed the expansion of wheat production to 2,420 hectares at this productivity level. However, <u>these projected yields should be regarded as a minimum</u>. Given a well-directed research and extension program, there seems no objective reason that average yields in the project area of 3.5 MT/ha. for wheat and 4 MT/ha. for sorghum cannot be reached in the late 1980s throughout the project area.

CROP BUDGETS

The following crop budgets were put together based upon discussions with farmers and Action Blé extension staff. It must be noted that calabasse irrigation (Crop Budget A) is practised upon .3 to .5 hectares only which accounts for the fact that so little wheat is planted. A canal is dug from the river to a location near the field to be irrigated. A large calabasse (a dried gourd) is fastened to a rope, dipped into the basin at the end of the hand-dug canal and water is poured onto the field. Calabasse irrigation is not without its risks since the level of water in the river often drops, emptying the canal and leaving insufficient water in the basin for irrigation purposes. Therefore, while $341 is projected on a per hectare basis, actual net revenue on a good year is between $102 and $171. Additionally, no labor costs were charged against the "delivery of water" as is the case in Crop Budget B. This results in a skewed representation of net revenue. Revenue per labor day for Crop Budget A and B is: $.88 and $1.51 respectively.

Crop Budget B is based upon on-going pump irrigation in the village of Bourem. The combination of: (i) a reduction in labor-days for irrigation; (ii) lowered risk; and (iii) revenues derived from a full hectare, is responsible for the popularity of this irrigation method. Crop Budget B includes fertilizer costs based upon recommendations for the 3rd year of cropping.

Flood recession sorghum is done in the Diré area only in and around seasonal ponds (mares). A "typical" crop budget is included to

illustrate the economic advantage of supplemental irrigation.

Crop Budget D continues the comparison of wheat and sorghum irrigation with admittedly conservative yields of 2.5 and 1.5 tons for wheat and sorghum respectively. This table's net revenue of $510 is used as the basis for calculating the end-of-project income figures.

CROP BUDGET A
WHEAT (SINGLE CROP) PER HECTARE
(CALABASSE IRRIGATION, NO FERTILIZER)

INPUTS	LABOR (Person-Days)	CASH COSTS (MF)
1. Land Preparation: (manual)	8	NCC[a]
2. Maintenance of Canals, Dikes	8	NCC
3. Seeding: 100 kg at 170 MF/kg[b]	3	17,000
4. Irrigation	200	NCC
5. Guardian: 1 person x 90 days ÷ 4 ha	22	NCC
6. Bird Control: 4 persons/ha x 30 days	120	NCC
7. Harvesting: Cutting and Binding	12	
8. Threshing: 10 person-days/ton	15	
TOTAL	388	17,000
Production: 1,500 kg/ha at 125 MF/kg		187,500 MF
Minus cash costs		17,000 MF
NET INCOME		170,500 MF ($341.00)

[a] No cash costs associated

[b] Includes cost of seed treatment

CROP BUDGET B

WHEAT (SINGLE CROP) PER HECTARE

(PUMP IRRIGATION, TRADITIONAL VARIETIES, FERTILIZER)

INPUTS	LABOR (Person-Days)	CASH COSTS (MF)
1. Land Preparation: (manual)	8	NCC[a]
2. Maintenance of Canals, Dikes	8	NCC
3. Seeding: 100 kg ea. 170 MF/kg[b]	3	17,000
4. Irrigation: Total 8,000 m^3/ha	21[c]	
A. First Application 800 m^3		72,500 (fixed)[d]
B. Second - Thirteenth 600 m^3		18,960 (variable
5. Fertilizer		
A. Triple Super Phosphate (33 kg ea. 135 MF/kg)	1	4,455
B. Urea (54 kg ea. 110 MF/kg)	1	5,940
6. Weeding: Manual[e]	25	NCC
7. Guardian: 1 person x 90 days ÷ 4 hectares	22	NCC
8. Bird Control: 4 persons / ha x 30 days	120	NCC
9. Harvesting: Cutting and Binding 8 person-days/MT	20	NCC
10. Threshing: 10 person-days/MT	25	NCC
TOTAL	254	118,855
Plus 8% on fuel, seeds and fertilizer		2,348
Production: 2500 kg/ha ea. 125 MF/kg.....		312,500
Minus cash costs.....		121,203
NET REVENUE		191,297 MF ($383.00)

[a] No cash costs associated

[b] Includes cost of seed treatment

[c] 5 irrigations at 1 person-day and 8 irrigations at 2 person-days

[d] Includes pump amortization over 5 years at 8% ÷ 4 hectares

[e] Weed growth expected by third year of operation

CROP BUDGET C

SORGHUM (PER HECTARE)

(FLOOD RECESSION, TRADITIONAL VARIETIES)

INPUTS	LABOR (Person-Days)	CASH COSTS (MF
1. Land Preparation	8	NCC[a]
2. Seeding: 10 kg at 60 MF/kg	3	600
3. Weeding	35	NCC
4. Guardian	22	NCC
5. Bird Control	120	NCC
6. Harvesting	4	NCC
7. Threshing: 10 person-days/MT	8	NCC
TOTAL	200	600
Production: 800 kg at 60 MF/kg.....		48,000
Minus Cash Costs.....		600
NET REVENUE		47,400 ($95.00)

[a] No cash costs associated

CROP BUDGET D

WHEAT AND SORGHUM ROTATION (PER HECTARE)

(PUMP IRRIGATION, TRADITIONAL VARIETIES, INCREASED FERTILIZER)

INPUTS	LABOR (Person-Days)		CASH COSTS (MF)		
	WHEAT	SORGHUM	WHEAT	SORGHUM	TOTAL
1. Land Preparation: (manual)	15[a]	8	NCC	NCC[b]	
2. Maintenance of Canals, Dikes	8	6	NCC	NCC	
3. Seeding:					
A. Wheat, 100 kg at 170 MF/kg[c]	3	-	17,000	-	
B. Sorghum, 10 kg at 70 MF/kg[c]	-	3	-	700	
4. Irrigation:					
A. Fixed costs[d]			72,500	-	
B. Variable costs	21	18	18,960	11,250	
5. Fertilizer[e]	2	2	15,650	6,000	
6. Weeding: (manual)	25	25	NCC	NCC	
7. Guardian	22	22	NCC	NCC	
8. Bird Control	120	120	NCC	NCC	
9. Harvesting: (cutting and binding)	20	7	NCC	NCC	
10. Threshing: 10 person-days/ton	25	15	NCC	NCC	
TOTAL	261	226	124,110	17,950	142,060
(Total labor days: 487)			4,128[f]	1,436[f]	
			128,238	19,386	147,624
GROSS REVENUE:					
Wheat 2,500 kg at 125 MF/kg			312,500	-	
Sorghum 1,500 kg at 60 MF/kg			-	90,000	402,500
NET REVENUE					254,876 ($510.00)

[a] 7 additional days to remove sorghum stubble

[b] No cash costs associated

[c] Includes cost of seed treatment

[d] Fixed price includes pump amortization over 5 years at 8% (72,500 MF) prorated by water requirements.

[e] Fertilizer requirements detailed in Table 2 to Annex

[f] 8% interest on fuel, seeds and fertilizer

CROP BUDGET E

WHEAT AND SORGHUM ROTATION (PER HECTARE)
(PUMP IRRIGATION, IMPROVED VARIETIES AND PRACTICES)

Continuous Two Crop Rotation

INPUTS	LABOR (Person-Days)		CASH COSTS (MF)		
	WHEAT	SORGHUM	WHEAT	SORGHUM	TOTAL
1. Land Preparation	15[a]	8	NCC[b]	NCC	
2. Maintenance of Canals, Ditches	8	6	NCC	NCC	
3. Seeding:					
A. Wheat, 100 kg @ 170 MF/kg	3	-	17,000	-	
B. Sorghum, 10 kg @ 150 MF/kg[c]	-	3	-	1,500	
4. Irrigation:					
A. Fixed costs	21	18	72,500	-	
B. Variable costs	-	-	18,960	11,250	
5. Fertilizer[d]	2	2	30,995	36,715	
6. Weeding: (manual)	25	25	NCC	NCC	
7. Guardian: 90 person-days per 4 ha	22	22	NCC	NCC	
8. Bird Control	120	120	NCC	NCC	
9. Harvesting[e] (cutting, binding, carrying)	28	20	NCC	NCC	
10. Treshing and Winnowing: 10 days/ton	35	40	NCC	NCC	
TOTAL	279	264	139,455	49,665	
(Total labor days: 543)			5,356[f]	3,957[f]	
TOTAL COSTS			144,811	53,622	198,43:
GROSS REVENUE:					
Wheat 3,500 kg @ 125 MF/kg			437,500	-	
Sorghum 4,000 kg @ 60 MF/kg			-	240,000	677,50(
NET REVENUE.					479,06: ($958.0(

a/ Additional 7 days to remove sorghum stubble.
b/ No cash costs associated.
c/ Cost of seed treatment and improved seed included.
d/

Crop	Urea at 110 MF/kg	Tr. Sp. Phos. at 135 MF/kg	Total/crop
Wheat	175 kg=19,250 MF	87 kg-11,745 MF	30,995 MF
Sorghum	200 kg=22,000 MF	109 kg=14,715 MF	36,715 MF

e/ Wheat 8 days/ton - Sorghum 5 days/ton
f/ 8% interest on fuel, seeds and fertilizer.

CROP BUDGET E
(CONT.)

WHEAT AND SORGHUM ROTATION (PER HECTARE)
(~~PUMP~~ IRRIGATION, IMPROVED VARIETIES AND PRACTICES)

Set-aside System: 2 Years Irrigated, 2 Fallow

Same Yields, Labor Requirements and Production Costs except Fertilizer[a/]	
Minus cash costs (wheat 130,506; sorghum 33,119; total 163,625)	-163,625
NET REVENUE	513,875 ($1,028.00

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a/

Crop	Urea at 100 MF/kg	Tr. Sp. Phos. at 135 MF/kg	Total/crop
Wheat	100 kg=11,000 MF	50 kg= 6,750 MF	17,750 MF
Sorghum	100 kg=11,000 MF	77 kg-10,369 MF	21,395 MF

TABLE I TO ANNEX I

PROJECT AREA CLIMATE AND CROPPING CYCLE

Weather Data From Tombouctou

Crop Season	/----wheat---/			/-----cowpeas----------/			/----sorghum----------/				/---wheat--/		
Month	J	F	M	A	M	J	J	A	S	O	N	D	Total Annual
Temperature, 1951 - 1976, Centigrade													
Max.	30.6	34.0	37.2	40.1	42.2	41.5	38.3	35.8	37.9	39.5	35.9	30.8	
Min.	12.5	15.1	18.3	22.0	22.0	25.5	26.4	25.2	24.2	22.5	17.8	13.7	
Ave.	20.5	23.8	27.2	30.6	33.5	33.6	31.5	30.0	30.3	30.1	25.7	21.4	
Rainfall, 1941 - 1975, mm.													
Ave.	0.6	0.2	0.3	1.0	3.6	17.4	57.5	88.3	29.6	5.0	0.1	0.6	203.9 1/
Evapotranspiration Potential, 1961-1975, mm.													
Ave. Tombouctou	160	167	219	238	258	236	223	182	194	208	181	154	2420
" Diré	161	208	226	244	238	197	170	161	164	189	159	149	2266
Maximum Wind Velocity and Direction, 1961-1977													
Velocity mph	38	29	31	45	47	67	74	65	96	40	29	29	
Direction	NE	NNW	N	NNW	E	W	ENE	SSW	ESE	E	N	E	

1/ 19 year average annual rainfall at Diré - 234 mm.

Comment: The striking depression in minimum temperature during December, January and February provides an ideal temperature regime for wheat of just sufficient duration. Optimum average temperature regime for wheat is 20° C during the vegetative period and 24° C during the reproductive period.
Although total rainfall is low, the associated weather pattern exerts an important cooling effect during July, August, and September and reduces evapotranspiration. This limited rainfall also helps lower the peak demand for irrigation water.
Wind is not a factor in wheat production. Fortunately, the highest wind velocity occurs during the sorghum cycle, the most tolerant crop from the stand-point of both physical damage and dessication. The variable direction of maximum wind velocities indicates that if wind breaks are used, they should be placed on all sides of crop areas rather than only on the side of the prevailing wind.

SOILS AND WATER

SOILS:

The soils of the project area were formed under the influence of the annual flooding of the Niger delta and the interaction of this system with east-west bands of dunes which formed during dry cycles of past climates. Subsequent floods of the Niger inundated the depressions between dune areas. In these lakes and ponds heavy textured lacustrine soil was formed. Superimposed on this pattern is the influence of a long period of soil weathering and erosion. The result is a mosaic of soils which range from very favorable for wheat, maize, or legumes to soils totally unfit for these crops. The crux of the soil problem, therefore, is that of suiting the crop to the soil.

Soil of the original Action Blé perimeter has been carefully studied and mapped.[1/] Soil of the major project area has not been studied and mapped. The best soil analysis, however, is provided by the plants themselves: the quality of the wheat stands irrigated by the pilot pumps near Bourem, and by calebasse throughout the area, indicated soil extremely favorable for wheat.

EVALUATING SOILS:

For determining the location of project pumps, the soil may be easily evaluated, merely by observing infiltration rate. If the infiltration rate is satisfactory, other soil characteristics also tend to be satisfactory, especially for wheat. If the infiltration rate is very low, the soil is not satisfactory, no matter what the other characteristics may be.

1/ Schema d'Amenagement de la Plaine de Diré, SCET International, 1975.

The soil evaluation required for matching crop and soil is very simple. Equipment needed is only a hoe and a calebasse. The material required is water. Proceed by building and compacting a levee 20 cm in height around one square meter of surface obtaining soil for the levee from outside the enclosed area. Then fill with water. If there is difficulty in filling the basin or if all water soaks into the soil within 1/2 hour, the soil is too sandy for surface irrigation. If ponded water remains for more than 24 hours, the infiltration rate is dangerously low. If water remains after 48 hours, do not bring this soil under irrigation. Most of the soil observed in the projected area was deemed favorable for wheat.

The accuracy of the evaluation can be improved by reinforcing and compacting the levee after the first flooding to prevent lateral seepage. Refill and check again the infiltration rate. Near the site, dig a pit of at least 50 cm deep to observe the profile. Dense layers, grey, blue, or black in color and fractured into cubes usually have extremely low permeability. Soil in low areas is usually unsuited for wheat. Local technicians will become proficient in judging soils, if they record observations for comparison with subsequent irrigation experience and crop productivity.

SURFACE WATER:

Supply of water for a 2,420 hectare project proposes no constraints. The amount to be used in this project is an insignificant part of the flow of the Niger. Satisfactory water quality is basic to any irrigation scheme. Adequate water quality data from the Niger river near Diré has not been obtained. However, the existing wheat stands showed no indication of a water quality problem.

Drainage water and field run-off will not return to the river because the land slopes away from the river's edge. The small amounts involved will be diverted to areas with good water infiltration rates and leave the rooting zone via deep percolation.

GROUNDWATER:

Groundwater is available throughout the project area and up to 2-3 km from the main water courses at depth which essentially correspond to river water level. A shallow well reaching about 5 m below the water table where the strata are pervious is expected to yield 3-4 l/s, or enough for irrigating 1-1.5 ha on the basis of 8-hour pumping. Owing to well excavation costs and the lack of well digging tradition in the region, groundwater was not considered in the project. It might prove to be of economic interest in future developments further away from the river.

TABLE I TO ANNEX II

SUGGESTED FERTILIZER PROGRAM 1/ FOR A 2.5 TON YIELD OF SORGHUM (WHEAT, A VARIETAL MIXTURE, SORGHUM, TRADITIONAL VARIETIES) STARTING WITH VIRGIN SOIL OR NON-CROPPED SOIL FOR AT LEAST 4 YEARS

Nutrients 2/ (kg or MF/ha)	1st Year	2nd Year	3rd Year	4th Year & Cont.Consec.Yrs.
WHEAT ALONE:				
Nitrogen as N	0	0	25	30
" as Urea (46%)	0	0	54	65
Cost 3/			5,940	7,150
Phosphate as P_2O_5	0	0	15	20
as Triple Super(46%)	0	0	33	43
Cost	0	0	4,455	5,805
Total Cost			10,395	12,955
WHEAT IN WHEAT - SORGHUM ROTATION:				
Nitrogen as N	20	30	35	40
" as Urea (46%)	43	65	76	87
Cost	4,730	7,150	8,360	9,570
Phosphate as P_2O_5	15	20	25	25
" as Triple Super(46%)	33	43	54	54
Cost	4,455	5,805	7,290	7,290
Total Cost	9,185	12,955	15,650	16,860
SORGHUM IN WHEAT - SORGHUM ROTATION:				
Nitrogen as N	0	manure 3/	manure 3/	manure or 30
" as Urea (46%)	0	manure	manure	65
Cost	0	6,000	6,000	7,150
Phosphate as P_2O_5	0	manure	manure	20
" as Triple Super(46%)	0	manure	manure	43
Cost	0	same	same	5,805
Total Cost	0	6,000	6,000	12,955

1/ To be adjusted through observation and testing.
2/ Price of: Urea - 110 MF/kg; Triple Super Phosphate 135 MF/kg.
3/ Manure, customary amount - 6,000 MF spread in field.

TABLE II TO ANNEX II

SUGGESTED FERTILIZER PROGRAMS[1/] FOR A YIELD OF 3.5-4.5 TONS OF WHEAT AND 4.0-5.0 TONS OF SORGHUM (IMPROVED VARIETIES AND CULTURAL PRACTICES) STARTING WITH VIRGIN SOIL OR NON-CROPPED FOR AT LEAST 4 YEARS.

Nutrients (kg or MF/ha	1st Year	2nd Year	3rd Year	4th Year & Cont.Consec.Yrs.
A. WHEAT EACH YEAR, NO OTHER CROP:				
Nitrogen as N	0	34	46	69
" as Urea (46%)	0	75	100	150
Cost[2/]	0	8,250	11,000	16,500
Phosphate as P_2O_5	0	17	23	35
" as Triple Super (46%)	0	37	50	76
Cost	0	4,995	6,750	10,260
Total Cost	0	13,245	17,750	26,760
B. WHEAT IN WHEAT - SORGHUM ROTATION:				
Nitrogen as N	34	46	69	80
" as Urea (46%)	75	100	150	175
Cost	8,250	11,000	16,500	19,250
Phosphate as P_2O_5	17	23	35	40
" as Triple Super (46%)	37	50	76	87
Cost	4,995	6,750	10,260	11,745
Total Cost	13,245	17,750	26,760	30,995
C. SORGHUM IN WHEET - SORGHUM ROTATION:				
Nitrogen as N	0	46	80	92
" as Urea (46%)	0	100	175	200
Cost	0	11,000	19,250	22,000
Phosphate as P_2O_5	23	35	40	50
" as Triple Super (46%)	50	76	87	109
Cost	6,750	10,260	11,745	14,715
Total Cost	6,750	21,260	30,995	36,715[3/]

1/ To be refined as research data and experience is accumulated by (1) trials on farms and (2) observation. (If more than 10% of the wheat crop lodges in any one year, do not increase the dosage the following year. If wheat plants are spindly and pale green, exceed the dosage recommended for the following year.)

2/ Price of: Urea - 110 MF/kg; Triple Super Phosphate - 135 MF/kg.

3/ Total cost requirement of 88.8 Million MF for 2,420 hectares at this fertilizer level ($177,700).

ANNEX III

PROPOSED WHEAT SEEDING DEVICE

Purpose: To provide an alternate seeding technique, in order to avoid the disadvantages of the traditional method of trampling seed into flooded soil.

The Proposed Technique: Broadcasting of seed, as now practiced, followed by dragging wedge-shaped shoes back and forth across the area. This shoves the seed (and fertilizer if used) and surface soil into ridges, simultaneously covering the seeds.

Materials Needed:

Wood: (1) one piece 36 x 24 x 15 cm, for 3 seed-shoving shoes;

(2) one piece 72 x 24 x 3 cm, for top surface;

(3) one round shaft, 150 cm long and 3.5 cm diameter, for control handle (farmers will use a tree branch).

Sheet metal: 1.5 mm (1/16") preferably galvanized, 38 x 25.5 cm for bottom surface of shoes.

Nails: 9 each, 24 penny, for attaching shoes to top surface.

30 each, 8 penny, for attaching sheet metal to shoe bottoms.

Cord: 1 cm diameter, 4 meter length, for towing.

Tools needed: (1) saw

(2) tin snips

(3) hammer

(4) wood brace and bits (farmers will burn holes in wood with a hot rod)

(5) punch or metal drill and bits

(6) tape measure and straight edge.

Steps in Construction: See Diagram.

(1) Saw the 3 wedge-shaped shoes 15 cm deep, with the horizontal cross-section an isosceles triangle of 18 cm base and 24 cm altitude.

(2) Cut sheet metal into 3 isosceles triangles of 19 cm base and 25.5 cm altitude.

(3) Punch ten holes in each sheet metal piece and nail to the wedge-shaped shoes.

(4) Nail wedges to top piece.

(5) Drill hole for control handle and shave pole for tight fit (a tapering hole as made by burning and a tapered pole base will give the best fit).

(6) Drill 2 holes in top surface for tow rope and attach.

This construction procedure should be modified to suit local materials and methods.

Design Modification: These dimensions should be modified to fit local soil conditions and farmers' preference; such as desired row width. Modifications in design which might be considered are:

(1) Staggering the shoes if the soil clogs and does not flow freely between the shoes, i.e. place center shoe 10 cm ahead of side shoes.

(2) Adding a chisel point centered between shoes and slightly ahead to form a slot if deeper seed placement is desired.

(3) Adding sheet metal surfacing to the sides of the shoes to decrease friction and reduce wear.

(4) Using heavier sheet metal for the base for longer service.

(5) Increasing or decreasing the number of shoes.

Operation:

(1) The devise is pulled across the seeded parcels, parallel with irrigation water flow if the surface is level. Ridges should be perpendicular to the flow of water in the parcel if the surface is sloping. This is to retain more soil moisture on the higher elevation by restricting water movement to the low part of the parcel.

(2) One or two men pull the device and one man steers, controlling both direction and depth, the latter by tilting the shoes either up or down.

(3) A series of small parcels can be ridged simultaneously by continuing from one to another in a single pass. The levees between the parcels are crossed without damage merely by tilting up the shoes; thereby, riding over and not through the levees. This procedure avoids the wasted effort of making many turns.

(4) Immediately following ridging of the seed, the parcels should receive the first irrigation.

(5) Bird abatement is necessary until secondary roots have securely anchored the seedlings.

Expected Advantages:

(1) Avoids loss of stand caused by the traditional method (in some cases near 100% loss).

(2) Permits use of only 1/2 as much seed as that which is now often applied in order to compensate for loss and the uncertainty of obtaining a sufficient stand.

(3) Avoids destruction of soil structure and the resulting decrease in water infiltration rate.

(4) Permits a efficient recovery of fertilizer (organic or inorganic), as the seed and fertilizer are placed in close proximity. This is especially important with phosphate.

(5) Arrange seed in bands spaced to permit weed control with the traditional hoe (daba); thereby reducing the weeding labor requirement at least by 1/2.

(6) Enhances roguing of off-type plants from seed fields by permitting easier movement through the wheat.

(7) Improves efficiency of the cutting operation of harvesting by the arrangement of the plants in rows.

Disadvantages:

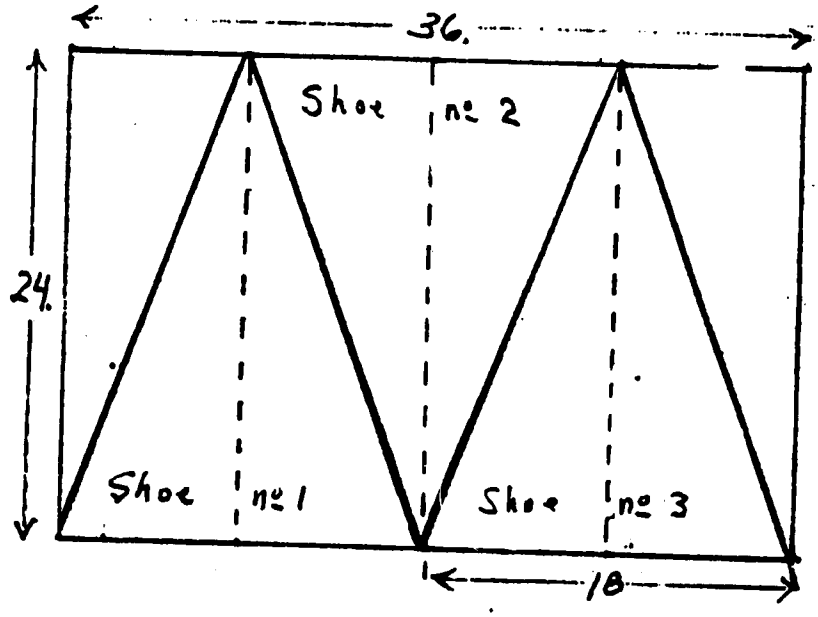
More vulnerable to bird loss until formation of the secondary root system. In the traditional system, tightly imbedding the seed in mud makes the seedlings more difficult for the birds to pull from the soil in order to eat the attached germinated seed. To overcome the early vulnerability, ridged seedlings will have to be guarded more closely. However, the vulnerable period will be shortened by the very favorable conditions for germination, emergence and seedling development as a result of improved aeration.

NOTE: A single shoe with a "V" bottom mounted and controlled in the same fashion would serve as an energy-saving ditcher. With an inverted open "V" on the bottom, the device becomes an efficient levee former - two operations which consume much of the farmer's labor.

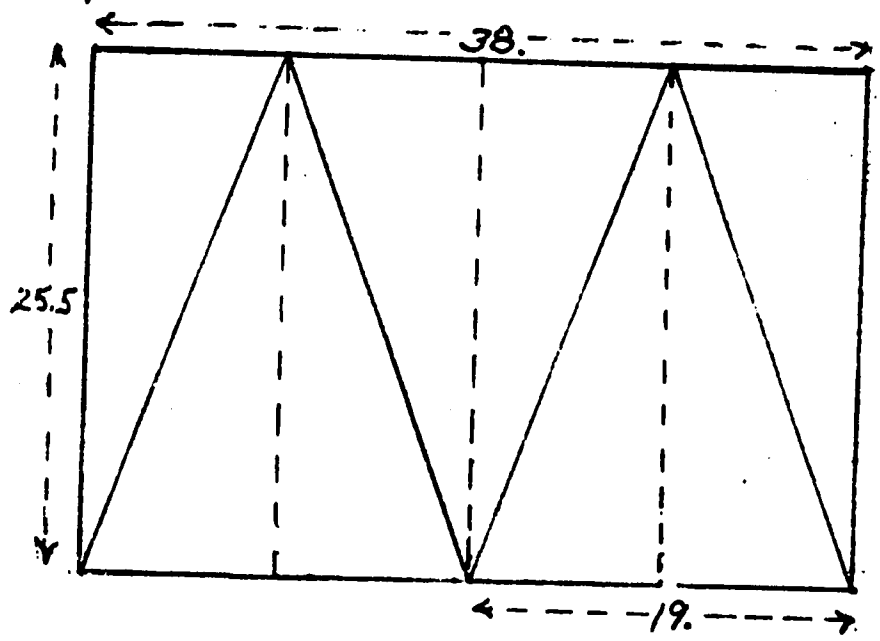
Seeding Device

Scale 1" = 10 cm

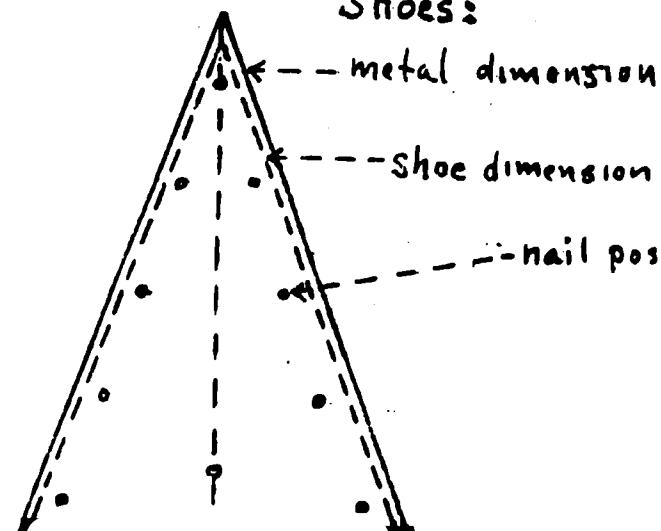
Cutting the shoes



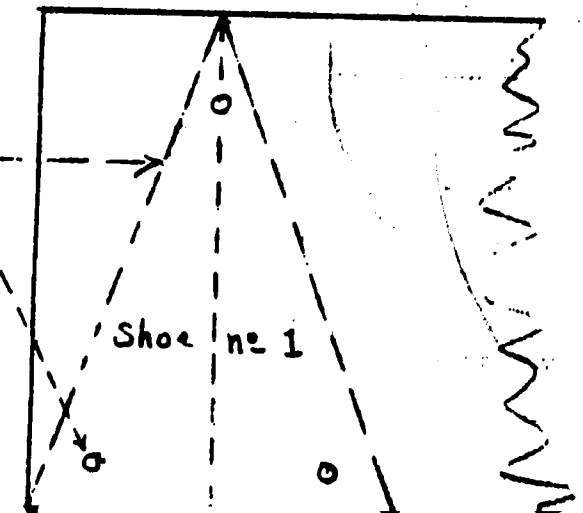
Cutting the sheet metal;



Nailing the metal to the shoes:



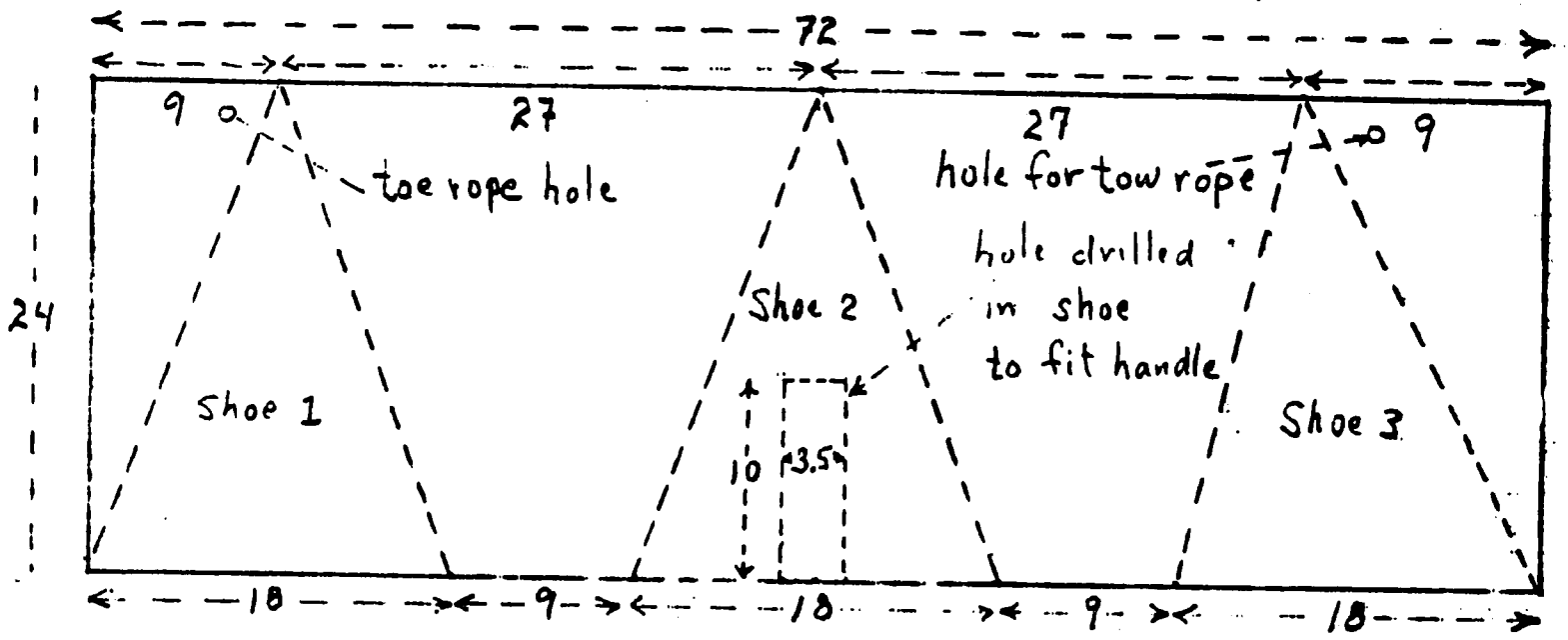
Nailing the shoes to the top



Seeding device

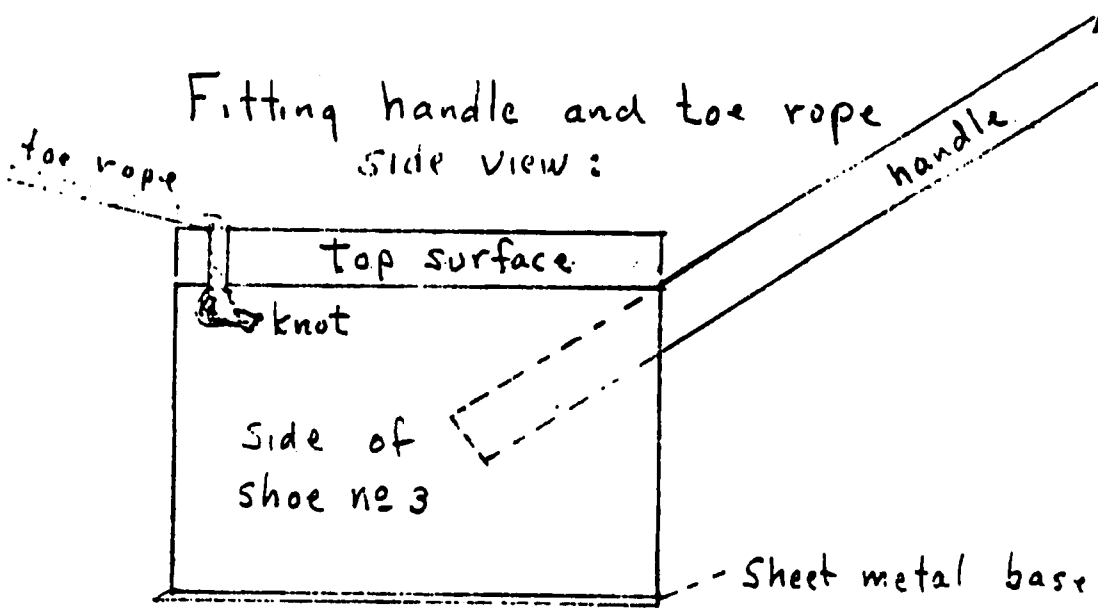
scale 1" = 10 cm

Placement of shoes, handle and tow rope - top view:

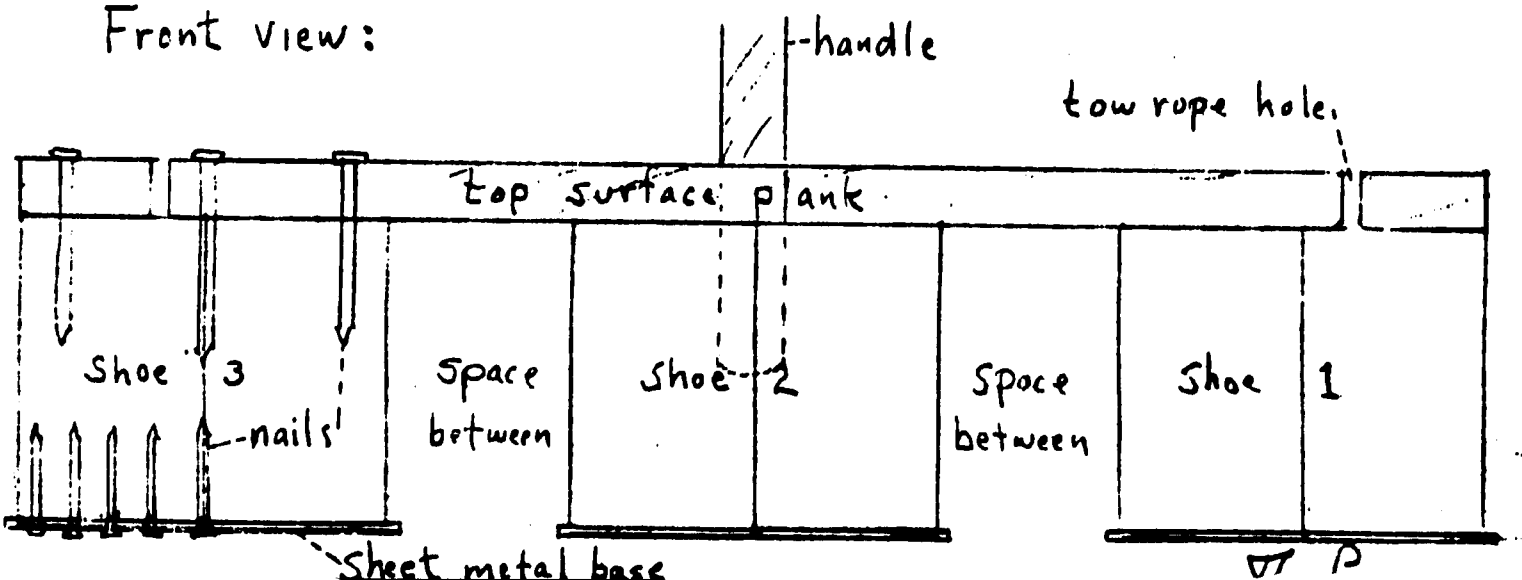


Fitting handle and toe rope

Side view:



Front view:



ANNEX IV

SUGGESTED SEED MULTIPLICATION PROGRAM FOR WHEAT.

A formal seed certification organization is not needed. This is a project function and can be more efficiently handled by the project than by an outside organization. However, a covenant should be signed with the newly funded Project Production des Semances Selectionés to insure cooperation and avoid misunderstandings.

There are 3 basic constraints: (i) choice of variety; (ii) overcoming the tradition of mixing seed; and (iii) assuring an adequate seed supply. The choice of a variety, or varieties should be made by a group and only after careful consideration of all research data as well as farmers experience. The choice must be made in time to make arrangements for seed purchase; however, if possible, it should not be made until the varietal performance of the current year is known.

The tradition of mixing seed can be overcome by providing the total supply of seed used by a village in order to prevent production of other grain which might be mixed with that of the improved variety. If this is accomplished, and if the purchased seed supplied was genetically pure, the crop produced would be equally pure. Purchase of seed is required in order to have a sufficient supply for total change over.

Seed of quality can be easily produced by farmers of the project. If off-type plants appear they can be rogued under the direction of the Extension service. Also extreme effort should be made to eradicate any weed species which may have been introduced with the seed. In effect, the farming unit of 4 hectares is a potential seed farm, and this system

has the capacity to supply the total project as well as future wheat expansion. Therefore, this is also the solution to the third problem, seed supply.

Seed quality standards can be maintained by selection of only the best farmers based on their record of yield, varietal purity, absence of disease, and freedom from weed seed or other impurities in the harvested seed. Farm units producing seed should receive an equal amount of grain or money equivalent plus a 20-25% bonus for the extra skill and special handling required. Competition among farmers based on performance is an accepted procedure in the present Diré project.

For the first few years seed produced by this system should be brought to Diré for safe storage. It should be treated and distributed to the villages in time for the next seeding operation. When the practice of mixing seed has stopped, and reliable storage is available in villages, the supply of seed for the next year could be retained by the village. Identification of variety and seed source by farmer, village, and year should be maintained with each sack of seed.

The amount of seed required for the total project area of 2,400 ha is 240,000 Kg (100 Kg per ha). This could be produced on 96 ha assuming a yield of 2,500 Kg/ha. However, for total saturation of the 600 ha planned for the first year of project operation, only 60,000 Kg is required. This would require the purchase of 60 tons of seed which could be trucked from North Africa where there are reliable certified seed programs. This could be a one time purchase because far more seed than needed for the coming year could be produced on the orignal 600 ha.

If a satisfactory variety (or varieties) has been chosen, the project could easily supply all future needs.

This plan for initial seed supply provides the essential element of flexibility if three varieties are obtained in the original seed purchase. Production from 20 tons of a single variety would produce most of the seed needed for the 1,500 ha planned for the second year, the original 600 plus 900 additional.

If it appears that another variety or varieties would be better than those originally chosen, a purchase from North Africa could be made for the second year. Also, a desired variety which was unavailable the first year, could be produced for delivery the second year. Likewise, in the third or any subsequent year, a purchase could be made to achieve a rapid shift in variety. This illustrates the continuing flexibility so essential to any plan involving biological systems.

To avoid seed mixing, most villages should receive only one variety, if possible. A village already producing wheat and possessing a sufficient supply of traditional seed could opt for staying with their own variety. In this case, sufficient seed for one or more 1 ha blocks of each new variety should be provided by the project for evaluation and demonstration.

The final provision for flexibility in obtaining varietal improvement on farms is provided by the on-going varietal work of the Diré research station, i.e. screening of many varieties, followed by multiplication of the most promising for release to farmers. In effect, this is the first step in conventional certified seed programs. The seed produced on the experiment station, carefully rogued to maintain varietal purity,

represents "Breeders" seed. This seed is then distributed to farmers who produce the "Certified" seed to be used by the rank and file of farmers for their crop production. This is presented to illustrate the selection and flow of increasingly improved varieties from research to farmers use, not to promote the formalities of a conventional seed certification program which would only impede progress at this time.

The suggested seed purchase program would result in starting the project with improved varieties. This risks large scale introduction of an unacceptable variety. The change from traditional to improved varieties can be accomplished at any chosen rate, the one fixed feature is that it must be carried out on a village by village basis. Large scale varietal introduction should not be undertaken until suitability of the variety is established. Farmers and village elders should have the opportunity to observe field demonstrations, sample food quality of the grain, and participate in the decision to make the change. In the meantime, all possible encouragement should be given to the varietal program of the present project at Diré.

ANNEX V

SUGGESTED RESEARCH PROGRAM FOR WHEAT, SORGHUM, AND PULSES

1. Varietal improvement: evaluation, selection, and original seed increase of those chosen. This includes purification by a strict program of rogueing (elimination of all types).
   (1) Wheat: continue the ongoing program maintaining a high level of seed purity in the most promising lines;
   (2) Sorghum: start varietal evaluations immediately;
   (3) Pulses: evaluate different crops, choose the most favorable and concentrate varietal and culture effort on these.

2. Water management including drainage: irrigation timing in wheat appears to be very well worked out, both on the experiment station and in farmers fields. Work needed on:
   (1) modification of amount and timing on heavy soils;
   (2) drainage on heavy soils;
   (3) use of plastic to conserve water and to avoid waterlogging, test lining ditches with strips of 150 to 300 micron thickness (6 to 12 mils), and tubes of various diameter of 300 micron thickness.

3. Tillage and seeding methods:
   (1) Tillage depth with local hoes, measure both labor requiremen and crop production;
   (2) Evaluate other hand tillage tools, include a spike as used in wood chopping, 20 cm long and cutting wedge set crossways;

(3) Evaluate pre-irrigation to soften soil for deep hoeing and determine optimum soil moisture content for working;

(4) Evaluate animal power and equipment when it becomes available to project farmers;

(5) Develop acceptable alternate seeding methods, including the suggested seeding devise for wheat (See Annex III..).

4. Fertilizer practices: to ensure farmer response and cooperation, recommendations should be based on farmers welfare - not maximum yield.

(1) optimum nitrogen level under various crop histories and soil conditions;

(2) optimum level of phosphate in relation to level of nitrogen;

(3) efficiency of phosphate application methods;

(4) relative effectiveness and cost of Malian rock phosphate vs triple super phosphate;

(5) yield response from local organic fertilizer practices compared with chemical fertilizer programs;

(6) develop recommendations for most efficient use of local fertilizer alone and in combination with chemical fertilizer.

5. Rotations: (cropping patterns)

(1) Economic/biologic evaluation of recommended and promising alternate rotations - continue the trial at base 4 years to measure influence on soil, yields, and possible problems.

(2) Date of seeding x variety of crop components used in rotations in order to design the most productive schedule of seeding dates.

6. Crop protection:

(1) Bird control,

(2) Rat control,

(3) Insect control, include protection of stored grain,

(4) Disease control, include evaluation of available seed treatment materials,

(5) Weed control,

(6) Evaluation of species for wind breaks and influence of wind breaks on crop performance as well as increasing the bird problem by providing shelter.

Research activity needs a USAID budget in order to insure adequate logistic support. This will also improve technical guidance and assistance. At this stage, elaborate technical equipment would be more of a liability than an asset because of restricted technical and maintenance capability; for instance, soil preparation, seeding, weed control, harvesting, etc. can be accomplished by day labor, as it is on farms. This means adequate budgeting for this labor is extremely important.

The most pressing equipment need of the research program at this time is canvas tarps on which to accomplish the threshing of grain. All harvesting is accomplished on the connected fragments on an ancient tarp. This results in seed mixing of

the improved varieties during the threshing operations. A minimum requirement is 2 large tarps 6 x 10 meters and 10 small tarps 3 x 4 meters for simultaneous threshing of 10 different varieties. As a first step a mechanical harvesting, a pedal-operated thresher is suggested (see next page).

THRESHERS

With annual wheat production of 6,000 metric tons, it is conceivable that Dire farmers may encounter threshing problems. Traditional threshing is time consuming and wasteful with losses estimated as high as 10 percent. Moreover, farmers have a limited time period between mid-March and the first rains in late June or early July in which to thresh.

SCAER presently has a very limited number of foot-pedal operated rice threshers adaptable to wheat.While few have been sold locally, it is reportedly well accepted for rice threshing in the Ivory Coast. Since SCAER has no plans for further imports, these machines will be produced locally at an estimated cost of $250 by SMECMA[1] or in Dire at the pump repair shop using drum threshers as developed at IRRI.

At a wheat price of 125 MF to the producer it would take only 1,000 kilos of reduced wheat losses for the thresher to pay for itself. Threshing capacity is rated at 100 kilos per hour. The savings on labor inputs would greatly increase the farmers' return.

This project will test the effectiveness and acceptability of these threshers and a line item has been included in the Action Research and Evaluation budget for such a purpose. One thresher will be tested in each participating village and another thresher at the research station. The effect on labor use and social acceptability will be monitored by the sociologist and the project analyst.

1 Société Malienne d'Equipment et du Commerce de Machinisme Agricole.

ANNEX VI

PUMPS

A. DISCHARGE AND HEAD CHARACTERISTICS

Required Pump Discharges: The following table shows the irrigation seasons in relation to the ETP (evapotranspiration) figures, in mm, available from the Timbuktu weather station.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
160	167	219	238	258	236	223	182	149	208	181	154
/—wheat—/ Total ETP 571 mm						/—— sorghum——/ Total ETP 546 mm				/—wheat—/	

Since the soil in the project area is fairly impermeable and the canals from the pumps to the fields very short (50 m for the first strip of fields and 300 m for the second strip - Diag. 3), conduction and field losses are likely to be minimal. Thus a figure of 72% of overall irrigation efficiency is on the conservative side. At this efficiency, overall pumping requirements for wheat are about 800 m^3/ha (approximately 10 hours of pumping) and 12 irrigations of 600 m^3/ha each (approximately 7.5 hours of pumping), spaced about 7 days apart. (8,000 m^3/ha are being provided at present on the small pump perimeters, and seem to furnish somewhat more water than necessary). Assuming 6 irrigation days per week, the pumping requirement is 100 m^3/ha, or (considering 8-hour days) 12.5 m^3/hr per ha.

For sorghum, which grows during the rainy season (average rainfall about 240 mm/year), the supplementary irrigation requirement is about 306 mm, which at an irrigation efficiency of 72% requires the pumping of 4,200 m^3/ha. This could be done in 7 irrigations of 600 m^3/ha each, at a frequency of about 10 days. Assuming 6 irrigation days per week, the pumping requirement is about 67 m^3/ha/day, or (considering 8-hour days) 8.4 m^3/hr per ha.

Pumping Heads: If the pump outlet is assumed to be situated 20 cm above the Niger River 100-year flood level, i.e. at an elevation of 6.40 m (Table 2, Annex VI), the necessary net heads (water level difference between water source and outlet canal) will be:

	Nov.15	Dec.15	Jan.15	Feb.15	March 1
Net head (m), average year	1.02	0.76	0.82	1.40	1.95
Net head (m), 20-year drought	1.46	1.55	2.48	3.73	4.45

During the sorghum season, the necessary heads would be:

	July 15	Aug.15	Sept. 15	Oct. 15
Net head (m), average year	5.04	3.44	2.10	1.44
Net head (m), 20-year drought	5.92	4.40	2.61	1.87

Thus the pump should provide a net head of 4.5 m during the wheat season and of 6.0 m during the sorghum season.

Pump and Field Layout: Each pump is calculated to irrigate a 4 ha unit with a 160 m width along the water-front and a 250 m depth (Diag. 3). Once the water-front fields have been occupied in a certain location, farmers could place a second pump near the first one to cultivate a 4-ha unit in the second tier of fields (Diag. 3). If infiltration losses in the 300 m long canal which this scheme requires prove excessive, the canal could be lined with plastic. This layout would have the advantage of having two pumps stationed next to each other, each programmed to work 8 hours per day, so in case that one pump needs to be sent for repairs, the other one could substitute for it, thus providing a 100% standby capacity at no extra cost.

Alternatively, after a few years of cultivating the water-front unit, the farmers could use the same pump to irrigate the 4 ha unit farther inland leaving the first unit fallow, thus practising in effect shifting cultivation under irrigation. This arrangement has the agronomic and economic advantages of reducing the build-up of crop diseases, eliminating the need for fertilizer and correspondingly reducing the farmers' cash costs for the same yield (Annex I). The farmers will have a choice between the two above types of layouts.

B. DIESEL PUMPS

Irrigable Area per Pump: A BERNARD 21-173 4 HP diesel pump (quoted here as an illustration rather than as a recommendation) has the following characteristics:

Head, m	5 m	10 m	15 m
Discharge, m^3/h	80 m^3/h	65 m^3/h	50 m^3/h

Considering the heads and discharges indicated above, a 4 HP low-head pump is capable of irrigating under project conditions about 5.5 ha. To allow for less than complete operating efficiency, the project design calls for 4 ha per such pump. This is viewed as a minimal figure, considering the fact that the pilot pumps are currently irrigating nearly 4 ha each while running well below full speed, and that at least one farmer, by staggering the planting dates, is currently irrigating 10 ha with a similar pump.

Improvements Upon the Existing Installations: The pilot establishment of 10 BERNARD F-51 diesel pumps has provided the invaluable precedent which

makes it possible to plan for the installation of 500 small motor pumps. As is to be expected, it has also provided indications for possible improvements in the system. Some recommended changes are:

a. The present pumps are medium-head (15-30 m), 6 HP models, equipped with a 65 mm discharge pipe. This head is too high for local conditions, and the pipe diameter too small, creating excessive friction losses. A 4 HP low-head (5-15 m) pump would have a purchase price about 20% lower, would consume less fuel, and be capable of delivering higher discharges.

b. The diameter of the delivery pipe should be increased to 80 mm to avoid excessive friction losses. On the other hand, a low-pressure pipe would be sufficient, and more economical.

c. A trench should be dug by the irrigators up to a certain distance from the water's edge and the pump placed near water level at the end of this trench (Diag.). This will decrease the cost of the delivery pipe (which at present is nearly 20% of the pump cost), as well as the friction losses (which at present are larger than the net lift height) and the fuel consumption. In addition, it will allow free circulation of persons, animals and vehicles along the shore.

Choice of Pump: The whole project will stand or fall according to the performance of the diesel pumps. In order to fulfill satisfactorily the demands placed upon them, the pumps must meet the following conditions:

- be robustly constructed;
- have slow motor speed;
- be capable of several overhauls;
- be thoroughly tried in tropical small-farmer conditions;

- have a satisfactory spare-part supply system.

For choosing a pump to meet these conditions, see Annex

Spare Parts: Given the uniformity of conditions in the project area, all 500 pumps will be of the same model to assure interchangeability of spare parts. Each pump will come equipped with a kit of spare parts worth 50% of the pump cost and sufficient for about five years' repairs. The kit will include the parts which need most frequent replacement such as filters, gaskets injectors, valves, pistons, piston rods, etc. The possession of the spare parts by the users will assure their immediate availability.

Repairs: The project will contract 8 itinerant mechanics to perform preventive maintenance and small repairs, and provide a central workshop at Bourem to handle more major repairs. The project will also provide stipends for 8 young men from the project area for 3-year studies in Bamako to become diesel mechanics, so that they can return to their villages to replace the outside mechanics at the end of their contracts.

Fuel Supply: For reasons of economy, all fuel must be shipped to Diré by river. During the navigation season (September-January) one must ship enough fuel to last through the sorghum irrigation season (July-October), which coincides with the Niger low-water period, and yet have enough fuel on hand for starting the wheat irrigation season (November) until new fuel supplies are brought. Thus, to assure fuel availability, a one year fuel supply must be brought in during the flood season. This amounts to 800 liters (four 200 l barrels) per pump per year, i.e. a total of 400,000 liters (2,000 barrels)

annually for the 500 diesel pumps. All fuel will be brought by barge to Diré in 200 liter barrels and distributed immediately by pirogue to the project villages, where it will be stored in the open under shade.[1/] Of the four barrels which correspond to each pump, two will be extended on credit and always in the farmers' possession: one stationed with the pump and one used for refuelling. The remaining two barrels will be either headed upriver full or downriver empty.

Pumping Costs: Initial costs of a small pump installation for 4 ha is about $2320. Based on a 5-year life span, the annual cost for irrigating one hectare is $182 for wheat alone, or $204.50 for wheat/sorghum rotation (Table 1).

1/ It is interesting to note that strong diseconomics of scale exist in the project area. Thus two 50,000 liter fuel tanks at Diré cost $36,000, or over twice as much as would have cost the same storage capacity in 200 l barrels costing $30 each. Similarly, three installed 100 HP pumps on the Diré pilot perimeter cost $230,000 or almost twice as much as would have cost equivalent horsepower in 75 4-HP pumps costing $1600 each. The reason for these diseconomics of scale is the extremely high cost of any contract construction in the isolated project location. Thus, in Diré conditions, "small is economical".

ANNEX VI

TABLE I - PUMPING COSTS

Fixed costs:

4 HP portable diesel pump with wheels, 7 m suction pipe and 3 m delivery pipe, CIF Bamako	$ 1400
Spare part kit for 5 years' operation - 50% of above	$ 700
20 m of 80 mm low-pressure delivery pipe, at $7/m	$ 140
2 fuel barrels, $30 each	$ 60
Transport from Bamako to site	$ 20
TOTAL cost, installed[a/] = 1,160,000 MF or	$ 2320

Assuming amortization over 5 years at 8% interest, annual fixed cost = $580 = 290,000 MF

If one pump serves 4 ha, annual fixed cost = $145 or 72,500 MF per ha.

Variable Costs (for wheat - 8,000 m^3/ha)

Gasoil, 500 liters at $0.26/1	$ 130
Lubricant, 6 changes of 2.5 liters each at $1.20/1	$ 18
Variable Costs (wheat) - 74,000 MF or	$ 148
Variable costs per ha (wheat) - 18,500 MF/ha or	$ 37/ha
TOTAL cost per ha (wheat) - 91,000 MF/ha or	$ 182/ha

Variable Costs (for sorghum - 4,200 m^3/ha)

Gasoil, 300 liters at $0.26/1	$ 78
Lubricant, 4 changes of 2.5 1 each at $1.20/1	$ 12
Variable Costs (sorghum) - 45,000 MF or	$ 90
Variable costs (sorghum) per ha - 11,250 MF or	$ 22.50
Total cost per ha (wheat/sorghum rotation)- 102,250 MF or	$ 204.50

a/ Quantity discounts of up to 20% may be realized on this cost owing to the quantities to be purchased. Also, the length and cost of the delivery pipe can be reduced by excavating a longer inlet trench.
(Source: SIEMI, USAID mission)

C. ANIMAL DRIVEN PUMPS

Flow Pump Characteristics: The situation in the project area seems very promising for the introduction of modern, efficient animal driven pumps, of the type which is rapidly replacing the traditional Persian water wheel on small farms in Pakistan, where it is known as a flow pump (Diagram 5). In a flow pump, the circular motion of the animal is transferred from a horizontal gear through a pinion to a vertical pulley which drags a chain up a vertical pipe. Washers placed at 2' intervals along the chain lift the water through the pipe. The assembly can be driven by an ox or a donkey. For the pumping heads considered above, a 4 inch to 6 inch lifting pipe would probably be best. With pipes of these diameters, the flow pump can furnish upwards of 25 l/s. Thus the area irrigable per flow pump depends on the animal driving power.

Area Irrigable per Animal Driven Pump: Considering that one 300 kg ox can provide continuously a force of 37 kg at an average speed of 0.6 m/s, it furnishes a power of about 22.2 kg-m/s. As the pump efficiency is at least 80%, this corresponds to 18 l/s x m (65 m^3/h x m) of delivered power. At the pumping heads shown above, one ox could thus irrigate 4 ha of wheat (possibly supplemented by a second ox during the last few weeks of the season or during years of extremely low flows). Considering the ox to work not over 4 hours per day, 1 or 2 additional oxen are necessary for relief. A sufficient number of animals are presently available in the project area to meet these requirements. During the sorghum season lifting heads are greater but the water needs are smaller, so that generally one flow pump can still irrigate 4 ha.

Installation of Animal Driven Pumps: A trench will be dug by the farmers from the water's edge to the top of the embankment, and the flow pump mounted on beams placed agross its end. A bridge of planks covered with earth will be

thrown across the trench to allow passage of the animals (Diagram 5).

Cost of Animal Alimentation: Under local conditions of feed availability, the most satisfactory ration for a working ox would consist of 10 kg/day of wheat straw or dry sorghum stalks and leaves, supplemented by 2 kg/day of sorghum grain and by mineral salts. Straw and stalks will be available on site from the previous harvest at quantities much greater than required for feeding the draft animals. Thus the cost of feed is only 2 kg sorghum/day x $0.12/kg x 100 days/season = $25/season per animal, or $50-$100 for 2-4 oxen per season. In comparison, a diesel pump requires 500 liters of gasoil and 15 liters of lubricant per season, at a cost of $200.

Draft Animals: Donkeys as well as oxen are capable of powering a flow pump. Both are abundant in the project area. The cost of a three to four year old ox would be about 80,000 MF ($160). It is interesting to note that throughout West Africa oxen appreciate in value as a result of (i) being trained for work and (ii) increasing in size and/or weight. Thus the value of the ox would increase for the first 7-8 years. Donkeys, costing approximately 1/4 as much as oxen, depreciate in value as work animals after two years of labor. Two donkeys would be needed to do the work of one young ox. A separate credit item was not included in the revolving credit fund for the purchase of draft animals. Interest earnings would be more than adequate to fund the purchase of all animals needed to power the flow pumps (estimated at $74,000 total).

Cost of Flow Pump: About $400 FOB Lahore, Pakistan, which should correspond to about $800 installed on site (including $100 imputed for excavation of inlet trench by beneficiaries), compared with over $1,600 for a diesel

pump capable of irrigating an equivalent area. In this relation one should note that the life span of a flow pump is 15 years vs. 5 years for diesel pumps.

Spare Parts: The only necessary spare parts for flow pumps are the washers, which should be replaced every season. 4 highly skilled Touareg swordsmiths and some 16 Sonrai blacksmiths reside in Diré alone, who can fabricate such washers from scrap sheet metal and old inner tubes at a cost of about $16 annually per pump. In comparison, the spare part cost for a small diesel pump will be about $160 annually.

Conclusion: Animal driven pumps hold considerable promise for providing irrigation at a fraction of the investment and operating costs involved in diesel pumps. Animal driven pumps will utilize local resources (animals and feed), and eliminate dependence on imported fuel and spare parts. Thus animal driven pumps appear worthy of a serious effort for their introduction. At the same time, since they have not yet been tried out in the project area, and since their introduction will take time, evidently they cannot at this stage constitute the base of the entire project. Consequently, the project provides for the pilot introduction of 5 flow pumps in the first year, 50 in the second and 50 in the third year, at a total cost of about $130,000. This installation, if successful, will provide the base for local manufacture of such pumps in Mali. The proportion between the number of diesel pumps and flow pumps will, however, be kept flexible and adjustable either way according to the experience gained with large scale installation of the two types of pumps in the project.

Other appropriate technology devices for irrigation, cultivation, storage and transport should likewise be introduced by the project on a pilot basis if considered to be potentially useful.

ECONOMICS OF SOLAR PUMPS

Water requirements for 4 hectares of wheat during its 120 day growing season are estimated at 32,000 cubic meters or 266 m^3 per day. At an average head of 5 meters, this would require 1300 watts or solar panels at a 1979 cost projection of almost $10,000 ($7,600 per KW x 1.3 KW equals $9,880). Panels represent roughly 50% of the total cost of the installation. Transportation to Diré, construction costs of footings and well re-inforcements, channel work and installation bring the estimated cost of a solar pump to $25,000 for four hectares of land (the "module" size used for the analysis of the diesel pumps) or $6,250 per hectare.

Panel life is estimated at 15 years, and the life of the pump is estimated at 7-8 years. The submersible pump would require little maintenance during this time and no fuel.

COMPARATIVE ANALYSIS

		Diesel Pumps	Solar Pumps
A. Fixed Costs:	Unit Cost	$ 2,320	$ 25,000
	Cost/ha	580	6,250
B. Variable Costs(1)		211.50	-
C. Total costs/ha over 15 years(2)		4,913	6,250
Discounted at 8%(3)		3,198	6,250

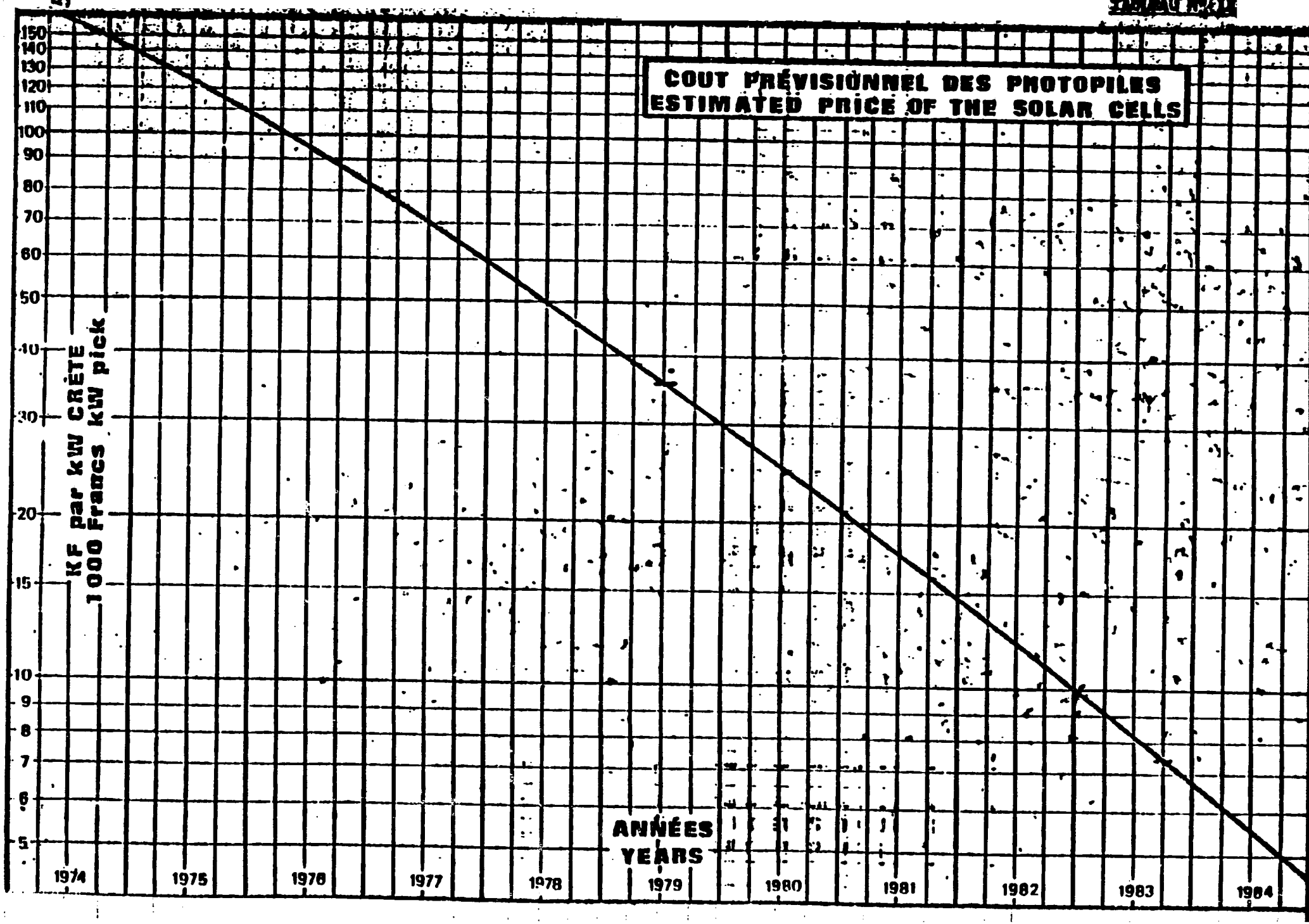
(1) Annex XI "Pumps" shows that the variable costs/ha/yr for double cropping (wheat and sorghum) is $204.50, to which is added $7.00 for maintenance, repairmen, etc.

(2) Solar pump has a 15 year life span. Figure for diesel pump includes 3 pumps and operating costs for 15 years.

(3) Discounting costs at 8% takes into consideration lost opportunity costs of having to pay out a large initial sum as opposed to paying out gradually over a number of years.

While per hectare costs per year-of-useful-life are more than double for the solar pump, there will be a use for these pumps in the near future. Prices per peak kilowatt hour will continue to decrease dramatically (see graph on following page). It is fully expected that solar pumps will be economical in the early 1980's. By that time, the Action Blé management capability will have been clearly demonstrated, research and extension delivery systems fully developed, and farmers should be in a better position to afford the initially higher costs of solar pumps. USAID/Bamako is designing a project to strengthen the capability of Mali's Solar Energy Laboratory to accelerate solar energy uses in the rural areas. Thus, the interest in promoting solar pumps for irrigation in Diré.

The provision of one 1.3 kilowatt solar pump, owned and maintained by Action Blé and capable of irrigating a four-hectare plot maintained for research, should be considered for demonstration during the life of this project. When not needed for irrigation, the solar panels could power a small grain mill or thresher. This demonstration would (i) hasten the acceptability of solar pumps when they do become economically competitive with diesel pumps; and (ii) demonstrate the economics of <u>small</u> solar pump irrigation. Funds from the Action Research and Evaluation budget (Appropriate Technology) could be used to cover the purchase and installation cost of this pump. The design team for the Energy Nouvelle project has reviewed the economic analysis and agrees that during Phase I of this project diesel pumps will be more economical (even discounting the rising costs of fuel. They support the strategy,however, of purchasing and installing one solar pump at this time.


COUT PRÉVISIONNEL DES PHOTOPILES
ESTIMATED PRICE OF THE SOLAR CELLS
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ANNÉES
YEARS
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

ANNEX VII

HYDROLOGY

All water courses in the project are part of the Niger River system. Historical water levels in the Niger River at Dire are shown in Table 1. The table shows that the lowest flows are in June. The flood peak comes in November, December, or January, arriving later in measure that the flood is higher. The table shows that in any year the difference between highest and lowest water levels is remarkably constant, being about 4.61 to 4.94 meters. The level difference between the 100-year high and 100-year low is 6.07 m.

The Niger River system consists at the project site of several branches (marigots), some of which flow into seasonal lakes (mares), from which water flows back into the river as the annual flood recedes.

TABLE 1 WATER LEVELS OF NIGER RIVER AT DIRE (in meters)

Frequency	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Max. Diff.
0.01	6.17	5.92	5.43	4.23	2.67	1.56	2.60	4.00	4.90	5.40	5.81	6.11	4.61
0.05	6.10	5.82	5.25	4.05	2.33	1.48	2.43	3.95	4.76	5.35	5.78	6.04	4.62
0.10	6.06	5.77	5.13	3.88	2.18	1.40	2.33	3.72	4.70	5.30	5.70	5.98	4.66
0.20	5.95	5.67	4.80	3.37	1.80	1.23	2.08	3.46	4.56	5.19	5.59	5.90	4.72
0.50	5.58	5.00	3.90	2.20	0.94	0.70	1.36	2.96	4.30	4.96	5.38	5.64	4.94
0.80	5.00	4.00	2.60	1.10	0.53	0.41	0.78	2.46	4.04	4.74	5.15	5.35	4.94
0.90	4.40	3.25	1.70	0.70	0.36	0.30	0.58	2.20	3.90	4.62	5.04	5.18	4.88
0.95	3.92	2.67	1.23	0.52	0.27	0.22	0.48	2.00	3.79	4.53	4.94	4.85	4.72
0.99	3.20	1.52	0.78	0.38	0.18	0.10	0.36	1.60	3.58	4.35	4.75	4.12	4.65

Water level = average level between 10th and 20th of month

Frequency = frequency with which that level is exceeded

Zero level corresponds to 256.80m above sea level

Source: Flood gauge at Dire

ANNEX VIII

THE CASE FOR DIESEL PUMPS

Small motor pumps of the variety proposed in this project are by no means unknown in Mali. Indeed, one of the principal reasons that diesel, as opposed to gasoline, pumps are being proposed stems from the experience of numerous farmers and Operations, such as that in Haute Vallee, that gasoline is too expensive (over 40% higher than that of diesel fuel) and that the life of such pumps is less than that of diesel models. Motor pump repairmen confirm that diesel models tend to last at least 50% longer. SCAER, in fact, has decided to import only diesel models.

There are other considerations as well - the quality of upkeep and productivity per hectare. Programs involving motor pumps which do not make adequate provision for repairs are doomed to failure. A large percentage of existing motor pumps in Mali are not operating for precisely this reason. On the other hand, where repair programs are assured pump operators are reaping sizeable benefits. A good example of this is the Catholic Mission in Gao, (7th Region) which has distributed over 30 gasoline pumps of 2 to 6 HP throughout the area. Essentially, about 85% of these pumps are working at any given time because there is a repairman to whom these pumps can be brought for repair. He agrees that no more than one repairman for every 75 pumps is needed. Their experience indicates that actual repair costs are quite small, and that the only major item which needs to be replaced is the piston. Monthly cleaning or replacement of spark plugs and a general overhaul every 2 to 3 years is also recommended. Models 10 years old exist in Gao. Experience with

pumps in Mali is that their life expectancy is normal whenever repair and routine maintenance is readily available.

An Economic Analysis of Small Pumps

The second crucial varable effecting pump viability is the productivity of the land combined with market prices; pumps on land producing 1 ton cereal/hectare tend not to be viable, but doubling the land's productivity changes the picture entirely. In this project, the wheat yields will be high (2.5 tons/hectare) and the market price will be much higher than that of any other cereal. As for sorghum, the yields will not be initially as high but on the other hand, the pumping demands will supplement natural rainfall so that the irrigation requirements are significantly less than with wheat. While the official price of sorghum is low (36 MF/Kg), no sorghum in the VI Region is sold to OPAM and open market prices are indeed favorable, ranging in Diré from a low of 65 MF at harvest time in a good year to 200 MF in June-August in a drought year. As of March 1978, sorghum prices were 125 MF/Kg in Diré.

A Cost/Benefit analysis of the pumps is given below. Because the benefits of small pumps for growing wheat are much more evident than they are for sorghum, this analysis divides the pumping costs between the two crops so as to enable a better understanding of the viability of each crop. Because the pumping hours on the wheat will be 60% greater than that on the sorghum, fixed costs as well as the costs of the repairmen and repair shop are split 62.5% and 37.5% to reflect real pump usage. A market price for sorghum of 60 MF/Kg is used on the assumption that an additional 3,500 tons will depress

prices slightly but with the significant regional deficit of 20-25,000 tons cereal assuring a continued strong consumer demand.

Pump Costs/Ha (total ha=2,240)	MF/Ha/Year Wheat	Sorghum
- Purchase cost (including spare parts kit)=$2,320 installed, amortized over 5 years at 8%, each pump covering 4 ha.	45,313	27,187
- Gas oil, for 4 ha: for wheat, 500 liters at 130 MF/l; for sorghum, 300 liters at same price.	16,250	9,750
- Lubricant, for 4 ha: for wheat, 6 changes of 2.5 liters at 600 MF/l; for sorghum, 4 changes at same price per liter.	2,250	1,500
- 8 mechanics at 50,000 MF per month each.	1,240	744
- Pump repair center: construction and equipment costs=$50,000, amortized over 10 years at 8%.	938	558
- Pump repair center annual operating costs=$2,500 per year.	323	194
	66,314	39,932
- Other costs (seed, fertilizer)[1]	36,778	8,136
Total costs, not including labor	103,092	48,068
Gross Revenue (2.5 tons/ha wheat at 125 MF/Kg) (1.5 tons/ha sorghum at 60 MF/Kg)	312,500	90,000
Net Revenue per ha (MF)	209,408 ($419)	41,932 ($84) [2]

The question confronting the participating farmers is whether

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At end of AID project's life.

This Table illustrates wheat/sorghum irrigation costs including charges for mechanics salaries and amortization of pump repair center. This figure is $57.00 less than the income projected on crop budget D for sorghum. Total projected income after amortization of these extra costs charged in this case to sorghum is $7.00 less than net income of Crop Budget D.

using the pumps on the sorghum is worthwhile. Without a second cropping of sorghum, the farmers receive nothing, whereas with the pumps they earn $84/ha if they sold it all at a low price. If they do not plant the sorghum, they are going to have to buy practically all their grain needs in the market, where prices sometimes go as high as 200 MF/Kg. The answer seems to be quite clear - farmers are going to chose to plant the irrigated sorghum, and it is going to add significantly to their incomes and to the economic viability of the project.

INITIAL ENVIRONMENTAL EXAMINATION

Project Location:	Mali
Project Title:	Action Blé
Funding:	A.I.D. FY 1978, $4.43 million
Life of Project:	4 years
IEE Prepared by:	I. E. Asmon Irrigation Engineer/Economist Thomas Park CDO Health Officer
Environmental Action Recommended:	Negative Determination
Concurrence:	_____ Ronald D. Levin Director _____ (date)
Assistant Administrator's Decision:	_____ _____ (date)

ANNEX IX

INITIAL ENVIRONMENTAL EXAMINATION
Action Ble

Project Overview

The project is a significant first step in replacing Mali's considerable wheat flour imports (U.S. $7.9 million in 1976/77) by local wheat production in the Dire area. The wheat will be produced entirely by small farmers, mainly by means of small-pump irrigation from the Niger River. At the same time, the project will eliminate the wheat deficit and a large part of the sorghum deficit of the VI Region (the chronically grain-deficient, isolated Timbuktu-Dire area), and substantially improve the incomes of about 2,400 small (1 ha. each) wheat producers in what is now the poorest region of the country.

The project will assist small farmers to grow wheat and sorghum on 2,420 hectares of irrigated land by means of 605 small pumps. Each pump will irrigate at least four hectares and be jointly owned and operated by four farmers cultivating about 1 hectare each. Action Ble will provide the farmers with extension services, fuel, supplies (at non-subsidized prices), mechanical service, and a non-obligatory marketing service at guaranteed prices. Some of the pumps will be animal-drawn, in order to introduce a simple, low cost lifting device into the area.

The Setting

In the Goundam and Dire administrative units (cercles), there are over 12,000 hectares of plains potentially suitable for wheat production. These are in addition to the 4,000 hectare plain around Dire which was the site of irrigated cotton and wheat agriculture between 1921 and 1946. Much of the area presents a topography characterized by (1) banks rising steeply to a height of about four meters, from the Niger River and especially from the Farabongo branch which is one of the important channels of the river; and (2) almost perfectly smooth plains sloping gently inland from the top of the river embankment.

The area offers nearly ideal agronomic conditions for wheat production because (i) the temperature and sunlight are all but perfect; (ii) the river supples ample water; and (iii) there is no shortage of land with good soil for cultivation.

Along the river, and especially along the aforementioned Farabongo branch (which is deeper than the main channel and assures water availability even in years of extremely low flows), over 48 kilometers of steeply-inclined banks have been identified in the Dire and Goundam cercles. At least 2,220 hectares are available along these banks which

could be irrigated year-round. Another 200 hectares adjoining the Marigot de Bourem have also been included in the project. Although the Marigot carries water only during the flood season (which corresponds to the wheat growing season), the soils of these 200 hectares are outstanding in fertility. Thus the total land area of the project has been defined as 2,420 hectares for wheat production during the cool period following the end of the rains when the river is still in flood, succeeded by a legume crop from mid-March to early July, with a final crop of sorghum grown during the rainy season. The typical four hectare farm unit will front on the water course for 160 meters and extend for 250 meters inland. This will result in a 250 meter-wide strip being created along the river. Later in the project, a second tier of farm land can be opened, widening the green strip along the river to 500 meters.

The soils of the project area were created through the interaction of the annual flooding of the Niger delta with the east-west bands of dunes farmed during past dry cycles. Subsequent floods inundated the depressions between dunes and formed heavy textured lacustrine soil which has further been influenced by a long period of soil weathering and erosion. The overall result is a veritable mosaic of soils ranging from sandy clay loam, to clay loam, and sandy clay. The nitrogen status of the soils is above the optimum level for wheat which means that no fertilizers will be needed until the third year of the project.

The area around Goundam and Dire is comprised of some 30 villages with a total population of about 17,000. All except two of these are Songhrai villages. The population density is estimated at 35 persons/km^2 (Ministere de l'Agriculture, 1975:56).

Village subsistence is derived mainly from agriculture. Principal crops locally consumed are rice, sorghum and millet. Wheat in very small quantities has been grown in the early dry season for at least 75 years. What is grown is sold, mainly in Dire, Goundam or Timbuktu to the Arab and Berber population. It is believed that the cash derived from the sale of wheat is used to supplement the diet of rice and sorghum with more of the same. Small quantities of fruits and vegetables are also grown for local consumption. The total grain crop presently harvested is estimated to be 20% to 50% less than what is required to satisfy local needs. Currently, about 150 hectares of wheat are grown, of which only 50 hectares are irrigated by mechanical means.

Cattle, sheep and goats are the usual livestock of the Songhrai, though in smaller numbers than are kept by the nomadic Peul and Toureg. The people of the project area now claim to have only one-tenth the number of animals they had before the onset of the drought. The Songhrai animals are left in the care of Peul or Bellah herders. They are the Songhrai

form of savings and investment and also provide milk and meat for the diet and wool and hides for the household.

Health conditions tend to be poor. People do not dig wells, but take their water directly from the river. Because latrines are rare, defecation often occurs at or near the river. Dysentry, schistosomiasis and malaria are said to effect the entire population. Tuberculosis is present among older people and leprosy is not uncommon. Give the shortfall in food production for the area, it is reasonable to assume that malnutrition has an adverse effect on health in the region.

Environmental Considerations

Land

The existing vegetal cover consists of sparse bushes, small trees standing several yards apart, and seasonal grasses. The replacement of this cover by a continuous wheat and sorghum cover is certain to reduce wind erosion caused by the harmattan and water erosion from flash rains. The project will essentially create a 2,420 hectare oasis along this desert stretch of the Niger River.

The land in the project area is flat and gently sloping. No land will be leveled except for the flattening of occasional termite mounds with hoes. This will have no effect on the texture of the soil. Because the soils in the project area are mostly untilled and barren except for scattered trees and shrubs, they are very low in organic matter and possess minimal structure. The introduction of crops will greatly increase root activity, organic matter and biological activity in the soil which will be beneficial to its structure.

The soil has been found to contain more than the optimum levels of Nitrogen for wheat crops the first year of cultivation. In the second year, no fertilizers will be added, but in the third year of cropping, minimal fertilizer dosages will begin. These dosages are intended to maintain fertility levels equivalent to those experienced in the second year of cultivation.

Biological breakdown will be rapid due to the high temperatures and soil moisture. The land slopes away from the Niger River, so that direct run-off of overflows into the river is not possible and any excess water can reach the river only after long infiltration. Thus, no direct contamination of the river system is possible. There are no wells in this area to be polluted by run-off and no pesticides or herbicides are contemplated in this project. To minimize any potential salinity and drainage problems, soils of excessive impermeability will be avoided or provided with drainage ditches, and in soils of excessive permeability, the main canals will be lined with plastic. The low water table in the area, the

natural drainage system and annual flooding greatly reduce likelihood of soil salinity.

The 20 year low flow of the Niger River is estimated to be 57 m^3/sec. The period of peak water demand for the wheat crop comes in early January at a time when the river is at its highest. The total pumping requirement will be about 2.5m3/sec which is considered insignificant when compared with the tremendous volume of water flowing at that time. Since wheat is a dry season crop and is the only cropping activity in the country during this time, this project will not adversely affect water availability downstream. Water requirements for eventual sorghum crops during the period of lower flow in the Niger will be minimal and similarly not significantly afffect the availability of water in the Niger for other irrigation projects downstream.

The canals on this project will be merely farm ditches, 0.3.-1.0 feet wide. They will be dry 4 to 6 months of the year and remade seasonally. A growth of choking weed population is not expected, and this is supported by the fact that the farmers have had no problems with weeds up til now. The team agronomist reports having observed only one potentially troublesome weed species in spite of a long but intermittent period of irrigation.

The water pumps will generate an insignificant amount of exhaust gas which will be more than offset by the reduction of dust content in the air due to the green areas created and to the windbreaks which will be planted in the project area if they prove advisable for crop protection. Furthermore, the ambient temperature would be reduced. Since the pumps will be placed on the river banks far from the villages, their noise will be inaudible during periods of pump operation.

Health

The rural population living along the Niger use the river as a source for all their personal needs: drinking, cooking, washing clothes and utensils, bathing, urinating and defecating. Consequently, water related diseases are hyper-endemic. Although there is no base-line health data, it is estimated that practically everyone has malaria and schistosomiasis, either in clinical or sub-clinical form. In one sense, the project foresees a potential increase in human contact with water via an expanded irrigation network. The same conta minated river water used for personal needs will be pumped into the irrigation ditches. However, the team believes that no significant real change in human contact with water will result because people are already fully exposed to contaminated water. Further, the irrigation ditches are of such small size that one must step over them rather than through them. To bathe, wash clothes or drink from the ditches would require a conscious decision to assume an uncomfortable position.

There is also the potential for an increase in breeding sites for disease vectors, though such sites are already abundant. However, the irrigation ditches themselves will be dry for 4 to 6 months of the year. During the rest of the year they will be in operation intermittently such that they will be dry at frequent intervals. This will have an adverse on snails (see Water, Engineers, Development and Disease in the Tropics, p. 72). The project design also calls for the use of plastic sheeting to line some of the ditches, thus increasing the rate of water flow and decreasing the amount of aquatic vegetation. Both these factors adversely affect snails and mosquitoes.

The Cercle of Dire has a health office with an effective outreach service. The project calls for training Action Ble agents by this service to teach villagers basic hygiene, such as drinking clean water and not using the irrigation system as a latrine.

The project therefore should not introduce any factors affecting the health of the local populace which are not already extant. The improved nutrition resulting from a subsistence-satisfying and cash-producing harvest of grain, as well as the improved health practices which can result from the health extension program, are positive gains that should help improve public health in the project area.

Social Environment

The present population density of the Cercle of Dire is relatively high (35 persons/km2) oompared to other cercles in Mali and is increasing at about 2 to 2.5% annually. The increased opportunities for work and income resulting from the project will probably keep at home some of the young men who would otherwise leave to look for work elsewhere. Some outsiders could also be attracted to the area for work, but considering that this is presently the poorest region in Mali, the increased opportunities may not be sufficient enough to attract many outsiders, particularly as development in other areas of the country is increasing opportunity in those sectors.

Wheat is the main source of cash income for people in this region. The project should have a positive effect on levels of income and create employment for wage laborers. Again, this will particularly benefit young men who are obliged at present to seek work elsewhere, although most would prefer to stay at home if employment was available. Although most Sonrai women do not take part in physical labor in the fields, some women (lower classes) work after the harvest is in threshing winnowing wheat in return for payment in cash or grain.

Changes in the patterns of access to land have been underway for a long time, making land available to people who have not had it or

cultivated it only on a sharecropping basis. The project may accelerate these changes in the direction of a more even distribution of income and egalitarian control of village life, but centuries old, deep-seated traditions will not be easily modified. Land will be allocated by Action Ble in cooperation with the village chiefs to ensure conformance with local customs.

Animal population increases will take several years. It is noted that herds in Mali are now estimated at 10% to 25% of their pre-drought size, and in the Dire area, hard hit by the drought this estimate is even lower Increased grazing pressure which caused severe environmental deterioration in the past is not expected to present significant problems as a result of this project. Wheat and sorghum stalks as unrefined by product and legume/forage production as a possible triple crop will provide animal feed during periods of maximal stress for the milk herd which traditional remains near the village. Additionally, disastrous experience during the drought is a lesson not easily forgotten and animal population build-up will be tempered by recent experience.

Recommendations

The preceding discussion has indicated that the effects of the project on the natural environment are expected to be minimal and, on balance, positive. No potential, non-reversible, negative effects are anticipated. However, since the project activities are essentially new and no data has been provided by experience, environmental effects will be monitored throughout the duration of the project by the research staff of Action Ble.

The increased economic opportunity and incomes generated by the project should have an overall positive effect on the social environment, but it is impossible to foresee all that may occur. To this end, the project will provide an anthropologist with a Malian counterpart to monitor the social changes in the area and identify and report any problems which may arise.

Consequently, a negative determination is recommended, together with a monitoring of the physical and social environment through the life of the project for early identification and correction of any possible negative effects.

ANNEX X TRANSPORTATION INFRASTRUCTURE AND NEEDS

I. INTRODUCTION

"Mali's internal transport system is fairly efficient in serving the populated areas of the country (except the Sixth Region)".

The above statement, from the recently completed Mali Agricultural Sector Assessment by the Center for Research on Economic Development, The University of Michigan, concisely reflects the transportation-related concerns of the Action Blé development project in the Sixth Region. It has been suggested that the transport situation is one of the most serious constraints on Mali's ability to market its crops, because costs are so high they sometimes equal or exceed prices paid to producers. For example, millet bought for 20 MF/kg in 1974-75 cost 22.8 MF/kg (excluding taxes) to transport from Bamako to Gao.[1/] Yet the adequacy and ability of Mali's transport infrastructure to efficiently handle and serve increased demand for transport services generated by Action Blé is largely dependent on the timing, volume, and direction of any new traffic which might be generated.

The overall purpose of this Annex is to identify expected shipment characteristics from Action Blé and compare these movements to transportation costs (of new movement) or transportation savings (of substituted imports into the VI Region and/or Mali), as well as the investment in transportation and storage facilities required to move the increased production. Finally, recommendations as to policy, covenants and project review will be presented.

1/ France, Ministère de la Coopération, Mission de Restruction de L'Office des Produits Agricoles du Mali (OPAM). Paris, BDPA, May 1975, p. 40.

II. THE TRANSPORTATION SYSTEM

A. Product Movement

Much of the transportation infrastructure of Mali is located in the southwest and along the Niger River, corresponding to the existing population and centers of commerce. The VI Region, a chronically deficit area in cereal needs, has large inbound movements each year, a condition which held even prior to the recent (and continuing in some areas) drought in the Sahel. With a population base of about 360,000 people in the VI Region, total cereal consumption amounts to approximately 50,000 metric tons annually. This figure is slightly lower than the country-wide average consumption of 180 kilograms/person (World Bank Estimate) because the nomads in the region consume only 40-50% of the World Bank estimate. Local production figures suggest that 50% of this is produced locally. This means that 20,000 to 25,000 metric tons must be imported each year. This along with the agricultural inputs and consumer products, e.g. salt, sugar, textiles, etc., place a strain, to say the least, on the transportation system serving this movement. Discussions with representatives of the individual modes (barge, truck and pirogue), indicate that increased movement down the river will be occasioned only by increased investment in facilities and capacity. This will be discussed more fully below.

Any directional movement, by its very nature, creates another possible movement, called a back-haul. The existing movements are heavily one-way, namely into Diré, Timbuktu or Gao. Estimates obtained suggest that 70-90% of back-haul capacity (Bamako destination) was presently empty. The economic cost of movement, both up-river and down, must consequently be paid for by the down-river movements. Any new movements on the existing empty leg of the transportation round-trip have the possibility of being carried at a lower rate (since the return trip must be made anyway). If

such an up-river movement contributes anything above its operating expenses, it further offers the economic possibility of decreased rates on the down-river movement.

The Action Blé Project, as we see, offers potential movements in either direction. For example, at fertilizer needs of 150 kg/ha and fuel needs of 125 L/ha per season, a 2,400 ha project would imply that about 1,000 additional metric tons will have to be moved down-stream annually during the time of maximum capacity utilization on the river. In the other direction, the volume of movement depends on the direction the Action Blé wheat will move. If it moves to Bamako or is consumed locally, no additional strain will be put on the transportation system. If it moves from Diré to Timbuktu or Gao, it becomes competitive with other products on the down-river leg. These possibilities will also be discussed more fully below.

B. Mode Characteristics

The transportation system serving agricultural producers and consumers in Mali has all modes at least partially available; rail, air, water and road. An examination of these modes will reveal operating attributes and available services relative to the demand for movement discussed above.

(a) Railroad

Much of the products entering Mali arrive from Dakar via the Senegal-Mali railroad. The trajectory, about 1,200 km, is half in Mali and half in Senegal. 2/

2/ The data on the railroad were obtained from the Center For Research on Economic Development, the University of Michigan, Mali Agricultural Sector Assessment, Second Printing, September, 1977, p. 5, and from International Bank for Reconstruction and Development, A Note on Transport Problems in the Sahel, Washington, August, 1975, p. 17.

The capacity of the railroad is not large, since the railroad has only 326 freight cars (186 owned by Senegal and 140 by Mali), with an average capacity of 29 MT each. A train usually comprises 20 cars with a total freight capacity of about 600 metric tons, and one train runs daily.

The capacity of this access route into and within Mali is severely overtaxed. The bottlenecks on the Senegal-Mali railway, caused by lack of rolling stock, poor roadbeds, inadequate loading and storage facilities, and traffic management problems, are severe enough to cause much traffic to enter Mali via the Abidjan-Bamako route, even though transport costs (due to additional maritime freight costs, higher road transport costs, and no back-haul opportunities) are one-third to one-half higher than via the Dakar route. 3/ With these physical distribution problems and accompanying higher transport costs, it becomes extremely important to search for any internal change in Malian production and consumption which will decrease the pressure on the system. On an export or outbound movement, substantial excess capacity over the year does exist at the present time.

It is also interesting to note that Malian train crews and locomotives change at the border and Senegalese train crews and locomotives take it the rest of the way, with the process reversed on the return trip - a procedure which reduce efficiency.

(b) Waterway

The Niger River is truly the life line of Mali both from the production and from the transportation points of view. It connects the

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3/ International Fertilizer Development Center, West Africa Fertilizer Study, Volume 3, Mali, 1976

agricultural surplus regions of the southwest (and the point of import of needed cereals) to the chronically cereal-deficit regions of the north. Mali has about 1,650 km of inland waterways, for which, as one study suggested, "dependence upon water transportation ..... is not recommended. This mode is poorly developed and the rivers are only seasonally navigable." 4/ Nevertheless, for the VI and VII Regions, water navigation, even though severely seasonally constrained, continues to be the primary access route for both bulk and non-bulk movements. On the river exist two modes of transportation: the Navigation Company and Pirogues.

The Navigation Company: A common element of transportation in Mali is government ownership. The largest navigation company, Compagnie Malienne de Navigation (CMN), is government-owned and managed and handles most of the traffic moving into the northern regions. Koulikoro, the railhead, is also the starting point for most barge movements on the river. CMN presently has a fleet of 12 tugs (remorquer), 55 barges, 4 passenger-freight vessels, and 2 solely passenger vessels. The barge capacities range from 60-80 MT for the slanted side barges (chaland) to 150-200 MT for flat-bottomed barges. The total existing capacity of the barges is about 5,000 MT, although two new barges of the flat bottom design are presently being constructed in Koulikoro. The draft of the barges range from 0.5 to 1.20 meters.

4/ Ibid., p. 29.

The tugs range in horsepower from 460 HP (2 vessels are of this size) to 100 HP. The two largest tugs, recently equipped with new diesel motors under a U.S.A.I.D. Rural Rehabilitation Project, can move up to 1,500 MT in a single tow of 6-8 barges. The smaller boats of 100 HP can move about 500 MT in a single movement, with a 200 HP tug moving 800-1,000 MT. Each tow travels at about 4-7 mph, with the two newer diesel-powered ones going at 8-9 mph. The combination of horsepower and size of movement dictate the length of time for a round trip. The round-trip from Koulikoro to Gao takes about 15 days for travel and 5 days for loading and unloading. The round-trip to Diré which is closer and which has good docking facilities, takes only about six days. The loading and unloading time is dependent, to a large extent, on the available workforce as well as on the docking facilities. Both Diré and Gao have a good transshipment facility and can load/unload 300 MT per day. Mopti, with its larger work force, can handle up to 350 MT/day. Recent improvements in loading facilities, e.g. changing of a platform scale, have increased the possible monthly tonnage by 700-1,000 tons/month.

As indicated in Chart 1, river navigation is only possible during the flood season following the rains. (August to the end of December for Koulikoro-Mopti movements, and September to the end of January for the Mopti-Gao section of the river). During this time all products for the VI and VII Regions (cereals, tea, suger, salt etc.) must be moved in. Various estimates of total capacity were obtained ranging from 40,000 to 50,000 MT per year.

Whatever the actual volume, it does appear that the down-river (Koulikoro-Gao) capacity of the CMN is completely utilized and that no increased movements are possible without further investment in capacity. On the other hand, on the up-river or back-haul movement a large available

capacity exists, may be as much as 25-30,000 MT, depending on what segment on the total river system the movement occurs. Table 1 indicates approximate distances on the river from Koulikoro to ports relevant to the Action Blé project potential movement pattern. The rates of CMN, which will be discussed later, are established at 10.25 MF/ton-km.

TABLE 1 - RIVER DISTANCE FROM KOULIKORO TO VARIOUS PORTS (in km)

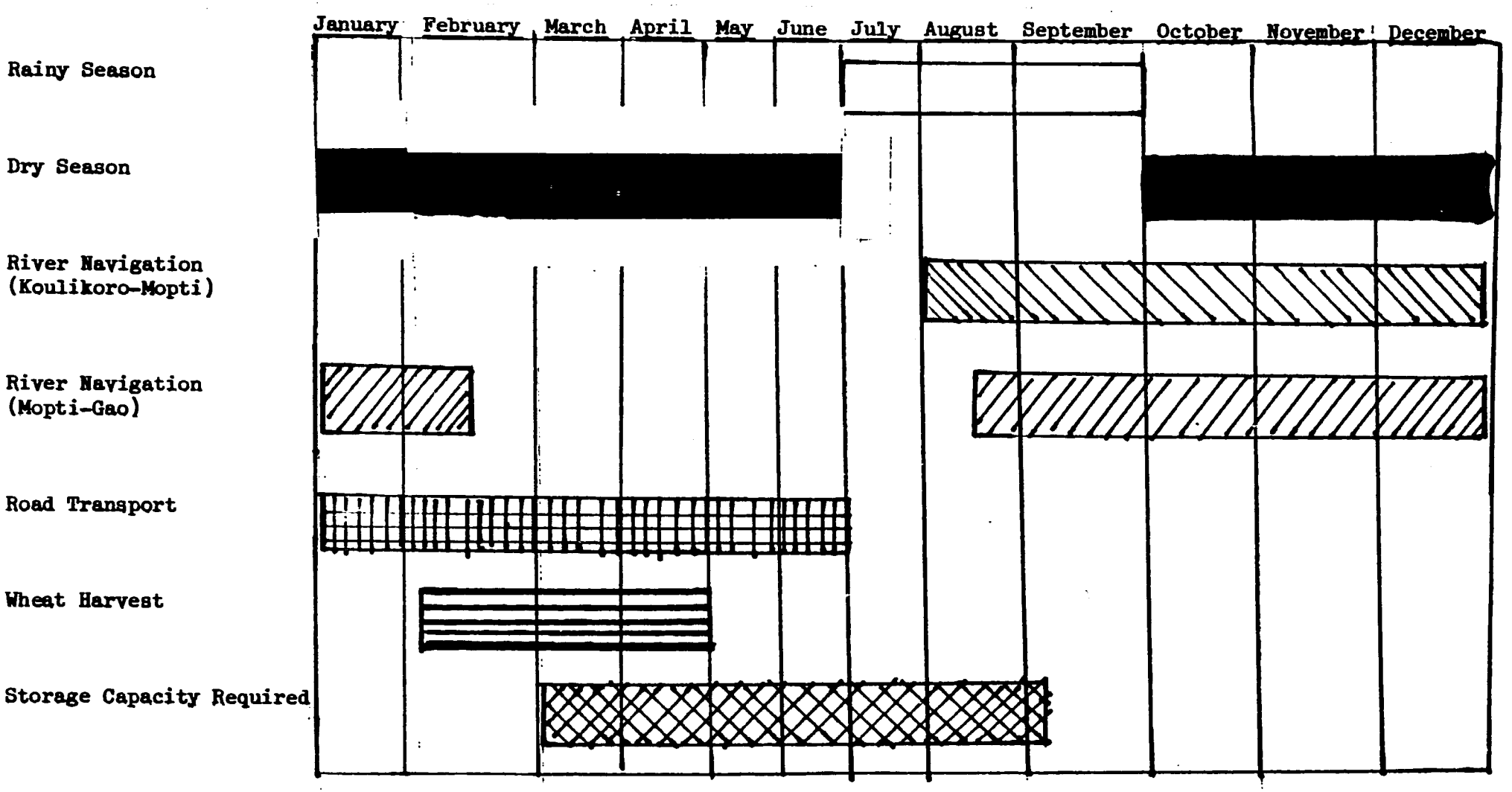
Port	Distance, km	Port	Distance, km
Segou	180	Timbuktu	900
Mopti	504	Bamba	1,103
Niafunké	729	Gao	1,308
Diré	815		

(Source: CMN)

Piroque: The movement of commodities on the inland waterways of Mali is not limited to the government-owned CMN. Many private entrepreneurs operate pirogues, varying in size from 1 MT to 30 MT capacities, with the 3-5 MT size being most common. These boats carry both passengers and freight on the river during the flood season. These operators provide a useful service funtioning as a complement rather than a true competitor to CMN. During periods of heavy demand they take the excess traffic above the CMN capacity, and they are willing to take any size load or type of commodity in combination. They operate on shorter sections of the river, predominantly on the Mopti-Diré and Mopti-Timbuktu stretches, thus allowing the heavily loaded CMN barges to take the long hauls from Koulikoro to Timbuktu and Goa, the most efficient movement for that type of larger vessel. There is a trade-off in service because the pirogue operators can more accurately specify when a

CHART 1

ACTION BLÉ (DIRÉ) PHYSICAL DISTRIBUTION CONSTRAINTS



particular shipment will arrive, while the CMN service is guaranteed and insured against accidents or pilferage. Also, the pirogues run earlier and later in the season because of their shallow draft.

It is also useful to note that a new traffic mode can be identified, namely a truck-pirogue combination. Much truck traffic stops at Mopti and is transhipped to pirogues for further movement. In several cases the same owner operates both truck and pirogue, and can quote a combined rate. The rates vary substantially during the season, but the CMN rate of 10.25 MF/km-ton serves as a minimum charge. During periods of heavy movements the rates may increase as much as 50-100% above the CMN government regulated rates, and much more after the CMN barges stop operating. Estimates of volumes moved by pirogue are sketchy at best, but only about 10-15% of the total movement appears to move into the VI and VII Regions in this manner. An informal co-operative of pirogue operators exists, mainly in Mopti, and serves as a meeting place and an unofficial traffic broker for these movements.

C. Road

Road transportation serves most of the population and economic centers. The physical road network consists of about 13,000 km of roads, but only about 5,000 km are suitable for year-round travel. The problem faced by the Action Blé project is that the road from Mopti or Segou north to Diré and Timbuktu consists of type C roads (a path or non-all-weather road) excepting the Diré-Goundam 34 km stretch which is classified as type B (all-weather access with the exception of short closures when fords are submerged). These roads are barely passable with a four-wheel drive vehicle during the dry season, and in the rainy season (roughly July-September) they are not passable at all. (The road from Bamako to Gao is paved for 634 km to Sevaré, an all-

weather road to Douentza (176 km) but becomes type C for almost 400 km to Gao, again limiting the potential movement to the dry season).

The institutional structure of the trucking industry in Mali reflects the government ownership fo some trucks and regulation of rates for all trucks. The Government firm, Compagnie Malienne de Transports Routiers (CMTR), is based in Bamako and was established in 1974 to fill an identified need where private trucking was not providing the service. Specifically, long-haul movements into areas such as Gao with products such as gasoline and other fuels were desired. In fact, CMTR presently stations some trucks in Gao to insure service in the area. 89% of the private truck capacity (which accounts for 71% of total capacity), is organized into co-operatives. Only in Bamako are there found significant members of independent operators. The typical firm size is 1 to 5 vehicles, with one company having about 30 trucks (20 of 30 MT capacity and 10 of 5-10 MT capacity).

According to a recent study 5/ the present truck fleet in Mali totals 1,533 vehicles of which 53% were less than 10 MT, 30% were of 10-20 MT capacity, and 17% were larger than 20 MT. Of these, 43% were stationed in Bamako, 63% of the vehicles were owned by private co-operatives, 19% by government agencies such as Operations, CMDT, and Office de Niger, and 8% by private firms not organized as co-operatives. 68% of these vehicles were active in moving agricultural products out of the production areas and 32% were used in moving salt, sugar, cereals, and fish into consuming regions.

The availability of trucks is not uniform throughout the country. Truckers are reluctant to go to Gao or Timbuktu because of bad road

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5/ République du Mali: Etude du Transport Routiér de Marchandises 1977

conditions, so even though truck capacity exists, the prevailing road conditions reduce considerably that capacity in the northern regions. Specifically, truckers have felt that the existing rate structure did not justify their vehicles going onto the unimproved roads.

Recent changes in tariffs have relieved some of the cost-rate inequity, with existing rates now substantially reflecting costs of operation: Type A Roads - 30.62 MF, Type B Roads - 45.93 MF, and Type C Roads - 61.24 MF per ton-km. It should be remembered that these rates reflect the truck operating costs, not the construction and maintenance costs of the roads themselves.

III. THE TRANSPORTATION RATE STRUCTURE

The rates of the various means of transport relevant to Action Blé production are summarized in Table 2. Most of the rates were obtained from government tariffs or private trucking firms. The truck pirogue combined rate is based on a 50% increase over government established rates for the pirogue segment of the tariff since most pirogue movements relevant to Action Blé would be during the heavy demand period. Also, for water rates, Bamako rates reflect Koulikoro as the departure point.

It should be noted that increased utilization of the previously-discussed excess capacity on the back-haul or up-river movement may well cause a lowering or softening of the established rates. This, compounded by the additional capital investment required to handle any further down-stream traffic, may make a significant difference between up-river and down-river rate structures. It was estimated that a new 200 MT

TABLE 2: RATES FROM DIRÉ TO SELECTED PORTS, MF/ton

Mode	Diré to Mopti		Diré to Timbuktu		Diré to Bamako		Diré to Gao	
	Distance (km)	Rate	Distance (km)	Rate	Distance (km)	Rate	Distance (km)	Rate
Truck A/	295	20,396	125	8,929	881	47,290	2,089	96,735
CMN	311	3,188	288	2,952	815	8,354	493	5,053
Pirogue	311	4,782	288	4,428	815	12,531	493	7,580
Truck-Pirogue	Not applicable		Not applicable		957	24,562	2,165	76,432

Rail, Dakar - Bamako 5,860 MF per MT

A/ Truck rates decrease as much as 40% when river navigation is available.

(SOURCE: Transport, CMN, Truck-Pirogue owners)

barge would cost $100,000 to construct or assemble in Koulikoro. The capital cost of such a barge, which at 5 round trips per year could move a total of 1,000 tons, spread over 20 years of useful life, means an additional capital cost of $5.00 per ton moved (2.5 MF per kilo), not counting interest charges. If rates are to reflect costs, as is the official government operating policy, the additional tonnage moved downstream on the river will face higher costs and rates.

IV. CONSTRAINTS ON THE TRANSPORTATION SYSTEM

A. River

The constraints on the river navigation activities in Mali are obvious: (1) seasonal dependence on a flooding river, combined with, (2) a physical volume capacity limitation during the navigation system. Pirogues serve to moderate the peak demand on the CMN, but cannot be expected to operate long distances or carry substantial volumes. The threshold cost of any further movement on the river is high. Consequently, anything that can be done to relieve pressure on the down-river movement would be extremely beneficial to the performance of the overall transportation system. Recent facility construction in the river ports by U.S.A.I.D. as well as other projects, have made the loading and unloading facilities capable of handling the up-river and down-river traffic with no further investment.

The shipping season on the Diré-Mopti stretch will be considerably prolonged if and when the Toussay barrage is constructed near Timbuktu. This project, however, is at an early study stage.

A. Road

The seasonal problem with road movement is also obvious: during the rainy season, the project area is isolated by road. The capacity of the trucking fleet may be sufficient in Bamako, Mopti, Segou and Gao, but

TABLE 3: CONSTRUCTION AND MAINTENANCE COSTS FOR NEEDED ROAD IMPROVEMENTS (in millions of MF)

		Private Company Construction		Government Construction		Annual Maintenance Cost	
	Distance to be improved, km	With taxes 7,2 mill MF/km	Without taxes 6.0 mill MF/km	With taxes 4.68 mill MF/km	Without taxes 3.82 mill MF/km	With taxes	Without taxes
Bamako-Diré (Segou Route)	577	4,154.4	3,962	2,700.4	2,204.1	410.8	293.7
(Mopti route)	265	1,908	1,590	1,240.2	1,012.3	188.7	134.9

(SOURCE: Bureau de Travaux Publiques)

this capacity is not available to serve the Diré market.

Until the road to Dire is constructed to at least Type B (an all-weather road), little trucking activity should be expected. On the Bamako-Diré road via Segou (881 km) there is an unimproved stretch of 577 kms while on the Bamako-Diré road via Mopti (945 km) there are 265 km of Type C road. At present the road via Segou is more frequently used owning to its somewhat "better" condition. Table 3 indicates the approximate cost of upgrading the road and also presents the annual maintenance costs on the additional roadway. The table shows that improvement of the shorter bad stretch (via Mopti) would cost over U.S. $ 2 million, and that the maintenance costs will be about $270,000 annually. Assuming that trucking rates (45.93 MF/ton-km on Type B and 61.24 MF/ton-km on Type C roads) accurately reflect trucking costs, an annual volume of over 50,000 MT (greater than the total present annual shipments to the entire VI and VII Regions) will have to arrive by truck to Diré just to make road user savings break even with the road costs. Thus the improvement of even the shorter bad road to Diré is not likely to be economically justified in the foreseeably future.

C. Traffic Movement

It appears that the development of Action Blé, rather than putting more strain on an overtaxed transportation system, will instead relieve some of the pressure. Wheat production of the Action Blé project will substitute cereals presently being shipped into the area. Thus, every metric ton produced in Diré for local consumption is one less ton that has to be moved during navigation season. The only addition to down-river traffic will be the fuel, fertilizer and other agricultural inputs required on the project.

When Action Blé gets large enough in scale to produce beyond local

consumption it might first appear to put some pressure on the transport system, i.e. wheat shipped from Diré to Timbuktu and Gao on the busy down-river movement. However, it is important to remember that every ton of cereal shipped from Diré is a ton that did not have to move from Bamako or Mopti to Diré. Thus even these movements will have a positive effect in making the extremely limited capacity more available for other products.

When the wheat production becomes large enough to be shipped into the Bamako market, this will have little impact on system capacity. Yet, since this wheat is also substituting for wheat flour currently imported, it will have the effect of decreasing, ton for ton, the movements on the overtaxed Senegal-Mali railroad -- another positive impact of the Action Blé project.

V. TRANSPORTATION SAVINGS

A specific benefit of the Action Blé project is the decrease in transportation costs occasioned by the substitution of locally produced cereals for those imported into the region. One MT of wheat, with FOB cost of $185.00 at U.S. Gulf Ports, incurs transportation, handling and other costs of $50.00 from U.S. ports to Dakar and $60.00 from Dakar to Bamako and $17 from Bamako to Diré. To this one should add $5.00/MT as necessary investment in new down-river barge capacity. Thus every MT of wheat which is produced in Diré and consumed in the VI and VII Regions in substitution for imported wheat signifies a transportation saving of $132.00.

A more common case would be that of transportation savings on wheat produced in Diré and consumed in the Bamako region in lieu of imported wheat. In this case, the transportation savings would amount to ($60.00 + $50.00 - $17.00) = $93.00 per MT, of which over 70% would be in foreign exchange.

A situation which may affect some of the savings identified is the possibility of a competing back-haul. Phosphate development presently being considered, whether near Gao or the V Region, may become competitive to the wheat movements.

VI. FLOUR MILL CONSIDERATIONS

As Action Blé level of production increases beyond the relatively small possibilities for local wheat consumption, it will become necessary to mill the wheat commercially. Thus the existence of a flour mill in Mali at the time that the project will start shipping wheat to the national market is a necessary condition for project realization.

A relevant question is that of location of the flour mill. Locating the mill at Diré would not be an economically and managerially sound decision, for the following reasons:-

(1) Construction costs in Diré would be substantially higher because of its isolated location;

(2) Communication is extremely difficult, making management of a processing plant which is dependent on good logistics very inefficient;

(3) There presently exists a shortage of gasoline and maintenance facilities in the region, necessitating construction and operation of such supportive services by the flour mill management itself;

(4) Minimal mill capacity should be about 20,000 MT of wheat annually in order to achieve an efficient operation. Since total Diré wheat production at end of project will be about 6,000 MT of wheat annually (which equals about 4,500 MT of flour) vs. current flour imports of about 20,000 MT annually, wheat imports will continue for a long time. Locating the mill at Diré would mean transporting all imported wheat from Bamako to Diré as wheat and Diré to Bamako as flour. Since Bamako and the western regions are the principal markets for flour, most of the wheat would incur this double transportation cost. It should be remembered that wheat shipped down-river (Koulikoro-Diré) moves at high transport cost;

(5) Substantial weight reduction, the main raison d'etre of locating in Diré, would not occur. Although the wheat-to-flour weight ratio is 4:3, the difference is mostly bran, which is likely to move almost entirely into the Bamako market;

(6) Modern flour mills are capital-intensive operations necessitating relatively little labor (less than 100 workers for a mill of this size), so that any local employment effect generated by locating the mill at Diré will be insignificant in comparison to the large number of productive employments (over 2,400) created by the wheat production at Diré.

The above considerations argue strongly in favor of locating the flour mill in the Bamako region. If the GRM desires to decentralize industrial production away from Bamako, a logical location for the mill would be at Koulikoro (60 km from Bamako), which is the end point both for the rail traffic from Dakar and for the river traffic from Diré.

ACTION BLE DIRE PROJECT

ANNEX XI : SOCIOLOGICAL ASPECTS

A. Project Goal

The immediate goal of Action Blé is to increase the production of grain (wheat and sorghum) in the VIth Region in order to satisfy local needs and thereby reduce or eliminate the importation of grain or flour to the region. This would also have the effect of increasing the economic welfare of what is now the poorest region of the country. Once regional self-sufficiency in wheat is achieved, the project will be able to deliver wheat to the national market, thus serving to reduce the national foreign exchange problem caused in part by the importation of wheat flour. It is appropriate that this effort be localized in the Diré area of that region, both because temperature and water requirements for wheat are met particularly well there, and because the inhabitants have a long tradition of wheat production by irrigation.

B. Ethnographic Background

The area of operation of the project lies within a region dominated by the Sonrai people, descendants of a once powerful empire that extended from Ségou to Dendi during the 15th and 16th centuries. Although other ethnic groups are represented in the sedentary population, they are very much in the minority. In the central arrondissement of the Diré Cercle, for example, in 1975 the Sonrai constituted 78.5 % of the total population of 21,360 (not including the town of Diré), the Peuls 20.2%,and the Bellah (economic dependents of the Touareg) 1.3%. The town of Diré (8,446) had a mixed population consisting of Sonrai, Peul, Bambara, and Bozo (fishermen). In addition, there were

estimated to be some 5,000 nomads (predominantly Touareg and Bellah) in the arrondissement. The density of population "for the region" as a whole has been estimated at 35 persons/km^2 (Ministère du Développement Rural, 1975:56). In the areas where irrigated wheat is expected to be introduced there are some thirty-odd villages totaling some 17,000 in population, all of which are Sonrai with the minor exceptions of one originally Peul village whose inhabitants now speak Sonrai, and a small village of Bellah ($\pm$ 150 persons). There are, furthermore, bonds of kinship linking the Sonrai villages together, since they were all settled from the village of Bourem near Diré beginning in the latter part of the last century. The Bourem village chief still functions as an informal chief of the region north of Diré of interest to the project.

The subsistence of all these villages derives almost entirely from agriculture. The principal crops grown and consumed are rice, sorghum and millet, but wheat in much smaller quantities has been grown in the off-season on land irrigated by hand from the river and from marigots for perhaps 75 years. Wheat is grown primarily as a cash crop, enabling the people to buy more rice and sorghum to eat. It is sold mostly in Diré or in Timbuktu, where the demand for it is high among the Arab and Berber population in particular. Transport is by pirogue. Vegetables and fruit are grown in small quantities. At present far less grain is produced than is necessary for local consumption (estimates of the deficit range from 20% to 50%), and in spite of the availability of some grain distributed by the Government at subsidized prices, there is real hunger, especially in the last months before the harvest. According to one report, for example, it is possible for many to eat only every other day during that period. Trade is not highly developed. In Bourem, the largest of the villages in the area with a 1975 population of 2,000 (the others range from about 100 to 1,200), there are only two shops and ten traders.

There is a weekly market there which serves the surrounding villages as well.

The Sonrai have traditionally kept cattle, goats, and sheep, th ough in smaller numbers than the Peuls or Touaregs. At present they claim to have only one tenth the number of animals they had before the drought. They do not take care of these themselves, but use Peuls and Bellahs as herders. Not only do the animals provide milk, meat, and wool for their owners, but at present, they constitute the principal form of investment and savings for them as well.

The time available to the team in the field did permit an overview of the social institutions of the Sonrai. Extended discussions with Sonrai's and other Malians elsewhere familiar with the area. A study was made of the pertinent literature that could be found in Bamako (particularly Beraud-Villars, Camara 1977, 1978; Cissoko, Instiut d'Economie Rurale; Miner, Ministere de l'Agriculture; N'Diaye, Seydoux and Damien, SEDES). Given the central position occupied by Bourem and homogeneity of the region, it seems safe to assume that the following description applies in general to the population.

Traditional Sonrai society is marked by hierarchical distinctions. A Sonrai from a nearby region (an educated man of slave origin) divided it into five classes: the rich, an upper class, a middle class (all of the above are considered "nobles"), a lower class, and "slaves", a number of "caste" groups typical of the western Sudan: smiths (diem or garassa), leather workers (sake), weavers (male), griots (male or garassa), and butchers (tandina)

The rich are descendants of the Moroccans who conquered the Sonrai in 1591 and of their Sonrai wives; they are usually referred to as Sanaye, a

term my informant thought was a Moroccan Arabic word meaning "my Lord". They are mostly merchants, possess land, cattle, sheep, goats, camels, and slaves, and are a source of financial support for the upper class.

The upper class are descendants of Berbers and Sonrai women and are known as arma. They bear the family name of Touré and have slaves, land, cattle, and other animals, including camels.

The middle class are known as gabibi (a Sonrai word meaning "black skin"). They, too, are "nobles", were the first occupants of the land and were typically warriors. They bear the family name of Maiga. Now they are both farmers and fishermen. They also have slaves, but fewer of them. The same applies to cattle, sheep, and goats, but they have no camels.

The lower middle class, also known as gabibi, but typically bearing the family name of Traore, are less wealthy. They do not own land, but are given land to work free by the middle class. Historically they came from the Mali empire and served as messengers for the Maiga, and they still pay taxes to them. They are not nobles and have no say in village government.

The (former) slaves, which might be more precisely called economic dependents, are known as Bania. Traditionally they own nothing. Now some have land, but they still depend on their (former) masters. They, too, have no say in the village government and their lot in general was described as miserable. Many have left their villages to seek work in the towns and cities.

People belonging to the caste groups (constituting a relatively small part of the population) also have no voice in village affairs.

Obviously a key distinctions in Sonrai society was that between those families which owned (or had a right to own) land and those which did not. The former were full fledged members of the community with a voice in the running of the society, whereas the others were not. The SEDES study (1972: 33) also distinguishes between land inherited from the founders (lasal) and land acquired since (gandakoy). The former type was inalienable and inherited undivided in the male line only. The latter was in theory alienable, but in practice was not sold, being lent, rather, to fellow villagers if necessary. It also could be inherited undivided only in the male line.

Village common lands (beit el mal) were administered by the village chief, who allowed them to be cultivated free by members of the village as needed or to be sharecropped or rented by slaves and outsiders if they were not needed by his own villagers. If families owning founders' land (lasal) died out, it would be added to the common land.

The slaves (economic dependents) and outsiders could only cultivate land on a sharecropping basis, giving the owner of the land a certain part of the harvest as compensation for use of the land. The basic sources of production thus rested firmly in the hands of the ruling class in this village society, with a degree of centralization of control in the hands of the village chief.

Although the SEDES study of 1972 was concerned with the zone of Lake Hore and the ponds of Niafunké, its description of the importance and efficiency of the land tenure system could also apply to the area of the present project. The study points out that the social system functions in such a

way as to most efficiently allocate, exploit, and adapt the available means of production and labor resources to land use. (SEDES, 1972, t.1:40). This traditional and efficient land allocation system must be respected and preserved. Project planners and implementors are aware of the necessity of preserving and building upon this tradition in order to assure project success and maximize social acceptance, at all levels.

The study further lists three main factors that have led to important modifications of this traditional system (ibid, p.50 f.): (1) the development of a monetary economy, which has led, in some areas to the sale of land (even lasal land deriving from the original settlers). The extent to which this is true of the project area is not known. The possibility of the sale of land was denied in Bourem; (2) the emancipation of the slaves, which has been increasingly rapid in recent years. This has not only altered the tenure situation, but has led to increasing monetarization of the economy in that nobles who formerly depended on their slaves for their food (this is particularly true of the Tuaregs and Peuls) now are forced to buy it. (3) The actions of public authorities.

In the colonial period the French made a number of attempts either to limit abuses of existing customs or to effect a redistribution of land. In the case of sharecropping they declared that "All payments should be lightened; they cannot be greater than one-third of the harvest. All other customs or presents must disappear". (ibid, p.41). In fact, it seems that the presents (of symbolic rather than economic importance) continued, and that harvests tended to be divided equally.

The French also attempted to prevent the abusive management by Sonrai village chiefs of the beit el mal by reasserting the traditional rights of village members to these lands. Since the revenue when they were sharecropped (by former slaves and outsiders) fell to the chief and not the village, it was obviously to his advantage to make such an arrangement.

Finally, where the French carried out water control projects, as at Lake Horo, they declared that all new land made cultivable by these efforts belonged to the state and was free of all traditional rights of property. The land was to be redistributed and both sharecropping and renting of land were forbidden. The new land was allocated in blocks to the Songrai, Peul, and Tourag eth nic groups in the area, with the distribution to individual families left to the groups themselves. In the case of the Songrai, where sharecropping was apparently extensive and emancipation of the slaves was relatively advanced, former slaves were included in the distribution, even though the noble families were favored. Sharecropping continued, however, because the nobles got more land than they could cultivate and allowed the excess to be cultivated by those who had too little or by outsiders, ususally Bellah. Among both the Peul and Tourag groups, however, the dominant mode remained that of sharecropping.

In the 1960's, the following independence, the new government attempted to impose a policy of land use and allocation on the populace. This went so far as to demand that a village devote one day per week to cultivating a common field, the harvest of this field being taken by the government. This was supposed to be each village's contribution to national development.

Needless to say, this aroused much opposition and at the time of the change in government in 1968, the common field idea was discarded by the people. The land tenure for all practical purposes reverted back to what had been traditionally acceptable.

The S.E.D.E.S. report notes that a major goal of the land reform attempt by the former regime was to move toward a more democratic land ownership. Thus, it sought to break down the central control of land. It was, however, this very characteristic of the traditional system that was so well-adapted to the considerable annual variation in land available because of the vagaries of climate and flood levels of the Niger River. This report therefore stressed the need for Action Blé to work within the existing framework.

Action Blé is aware of these difficulties and, to its credit, has made a conscious effort to work within the existing social structure. No changes in this structure or the present land tenure system is contemplated or recommended. The use of the Commission des Paysan is an example of the type of sensitivity necessary to assure open lines of communication between the government agency and the intended beneficiaries. Because it is difficult to recruit and retain extension agents in this remote area of the country, Action Blé will, as well, draw upon local youth to serve as mechanics and assistant extension agents. This will: (i) further increase village confidence in the project and increase their perception of greater control over the development process (which was notably lacking in previous development programs tried in the area); and (ii) reduce the chances that traditions would be ignored or disregarded due to insensitivity of Action Blé personnel.

The typical Songhrai village is governed by a chief and a council of notables. The former position descends in the male line from father to eldest son. Only in cases of complete incompetence, it was said, would anyone be passed over. The power of the chief vis-a-vis the council and the rest of the village would seem to depend on his personality, tradition, and a variety of particular circumstances. In the case of Bourem, where the present chief is the grandson of the founder, who is regarded as a saint, his power seems to be quite great.

The council of notables is elected by the men of the village. In the past, and there are indications that this is generally true today, only the nobles might participate in the election. In Bourem it was maintained that every male from the age of 15 or 18 could vote, but only careful investigation would bear this out. Bourem, presumably because of its size, is divided into three quarters or wards, each of which elects from 2-4 councillors depending on its population size. This gives a council of nine men which is chosen every five years. Normal procedure is for complaints or problems to be brought to the village chief, who then convokes the council to discuss them. Decisions are taken by unanimity.

Age groups (koterey) are a characteristic feature of village life. In Bourem there are many such, formed, it was said, on the basis of friendship rather than according to a strict chronological order. Each such group chooses its own chief, and in addition to performing a variety of social activities, the groups may be called on by the village chief to carry out tasks for the village, in which case they may be paid.

The primary social unit in the village is the extended family. Sons will stay with their father after marriage and the whole family thus formed constitutes an economic unit. So important is it for a man to have sons that a man without them would be given a grandson by his son-in-law to raise so that he could work for him. Such families apparently tend to split up after the death of the father, but one family consisted of five elderly brothers together with their wives, sons and their wives, and grand-children totaling some fifty-odd persons.

People tend to marry young - boys at 20 and girls at 16, and supposedly, at least as far as Bourem is concerned, within the village. The marriage price once varied from two to ten cattle according to the standing of the girl's family, but now it is fixed by law at 20,000 MF. Divorce is said to be uncommon.

Property tends to be inherited according to Muslim law, with triple shares going to males as opposed to females in particular categories, except in the case of such personal property as jewels or clothes which are passed on directly from mother to daughters; and land, which passes undivided to the sons only as family property. The value of such property does not enter into the division of an estate. A man's house goes normally to the son who can most easily pay for it. Actually the Code Malien provides for the equal division of property between the sexes, but it would only be in cases of disputed inheritance that the matter would come before a civil court.

The sexual division of labor seems to be rather strict. Men tend to do almost all the work in the fields, whereas women care for the children, do the cooking (which includes 1½ to 2 hours of pounding grain per day), and

make mats and bread for sale at the market. They may (though not ordinarly) help with the harvest, winnow sorghum, and both thresh and winnow wheat. In the latter case they may be paid at the rate of 2.5 to 3 kg of wheat per day. (See Women in Development, Annex XII).

In Bourem it was claimed that most land was cultivated directly by the families that owned it, though people would lend land to relatives at no cost. There was also said to be some sharecropping, with a third share for the owner. Normally in such cases the sharecropper provides the seed, and each harvests his own share. Renting is also possible at mutually agreed-to rates, and some labor is hired at 500 MF per day without food or 400 MF with food.

It is possible on the basis of such a brief acquaintance with the society, to give only a brief account of the distribution of income. People in Bourem claimed that economic differences were minimal. Certainly there was a shortage of work opportunities, so that virtually all youths in their late teens and twenties left the village to seek employment elsewhere. However, the village chief and at least some of the traders certainly form an exception to this rule, if it is one, and the extent to which the traditional class system still results in an uneven distribution of wealth can only be discovered by patient investigation. However, the society is not highly commercialized (credit is practically non-existent outside of government agencies like SCAER); and the widespread network of kinship relations must act as a distribution and leveling device.

Health conditions are poor. All water is taken from the river, and it was reported by a local school teacher that most people suffered from schistosomiasis as well as malaria and dysentery. Tuberculosis was said to

be prevalent among older people and leprosy not uncommon. Given the shortage of food in the region, it is reasonable to assume that malnutrition also plays a significant role.

The extent of literacy is not known. There is a primary school in Bourem which serves eleven outlying villages as well, but the problems of instruction are great and attendance is not high. With a total population of the school district of something over 8,000, there are only 200 pupils enrolled and about 160 that attend. It is particularly difficult for the children from outlying villages, who may have to walk several miles to school in the morning, return home for the noon meal, and repeat the journey for the afternoon session.

There are Muslim religious teachers as well, but their number and influence was not determined.

Interest in the project among the villagers of Bourem was high. Few were willing to take the risks of buying and using motor pumps when they were introduced last year, but their apparent success has now made everyone eager to have pumps. The reason for this is easy to see. The pumps greatly reduce the labor involved in irrigating a crop that they have long grown by hand methods, and they also make it possible to expand greatly the area that can be cultivated. Since the sale of wheat constitutes the only source of cash income for most of these villagers, any increase would be welcome. So far they have experienced no mechanical failures with the pumps or fuel shortages.

Considerable numbers of cattle and donkeys were observed around the villages, more than enough to activate the animal-driven pumps contemplated

in the project. It may be that ownership of domestic animals will somewhat increase in number in future years if villagers use income derived from participation in the project to buy more animals. Additional cattle, if purchased, will join the existing herds on the annual transhumance south during the dry season. In a recent study published by the International Monetary Fund (March 1977), it is reported that no undue environmental pressure will result even if herds someday reach the pre-drought size again.

When asked how they might spend new wealth, villagers usually respond, as is the norm, that they will buy more animals. Inevitably, animals are considered to be money, on hoof rather than in the bank. Commerce was suggested as an afterthought. A local official in the Dire areas suggested the following order of priorities: food, marriage, animals, and (conceivably) land. As noted above, commerce is not now highly developed in the region, and the local official did not think the Songhrai would take to it readily. It is possible, however, that as income rises outsiders will come in to take advantage of the increased commercial opportunities available.

C. Issues

Any project that proposes to introduce irrigation and markedly improve the economic welfare of the people in a Sahelian area will have the potential of influencing both the physical environment and the society itself. In this section, we will look at what appear to be the principal possible effects or outcomes and problems that might be encountered, assess their relative importance, and suggest solutions, methods of prevention, or requirements. What actually happens, of course, will depend on a number of local factors about which it is impossible to generalize at this stage of project development

As far as the environment is concerned, no negative effects resulting from the technical aspects of the project are anticipated. While there is a possibility of increasing plant and soil diseases and pests, and inducing salinization of the soil, it is the opinion of the team that all these can fairly easily be kept under control by proper management, particularly if the rotational scheme recommended by the agronomist is found to be acceptable. On the other hand, the bringing of land into cultivation will improve soil structure and, together with the establishment of windbreaks, have the effect of increasing resistance to erosion. All of the foregoing, of course, assumes that the project will be administered wisely and that no excessive demands will be placed upon the soil. See the IEE for further details.

We do not anticipate any negative effects on the physical evnironment as a result of increased animal or human population. However, some points must be made in this regard. First, it is expected that if personal income increases as a result of participation in the project, people will indeed buy some animals, probably cattle. Thus we envision an increase cattle ownership but this will pose no threat to the environment unless the numbers of cattle reach the pre-drought level. This is not expected to become a problem for several reasons. Unlike in other areas, such as the Office du Niger, where land was settled by outsiders, the villagers have long standing relationships with Peul and Bellah herdsmen. The Office du Niger colons (government tenant farmers) had little land security and instead of increasing their investment in this land, bought cattle with their farm profits. The colons however did not intrust their cattle to the herders fearing that they

would sell them, so they keep the animals themselves and did not send them on the annual transhumance. By keeping the cattle so close to the project area over-grazing occured and soil cover was destroyed. It is reported that numerous quarrels took place because the "newcomers", unaware of centuries of tradition, disturbed the cattle grazing pattern in that section of the Niger delta. The Songhrai, however, are quite aware of the need to maintain the balance of animals to pasture and practice "pasture rotation" by moving through and across the vast grazing lands of the Sahel. Little or no environment degradation occurs if these patterns, which have proven successful for thousands of years in an extremely harsh environment, are left undisturbed. Moreover, this area of the Sahel was extremely hard hit during the drought, and the lessons learned in the recent past are not likely to be forgotten.

Slight increases in the human population are to be expected. Annual growth rate in the cercle of Dire is estimated at 2.5%. The Action Ble project will, eventually, reduce the increasing outflow of young men to urban areas (Mopti in the 5th Region, Segou, Bamako, or even neighboring countries) in search of employment. The young men are unskilled, poorly educated, and for the most part, speak only Songhrai, a lanugage restricted to the northern part of the country. If the young men are unsuccessful in finding employment, they return prior to planting season and out-migrate again at harvest. Most would prefer to remain in their home villages, and there is increasing concern among the elders over weakening of family ties and eroding values. If new employment opportunities are created that have to be filled by outside labor, it is anticipated that migrant workers would come primarily from the

VI and VII regions where unemployment is high. Should this occur, however, language will not pose a problem for these laborers, and family links and a common ethnic background will help assure that these laborers will be integrated in such a fashion that they will not upset existing social traditions or result in an unemployed, unskilled labor pool as can be seen in the urban areas.

It seems likely that the project will have more effect on the socio-economic environment. In most instances, the effect should be beneficial. Increased economic opportunities which encourage young men to stay at home will reinforce already strong extended family ties. The rising economic welfare should benefit all the levels of Songhrai society, particularly the former slaves who, more and more emancipated in recent years, now participant in the agricultural production process as individual farmers. Moreover, we see the Songhrai extended family system, still strong after having withstood the attempts of the French colonials and the independence government to change it, as the barrier to excessive commercialization of family-held land. The strong Songhrai kinship networks built up over years of inter-marriage between families in the same and neighboring villages should ensure that community interests or group interests are not supplanted by individual interests.

To assure success, project management should monitor the development process and confront any possible problems that may arise and detract from project performance. Project management should pay special attention to: (i) resolution of possible conflicts between farmers over water, labor, fertilizers, etc; (ii) avoidance of artificial pricing and/or quota policies that would eliminate or sharply reduce economic incentives; (iii) prevention

of excessive dependence on modern agricultural inputs that might result in higher costs and related indebtedness due to rising world prices; (iv) prevention of persistent mechanical or supply failures.

There is reason to remain optimistic about the success of the expansion of the 4 hectare "modules" proposed in this project. It is ongoing and successful at present, and the system planned has an ample number of safeguards to alert management of problem areas. Kinship relationships in these "modules" are a strong positive feature.

The climate of the Diré region, together with an assured source of water throughout the year, makes it technically possible to grow enough grain to satisfy the needs of the 6th Region with a surplus that could benefit the rest of the country as well. It must be done, however, without adversely affecting the social and physical environment which we feel will indeed be the case with this project. It has been convincingly argued that for the tropics in general what must be developed are "sustained yield tropical agroecosystems" specific to particular areas in which the biological aspects of agriculture, population, education, public facilities, administration, and social aspirations all fit together (Janzen, 1973).

The evolution of such site specific systems calls for a cautious approach to all interventions and a constant monitoring of what is taking place. Also essential is the project administration's ability to implement the measures that the monitoring shows to be useful or required. In short, it will not be sufficient to judge the project only on its aim of producing enough wheat to meet local and alleviate national needs. To be truly successful, it must benefit the people involved without causing any deterioration of the physical and social environment in which they live.

D. Operational Considerations and Recommendations

One of the principal advantages of the Action Blé program as it has now been redesigned, is that it has abandoned the idea of a large-scale irrigation project in favor of direct aid to the peasants themselves through the use of small pumps. Large-scale irrigation projects elsewhere have rarely been successful economically or ecologically and have frequently had undesirable social consequences. Furthermore, the Malian Government has had great difficulty in recent years in getting the experimental station in Diré to function properly or in completing the new irrigation system for it, whereas this season's first attempts at village level irrigation seems to have been a great success.

In putting the project into operation, there are certain conditions that should be met and guidelines that should be followed:

1) It should be agreed at the start that the peasants will be paid a fair price for their grain and that unreasonable quotas, if any, will not be imposed. If this is not the case, it will not be in the interests of the peasants to participate in the project and they will not do so (unless they feel that they can somehow avoid selling to the government).
2) At the same time, the peasant should have to pay the real cost of his inputs and credit for them; otherwise the impetus derving from the project will not be self-sustaining. Whether the producers should pay the whole cost of the Action Blé apparatus is another matter. The national government and the country as a whole will also benefit from the project, both economically

and in terms of social and technical experience and knowledge, and it seems reasonable that the government should bear a portion of that cost.

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3) The peasants should be isured against disasters or crop failures beyond the control of the peasants during the four years of the project, possibly through restructuring of their loans.

4) It is essential that all needed material inputs - pumps, fuel, pipes, plastic sheeting, fertilizers, agricultural implements, etc., be on hand well before the beginning of each planting season, and that trained mechanics will be available as programed.

5) Action Blé itself must maintain the close collaboration and relationship it has developed with the villages involved in the program, and carefully explain the roles and responsibilities of farmers and Action Blé personnel. This will be crucial both at the outset and later on as technical, social, and environmental needs change. Action Blé will cooperate with village elders in arriving at a just allocation of currently unused land. Although by GRM law, the land would never technically become private property, permanent right of usufruct will be assured to those farmers who fulfill obligations mutually agreed upon in a billet à ordre. Each participating farmer will sign a billet à ordres committing him to responsibility for payment of materials sold to him on credit and for fulfilling various conditions of cultivation (such as the agronomic procedures to be followed). The document signed by each beneficiary will also specify the relationships among the cultivators grouped around each pump, guaranteeing equal access to land and water and a mutual [illegible]

It is further envisaged that a commission des paysans, consisting of five members including the village chief, be elected in each participating village (as has been the case in Bourem). The commission would work closely with the local agent of Action Blé and village elders in arriving at a just allocation of the land to be irrigated on a basis of both need and ability to work, and would serve as a permanent liaison between the producers and Action Blé. It is felt that the sanctions contained in the contract would help insure maximum cooperation with Action Blé in carrying out the technical procedures that prove advisable.

Agreement with the villagers must be clear as to the allocation of these lands and to the principles on which it is based. Not only at the start, however, but also throughout the life of the project, its success will depend on the degree to which the formers understand and accept its goals, not just with respect to technical matters, but with respect to social and ecological ones as well. For this to happen, a high degree of mutual confidence and respect will be necessary. These could be fostered on the one hand by choosing sympathetic agents willing to live in the villages they are helping, and on the other by making it possible for Action Blé itself to provide the necessary material inputs and credit instead of requiring people to apply to another government agency.

As an aid to communication and to alert the peasants to the nature, opportunties and problems of modern life, one should consider establishing a functional literacy program such as has been conducted by the Direction Nationale d'Alphabetisation Functionnelle et de Linguistique Appliquée in conjunction with other operations. This should be particularly useful in helping to prevent excessive investment in livestock and in convincing the

villagers of the need for and methods of preserving the environment.

6) The extension of the project to new villages and lands should proceed contiously, not only to avoid supply problems, or to prevent sudden drops in prices by flooding the market with grain, but also in order to be able to make advantage of experience gained and to keep abreast of the changes it demands.

It should not be assumed, moreover, that what Action Ble might regard as desirable from a point of view of maximizing yields will be seen in the same light by the peasants. The acceptability of new varieties of wheat, or other crops introduced, may depend as much or more on their taste or other characteristics, including the amount of fodder material they provide for livestock, as on how much they produce.

7) In addition to the technical and extension personnel that will have to be associated with the project, it will be absolutely essential, if one accepts the arguments of the proceeding section, that expert assistance in the fields of sociology and social anthropology be available throughout the project. It would be necessary at the start in providing an adequate basis for understanding the reactions to the project and helping to prevent untoward social or economic consequences. It is recommended that one American or European trained expatriate social anthropologist who speaks French and either knows or will learn Sonrai be provided to Action Blé-Diré for one and a half to two years. This could be at the ABD* level, a person who would use this period of field work to form the basis for his or her dissertation. Given the need to learn Sonrai, it would be unrealistic to expect any one

* All-but-doctorate

to spend less than 1½ years in the field. At the same time a Malian counterpart should be appointed either a social anthropologist or (which would probably be easier to find) a sociology student at an advanced level. Such a student or series of students should be avaiable throughout the life of the project. In addition, shorter visits should be made annually by a senior expatriate social anthropologist for review and advice. The anthropologist should meet regularly with the rest of the Action Blé staff to discuss the development of the project and any problems that might arise.

A suggested scope of work for the social anthropologist is included in Annex XIV.

Summary:

The project capitalizes on long standing traditions of irrigated wheat production. Changes as a result of increased income will inevitably modify existing social patterns. These changes should build upon rather than abruptly overturn the existing social structure. Unlike other projects which begin by introducing a new crop or modifying very traditional cultivation methods, this project builds upon a small but successful system. It further takes advantage of prior experience in other agricultural activities which have not been successful because they by-passed village leadership structures, ignored tradition or arbitrarily imposed change in existing farming practices. Failures to strenthen the relationship between the government agents and the villages is also responsible in a large part for past failures. As designed, Action Blé is soundly conceived from a sociological standpoint, and if the project is well managed, it should have a good chance of meeting the objective of increasing cereal production in a way which maximizes

benefits to the farmer, while preserving his cultural setting and protecting the physical environment.

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ANNEX XII
WOMEN IN DEVELOPMENT

General Observation: In Mali, there are many ethnic groups whose cultural characteristics differ widely. In the project area, the predominant ethnic group is the Sonrai, descendants of a once powerful empire. Devoutly muslim, typified by class and caste systems, the role of women is not easy to characterize; it is diverse, complex, and largely hidden from the eye of an outside observer. Valid conclusions can only be made upon the careful analysis of the milieu by a trained observer proficient in the local language, trusted by the people, and familiar with the history of both the families observed and the villages studied.

The Action Ble project deals almost exclusively with what is considered a male role in this culture - physical labor in the fields. Unlike the animist cultures of the south (Malinke or Bambara where women are expected to work in the fields) it is considered both undignified and unbecoming for women to perform such labor. Chores performed by women, which are examined briefly below, are not, interestingly enough, considered "labor" and are not distinguished as such, but are "expected" and taken largely for granted by the male population. This is not to say that women cannot be found working long and hard under conditions which would be considered quite difficult even by their own standards. It is to say that there is no "social premium" placed upon opportunities to participate in the specific type of activities proposed by this project. Employment opportunities for women, apart from

"housework" and retailing in local markets, do not exist. Opportunities for increasing education are practically nonexistent and not highly valued.

It should not be the express intention of any development project to attempt to deliberately reverse a long standing cultural tradition in the absence of detailed analysis of the outcome - both short and long-term. The comments and observations made below are considered scanty at best. They have been pieced together through observation and discussions with educated informants and supplemented by contradictory documentation. During the course of the brief on-site visit it was not possible to interviewmany women. As a result, the conclusions set forth should be validated by the sociologist recommended for a two year assignment in the project area. The detailed analysis which would be the result of the contract would (1) be a "first" for Sonrai women in development (and a major contribution to the literature); (2) contribute significantly to the identification of their present and future role; (3) give planners a precise decision base; and (4) be a more permanent, long-lasting overall contribution to their participation in their own development than the tentative suggestions noted later in this section.

Role of Women:

As would be expected, roles vary considerably depending upon (i) class, (ii) caste, (iii) family size, (iv) age, and (v) marital status.

I. Class and Caste: Roles that are charactertistic in general of a low or middle class family background ("gabibi"or "bania" for example) would be considered totally inappropriate for the wife, daughter, daughter-in-law of a nobleman ("arma"). This sense of class "identification" extends in many cases into relationships which are in fact quite remote to the actual "class lineage". In certain cases, sharing the same last name as a middle class family (Maiga, for instance) would inhibit the assumption of a role deemed appropriate for someone whose actual economic standing was clearly less than middle class.

It was less difficult to identify the visible role of women of low class or caste. They are the ones that perform the limited marketing functions which take place weekly or those tasks visible outside of the family compounds.

It must be noted that roles include both the "expected", almost mandatory role pre-determined by birth and lineage, and those which are "accepted" or acceptable in the eyes of the villagers. The norms are complex but well-defined to the initiated - sanctions for the most part are not challenged.

II. Family Size: The relationship of family size to role is one of chore-sharing. If the extended family is composed of a large number of able-bodied women, the "burden" of chores which are performed in and for the compound are shared relatively equally depending upon relationship, age, and marital status. Family size is important for women who are no longer of childbearing age - those having a large number of surviving children (male or female, though female are preferred) will have a lighter load compared to young married women with young children requiring ~~continued~~ care. Wives of the compound "breadwinner" (cash income is scarce, more often this status is judged by the number of cattle or sheep owned) would have a choice of roles not available to the wife of a compound-member who contributes nothing to the extended family.

III. Age and Marital Status: Marital status plays an important part in the acceptance or rejection of a role. Young women of marriageable age, especially those for whom marriage bargaining has already begun, will spend much time and money fixing their hair into elaborate hair-dos, tattooing their lips, hands, or feet, stringing or polishing beads or brass trinkets, etc. to maintain their favored position in the eye of their intended marriage partner and their status in the eyes of their peers and family. The importance of this pre-marriage preparation should not be ignored for it is a significant and

motivating force in their lives.

The role of pre-pubescent girls (mimsy) would depend upon size and strength as well as need. They perform routine chores as do their older sisters as their age/size permit. The roles are learned through doing and are reinforced through oral tradition.

IV. Chores: The following tasks were identified and the approximate time spent performing each has been estimated. It is difficult to determine precisely the duration of some of the tasks which are either shared functions on a rotating basis (cooking) or those which are performed together with assistance from other women (pounding).

A. Pounding Grain: This chore takes 2 1/2 hours per day and is often performed by two or more women at the same time. Pounding grain (millet, sorghum, or rice) in a large wooden mortar with a hardwood pestle is one of the more visible and audible chores performed. Pounding takes place during all times of the day but was most often observed in the early morning or evening. Grain is pounded near the "kitchen" of the compound. It is attended by the cackling of chickens scavenging for spilled grain and performed to the rhythmic beat of the pestles and the clapping of hands as the pestles are tossed into the air. Young children of nursing mothers are strapped to their mothers back, while toddlers, if not watched by older

siblings (usually sisters), wander within the courtyard under their mothers' eyes. Discussions taking place during pounding are lively and animated. The presence of males is not felt.

B. Gathering fuel: The provision of cooking fuel is a time-consuming task and the subject of a lengthy discussion. An average of 3 hours/day was finally agreed upon. It must be pointed out that firewood is increasingly scarce (or non-existent) in the area, and distances between good sites are becoming greater. Firewood is gathered at the rivers' edge during and after the flood of the Niger when logs and branches are swept along and deposited close by the villages. Chopping or large logs is often done by the men. Excess firewood is gathered and sold in weekly markets.

C. Meal preparation: Three hours per day was the concensus. This taks is shared with other women, under the supervision of the eldest woman in the compound. It was rumored, though not confirmed, that in polygamous relationships (becoming increasingly rare) the husband sleeps with the wife who has prepared the dinner. Meal preparation, in this case, is rotated on a two night basis.

D. Washing, cleaning and carrying water: Clothing is washed frequently but not daily. Utensils are carefully cleaned daily (pots and pans only - food is consumed with the right hand).

Since these functions are all performed at the river, it was not possible to arrive at an individual figure. An estimate of two hours per day was agreed upon after another lengthy discussion.

E. Caring for children: Informants reported that most of the remainder of the day was taken up by child care. It would, of course, vary greatly upon age, number of children, and family class.

V. Spare Time: There is little time left for other "chores" upon the completion of the above tasks. However, women find time to weave mats, make clay water jugs for sale in local markets, and groom the hair of daughters or other women.

VI. Marketing: Market days in the villages are weekly, beginning late (about 10 o'clock) and lasting some three to five hours. The Dire market is large and active, and there is a "residual market" daily. Almost 85% of the vendors of dried and fresh fish, cereals, spices, salt, and other

consumer goods are women. Although village commerce is not well developed, goods made by a woman (mats, clay pots, small blankets, etc.) are frequently sold, and the proceeds remain with the woman. The spending of this money is mostly on personal items: usually cloth, trinkets, beads, or oil for the hair. If items are bought for resale in the market, the proceeds are reserved for family consumption (salt, medicine, cereals).

VII. Other Labor: Physical labor in the fields is considered undignified and unbecoming for women. Some women (usually of ex-slave class) work after the harvest is in threshing wheat for cash . Sorghum is threshed as it is needed (see main report).

Summary:

This project has been designed to increase the production of cereal grains in a cereal deficit region. The benefit of this project will accue to women as a benefit of increased family income, commerce, and purchasing power in the area. Unlike other AID financed projects in Mali, this is not an attempt to achieve "integrated rural development" but is carefully and specifically focused upon production and the increase of farm income.

Cognizant of the need to incorporate and distribute benefits equally to all beneficiaries, this project proposes that the role

of women in this highly complex ethnic group be carefully and fully examined and that concrete recommendations be made as further information becomes available. The introduction of certain labor-saving devices and technical assistance in handicrafts, gardening, health, and child care have been tentatively identified as appropriate. A budget line item, to finance grain mills and threshers has been included in the Action Research and evaluation budget. Small tools and other implements have been budgeted for in the credit fund.

ANNEX XIII

PROJECT LOGICAL FRAMEWORK

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
GOAL: Increased food grain production which will contribute toward Mali's achievement of self-sufficiency in food.	Cereal imports provide a progressively decreasing percentage of Mali's food requirements.	1. Customs Office 2. OPAM Records 3. MDR Records 4. Donor food shipment records	1. Increased national grain consumption does not grow at a faster rate than projected. 2. Food self-sufficiency remains a policy of highest national priority.
PURPOSE: 1. To demonstrate that wheat and sorghum production can be increased under irrigation in the Diré area, in a manner which maximizes benefits to the small wheat producers.	EOPS: 1. Total of Farmers whose annual income increases from $266 to $510/year (1981: 620; 1982: 1520; 1983: 2420) 2. Wheat grain supplied from Diré to VI Region, (MT) (1981: 550; 1982: 650; 1983: 750) 3. Sorghum supplied to VI Region, (MT) (1981: 930; 1982: 2280; 1983: 3630) 4. Wheat provided to national market (MT) (1981: 910; 1982: 3150; 1983: 5300)	1. OPAM (records of grain shipments to VI Reg.) 2. OPAM (records of wheat shipments from Diré) 3. Action Blé evaluations.	1. GRM applies during and after project wheat prices which provide sufficient initiative to producers. 2. Wheat flour mill at an appropriate location is operating by 3/1981.

Narrative Summary	Magnitude of Outputs	Means of Verification	Important Assumptions
OUTPUTS: System of irrigated grain production functioning in the project area, comprising the following elements:			
1. Small pumps installed.	1. Small pumps irrigating 4 - 6 hectares each installed as follows: PY 1 / PY 2 / PY 3 / Total Diesel pumps: 150 / 175 / 175 / 500 Animal drawn pumps: 5 / 50 / 50 / 105 Total: 155 / 225 / 225 / 605	1. Action Blé records, field inspections, and quarterly reports of project analyst.	1. Sufficient numbers of farmers willing to purchase pumps.
2. Extension System established.	2. By 1980, 24 extension agents have received pre-service training and are functioning in the villages and undergoing regular in-service training.	2. Ditto.	2. Farmers follow extension recommendation.
3. Farmers organized.	3. 605 small farmer groups (4-6 members) established (155 in 1980, 225 in 1981, and 225 in 1982).	3. Ditto.	3. Farmers willing to pay credits as scheduled.
4. Farmers trained.	4. 2400 participating farmers undergo training in pump maintenance, water management, application of unmixed seed, and other cultural practices.	4. Ditto.	4. Farmers willing to pay irrigation duties.
			5. The types of pumps selected are appropriate to local conditions.
			6. Construction costs stay within the projected range.

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Narrative Summary	Magnitude of Outputs	Means of Verification	Important Assumptions
5. Cereals and some legumes cultivated.	5. CY 1979 - 80 / 1980 - 81 / 1981 - 82 Area growing wheat - ha. 620 1520 2420 Area double-cropped with sorghum, ha 620 1520 2420 Area triple-cropped with legumes, ha 100 500 Wheat produced, MT 1530 3800 6050 Sorghum produced, MT 930 2280 3630	5. Ditto	7. Sufficient fuel available at the Mopti roadhead. 8. Agronomic inputs (esp. fertilizer) remain available at affordable prices. 9. Adequate supply of improved seeds is available. 10. Inflation does not exceed the margin provided in the budget. 11. All relevant GRM agencies achieve the cooperation necessary for execution of the agreements. 12. No unforeseen problems encountered in extension of irrigated strip to 500 m from river bank. 13. Research activity succeeds in improving the package of agricultural practices and in finding effective means for reducing losses due to birds, rats, termites, waterlogging, and other possible problems. 14. Niger River water levels do not drop much below levels of last 10 years. 15. Precipitation, temperature, winds remain within historical range. 16. Min. of Rural Development passes decree by 12/78 specifying mechanism for determination of production levies sufficient to guarantee auto-financing of Action Blé. 17. Min. of Rural Development passes decree by 12/78 establishing product prices sufficient to assure producer incentives.
6. Pump repair system functioning.	6. All pumps kept in good repair by the 8 itinerant mechanics and the central repair shop.	6. Mechanics repair/maintenance records, Action Blé reports.	
7. Fuel supply system functioning.	7. Adequate quantities of fuel (500 liters/pump) shipped during flood season to assure regular supply at farmer's level.	7. Ditto	
8. Credit system functioning.	8. Famers can obtain inputs when required, and pay rates sufficient to assure permanence of the credit system.	8. Report of Credit and Marketing Units and other Action Blé documents.	

Narrative Summary	Magnitude of Outputs	Means of Verification	Important Assumptions
9. Station and on-farm research functioning.	9. Up-to-date recommendations regarding varieties, fertilizer, irrigation, seeding techniques, cultural practices, and other important aspects regularly issued by the Diré research station and tested under farmer conditions. Research appraised by international agronomists.	9. Ditto.	
10. Seed production program functioning.	10. Sufficient quantity of certified seed produced each year for next year's needs; farmers producing own selected (unmixed) seed.	10. Ditto.	
11. Market system functioning.	11. Producers able to sell after every harvest all marketable grain either on the free market or through official channels at a price which provides sufficient incentive to production.	11. Ditto.	
12. Action Blé operation auto-financed.	12. By 3/1982, irrigation duties or other project levies collected are equal to project operating costs.		

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
INPUTS:			
1. Staffing of Action Blé	1. Through new units created in Action Blé and a total of 25 people added to the organization.	1. Action Blé records and field inspections.	1. Sufficient numbers of functionaries of adequate qualifications available to fill the essential posts and are appointed by GRM as programmed.
2. Small pumps, certified seeds, implements and other inputs.	2. See Budget Table for Commodities.	2. Ditto.	
3. Funds for construction of project input warehouses, offices, pump repair shop, staff housing.	3. See Budget Table for "Other Costs-Construction".	3. AID accounting records and Action Blé records.	
4. 3 vehicles and 3 motorboats.	4. Commodity Budget Table.	4. Ditto.	
5. Equipment for office, repair shop, research station, extension agents, mechanics.	5. See Commodities Budget.	5. Ditto.	
6. Participant Training.	6. See training schedule.	6. Ditto.	
7. [illegible]toring.	7. 1 U.S. graduate student performs Ph.D. dissertation establishing base line and initial developments. One Malian sociologist (probably from IER) provides annual follow-up.	7. Sociologist's report.	

ANNEX XIV : Technical Assistance

Social Anthropology

The success of this project requires the assistance of a social anthropologist. First, if an evaluation of the project is to be meaningful, and judgementson the feasibility of project expansion are to be realistic, much social and anthropological data will be needed. At present, no such data base exists, The social anthropologist would be responsible for the collection of such data during his contract period. Second, since one of the major aspects of the research and extension component of the project is flexibility and adaptability to the farmers needs, a feedback system is needed to judge the effectiveness and appropriateness of the extension program. The social anthropologist is needed to assure that the project is continually sensitive to the complex society in which it is attempting to function. Increases in production may be only temporary and perhaps unforeseen damage is being done to the very society which this project is attempting to assist.

The social anthropologist will be recruited from a U.S. university. He will receive modest financial support. It is fully expected that the work performed under this fellowship will lead to the completion of a doctoral dissertation.

"SUGGESTED SCOPE OF WORK" - SOCIAL ANTHROPOLOGIST

1. Census of selected villages in the area of the project, recording: age, sex, origin, occupation, class, ethnic group, language(s) spoken, education.
2. The kinship system, marriage patterns, and family organization and the roles of individual members in social, econo-ic, and political life.
3. Age groups: recruitment, structure, activities.
4. The land tenure system: distribution of land and size of holdings, village common land (its extent, location, type, and administration), inheritance, sale, forms of tenure (including sharecropping and rental).
5. Economic system: production, distribution, consumption, and investment with respect to agriculture, animal husbandry, trade and marketing.
6. Political system: political offices and their interrelation operation, relative importance, election procedures, effectiveness of system, degree of village unity.
7. Judicial system: local, regional, national, religious; informal and formal; sanctions.
8. Religious system: offices and roles; extent and nature of influence on and interaction with other systems.
9. Educational system: informal and formal, who attends, numbers, curriculum.
10. Class/caste system: classes/castes present, relative numbers, power, wealth, interrelations, influence on all other systems.
11. Inter-village relations: kind (political, economic, religious,

kinship, educational, etc.), frequency, important, way conducted, individual vs. group, extent of local or regional interdependency or grouping and basis thereof.

12. Inter-ethnic relations: quality, frequency, importance.

13. Relations between villagers and Action Ble.

14. Relations between villages and national government organizations at all levels and all kinds.

15. Values and attitudes with regard to the above.

16. History of the region.

Trends in all of the above and their consequences for the socio-economic system as a whole and for the physical environment.

18. Roles of women by clas, castes, age and marital status. Present and possible future roles.

SUGGESTED SCOPE OF WORK FOR AN ON-SITE PROJECT ANALYST FOR ACTION BLE

Action Blé's project activities will be implemented on one of the more remote areas of Mali. To assist U.S.A.I.D. project management, the Project Analyst will live in the project area, work day-to-day with Action personnel (management and extension personnel) thus providing a direct link between Project Management in Bamako and Action Blé/implementation activities in the VI Region. As such the contractor will be required to serve as primary liaison between Bamako and Action Blé; assist in all facets of project implementation as required and directed; monitor project implementation identifying constraints and making recommendations for solutions; assist and advise extension personnel when appropriate; develop management information systems and monitor and analyse reports from extension production personnel; assist in preparation of research designs or study plans which might be developed for the area; conduct, in collaboration with Action personnel, interviews with farmer participants in the program to ascertain if project is reaching its objectives as planned; assist in the integration of research and extension efforts, assuring their appropriateness to local situations; assist in planning the design of baseline data-gathering techniques and assist in the implementation of such techniques; assist in the planning, procurement, and delivery of project commodities; assist in the development, implementation and evaluation of credit systems, lower extension repayment, etc; perform other research, or related activities as may be requested by the Director

of Action Ble, his designee or the USAID Project Manager.

The Project Analyst should have good French language capability; the ability to learn local languages must also be demonstrated. The analyst should have experience in West Africa, preferably in Mali, in rural development and/or agricultural project supervision. A familiarity with Malian institutions and AID procedures would be useful. The Analyst should have a proven ability to work effectively in remote areas and should be able to adapt to and integrate into other cultures.

The Project Analyst will be required to submit quarterly reports on his activities to USAID/Bamako. This report shall be submitted in 3 copies in English to the Mission, who will coordinate its translation into French and circulation to approrpriate GRM officials. Other reports will be submitted as requested by the USAID Project Manager.

The project analyst will be recruited locally and hired on renewable one-year personal services contracts. Peace Corps volunteers who have successfully served their tours will be among the likely candidates for this position.

ANNEX XV

MEMORANDUM

TO : THE FILES

FROM : Ronald D. Levin, DIR/Bamako

SUBJECT: Action Blé - 611(e) Certification

Certification on Capacity of the Government of the Republic of Mali to Maintain and Utilize the Project.

The Action Blé project is to be undertaken in Diré, Mali. The purposes of the project are: (i) increase wheat and sorghum production through the provision of small pumps; (ii) increase the income of area farmers; and (iii) establish an effective self-financing extension staff. The maintenance of the small pumps will be assured through provision of a spare parts kit, a crew of 8 mechanics on Action Blé staff, and a pump repair shop to be established in a central location. A condition precedent to the project will be a contract for construction of a flour mill. This outlet will guarantee purchase of Diré grown wheat at reasonable prices. A levy, for the operating expenses of Action Blé, will be determined and included in the price to be paid to producers.

It appears that adequate financial and human resources will exist in the project to maintain facilities and implement planned activities. The maintenance and utilization by the people of Mali in previous projects financed and assisted by AID has been satisfactory.

I, Ronald D. Levin, Director/USAID, Bamako, do certify that in my judgment, based upon experience with donor assistance programs in Mali and the level of technology being introduced in this project, that Mali will have the financial and human resource capability to effectively maintain and utilize the inputs provided in the Action Blé project.

ANNEX XVI

CONSTRUCTION

Construction on project will be limited to (i) a pump repair shop at Bourem, (ii) 2 staff houses, and (iii) provision of non-locally-available materials (roofing material, window and door frames) for village-level structures to be constructed by the villagers, namely: extension offices, extension agents' houses, village input warehouses, and concrete floors for temporary grain storage. All of these constructions involve standard construction methods and traditional design; the total cost is under $100,000. Prior to obligation of funds for this purpose, preliminary plans and cost estimates will be prepared and reviewed in compliance with Section 611(a).

The possibility of warehouse construction is discussed on page 70.

MINISTERE
du
DEVELOPPEMENT RURAL

Rec'd. 3/12/78

REPUBLIQUE DU MALI
Un Peuple—Un But—Une Foi

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N° - 0324

ANNEX XVII

Bamako, le 17 MARS 1978

Action : AGR
cc : PRO
CSO

Le Ministre du Developpement Rural

à Monsieur le Directeur de l'US-AID

B A M A K O

OBJET : Requête pour une intervention au niveau de l'Action Blé DIRE.

Monsieur le Directeur,

J'ai l'honneur de vous demander par la présente, de bien vouloir solliciter auprès des autorités compétentes de l'US-AID, une intervention dans le cadre de la promotion de la culture du Blé dans la zone de Diré.

Les possibilités existantes en la matièr et surtout l'intérêt marqué du Gouvernement du Mali pour atteindre ses objectifs d'autosuffisanc alimentaire militent en faveur de la présente requête. Je vous saurais en conséquence gré de la suite utile que vous pourriez lui réserver.

Je vous prie d'agréer, Monsieur le Directeur, l'expression de ma considération distinguée./.-

Ministère du Développement Rural
LE MINISTRE

IMPLEMATION :
- Agric. (p. inf.)

ANNEX XVIII

PROCUREMENT PLAN

1. Responsibilities:

All procurement under this grant will be the responsibility of the Action Ble staff. If Action Ble so wishes, however, and designates in writing, USAID/Mali can act on behalf of the Action in order to effect procurement in accordance with current AID regulations.

2. Procurement Services Agent:

In view of the quantity of items and the high U.S. dollar value, Action Ble will appoint a professional procurement services agent to undertake the necessary purchases. A service contract will be negotiated with a firm selected in accordance with Chapter 1 of Handbook

If the GRM so requests, USAID/Mali and/or any other United States Government agency is eligible to act as the project PSA.

3. Equipment Commodity List:

The items listed under this heading are those that represent the general needs of the project over its four year

lifespan. More precise specifications will be furnished in the Project Implementation Orders Commodities which will be issued to enact procurement.

Description	Quantity	Total
VEHICLES		
4-wheel drive vehicles	4	$ 60,000
Light passenger vehicle	1	10,000
10-ton truck	1	45,000
PUMPS		
4HP diesel pumps[a]	500	1,130,000
REPAIR SHOP EQUIPMENT		
Metal lathe, 3/4 HP motor, 115/230 volt with misc. bits	1	4,500
Drill Press (15", variable speed, bench model)	1	1,800
Heavy duty bench grinder (w/8" aluminum oxide wheels)	1	450
Electrical generator (7,000 KW)	1	2,500
Arc welder (295 AMP AC dual range)	1	350
Rods, fluxes, etc.		300
Oxyacetylene welder (2 stage regulator)	1	450
Rods, tanks, cylinder holders and gas		400
Gas-fired shop forge	1	650
Workbenches	2	400
Tool chests	2	320
Shallow drawer small parts drawer	3	300

[a] Pumps with spare parts kits

Description	Quantity	Total
REPAIR SHOP EQUIPMENT (Cont.)		
Tool cart and cabinet 635 pc set (Sears)	1	$ 2,500
Hand truck	1	200
Pipe cutters, threaders, and fitting equipment	1	800
Metal shears (bench model)	1	400
Large circular vise	2	100
Swivel-base utility vise	2	180
Flange spreader	1	350
Flange jacks	1 pair	200
Manual stone grinder	1	75
Wire-wheel brushes (8" asst'd)	40	800
Aluminum welding clamps	4	380
Hand tools		
a. Pliers	Asst.	175
b. Screwdrivers	2 sets	100
c. Files/rasps	100	300
d. Hammers	Asst.	200
e. Adjustable wrenches (4"-16")	2	120
Tap and die set (STD and Metric)	1	200
Assorted sheet metal stakes		400
Spark proof drum wrench	3	90
Anvil (wrought iron, 100 lbs.)	1	350
Block and tackle	1	150
Lubricant dispenser and lubricants	1	250
Work gloves, hoods, goggles and other safety equipment		200
Misc. supplies (sheet metal, pipes, etc.)		2,500
Repair Shop Equipment Total.....		$23,440

Description	Quantity	Total
OTHER MISCELLANEOUS U.S. PROCUREMENT		
Small gasoline generators	2	$2,000
Tool kits for pump mechanics	10	1,500

4. Source of Procurement:

The source and origin of other than motor vehicles and fertilizer commodities being procured for this project will be the Code 941 of the AID Geographic Code and Mali except as authorized under waivers or exempted as shelf items purchased under sactioned local currency procurement.

Suppliers of motor vehicles must have a service representative in Mali who can assure the project of after-sale support. The local representatives must be able to provide warranty back-up, start-up and check-outs, spare/repair parts support and adequate service and maintenance facilities.

5. Date of Procurement:

In accordance with the PPT, efforts will be made to effect delivery of the diesel pumps as soon as possible. The pumps have the highest project priority for off-shore procurement.

6. Shelf Item Procurement:

Imported shelf items having their origin in countries included in Code 941 can be purchased without restriction, except for the limitation on the total amount available for local procurement.

Shelf items having their origin in Geographic Code 935 countries (that are not also Code 941 countries) are eligible for local cost financing if the unit cost does not exceed $2,500 and the total of such financing does not exceed ten percent (10%) of the total local costs financed by AID or $10,000, whichever is higher.

Commodities mined, produced or assembled in Mali are available for purchase without restriction, except for the limitation upon the total value of local procurement established in the Agreement. Procurement of imported shelf items shall conform to good commercial practices, shall be at reasonable prices, and shall be consistent with local laws and practices.

A supplier furnishing shelf items for the project must provide a statement attesting to the source and origin of the commodity sold. The AID Director, in turn, must attest that the price being paid is reasonable.

Local Currency Procurement

To support activities of the project, local currency authorization will be required to purchase the goods and services indicated below:

Description	Quantity	Total
Boat and motor	2	$ 5,000
Mobilettes	24	12,000
Fuel barrels (4/pump)	2,000	60,000
OFFICE EQUIPMENT		
Duplicating machine	1	2,000
Typewriters	4	2,000

Description	Quantity	Total
OFFICE EQUIPMENT (cont.)		
Desks (metal)	5	$ 650
Tables	6	450
Chairs	30	600
Safes	4	1,960
Filing Cabinets (metal)	6	600
Calculators (desk top, battery operated)	6	600
Vehicular operational and maintenance costs, shelf item purchases, vehicle servicing		118,000
	Total	$203,860

7. Waivers:

The following waivers are required:

A. A source origin waiver from US Geographic Code 000 (U.S. only) to Geographic Code 935 (Free World) for vehicles must be obtained.

Item: Four four-wheel drive vehicles, one light passenger vehicle, one-ton truck

Probable source: Great Britain, France

Costs: Approximately $10,000 each for 4-wheel drive vehicles;

Approximately $18,000 for passenger vehicle; and $45,000 for truck

Total costs: $115,000

Justification

Mali's imports emanate almost entirely from France and other E.E.C. countries. As a result, Malians have been trained in

the operation and maintenance of mostly European-made vehicles. Additionally, automobile distribution and service facilities in Mali are almost exclusively European. Spare parts, tools and repair service for American vehicles are difficult if not impossible to find and costs, due to this scarcity, are prohibitive.

For vehicles to be of any use in this project they must be of a type that the host country can use effectively in light of the availability of spare parts and accessibility to service and maintenance facilities. This is especially true in the case of this particular project where savings can be achieved by standardizing new vehicle purchases with vehicles in the present motor pool.

It is deemed essential to the successful implementation of this project that a waiver of the requirement of Section 636 (i) of the Foreign Assistance Act be granted to permit procurement of vehicles which can be maintained and repaired locally at a reasonable cost. It is felt that failure to grant this waiver would seriously impede attainment of U.S. foreign policy objectives and the objectives of the foreign assistance program.

B. A waiver of the source and origin restriction on purchase of motor vehicles is requested to permit the local purchase from Code 935 of the following items:

Description	Unit Price	Total
24 Mobylettes	$500	$12,000

Justification: This waiver is needed to permit the local purchase of Mobylettes, a very common means of public conveyance and required in the extension activities of the moniteurs and encadreurs of this project. There is no known manufacturer of this item or a comparative item in the United States. Mobylettes are of European origin and are readily available in the local market. Repair parts are available almost everywhere and maintenance can be performed by relatively unskilled labor.

C. A waiver from Geographic Code 000 to 935 is requested for the purchase of a total of 374 tons of urea for this project.

Justification: The following amounts and types of fertilizer have been recommended by the design team agronomist: 374 tons of urea and 268 tons of triple super phosphate.

Locally mined rock phosphate will be substituted for the triple super phosphate. It is estimated that a substantial savings on transportation (ocean and inland) would result if rock phosphate is procured (20% according to recent estimates). A source waiver for the purchase of urea (probable source France) is justified because it is highly unlikely that a U.S. firm would be interested in bidding on such a small amount of fertilizer or that a reasonably competitive bid would result in savings to the project.

Approximate cost of fertilizers is $154,000.

D. Approval is requested to increase the amount of shelf items that may be procured from Code 935 countries, other than those included in Code 941, from 10% to 43% of the total local currency costs financed by A.I.D. Shelf item procurement will total $673,000, including over $500,000 for POL products, mostly diesel fuel and lubricants for small irrigation pumps. From a management point of view, it makes best sense to procure fuel in-country as it is needed. Bulk importation and storage of the amount of fuel needed during the life of project would not be efficient. The 43% figure assumes all shelf item procurement will be from Code 935 countries. In fact, there is a good possibility that POL products procured locally will be from Code 941 sources (e.g., Nigeria), but it will be impossible to so determine or ensure at time of purchase.

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TELEGRAM

CTION: USAID
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UNCLASSIFIED
Classification

CONTROL: 191
RECD: 4/6/78 1109

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O AMEMBASSY BAMAKO 8122
T
NCLAS STATE 088053

IDAC, ABIDJAN FOR REDSO/WA

.O. 11652: N/A

AGS:

SUBJECT: SMALL IRRIGATION PUMPS.

EF: BAMAKO 1359.

. HAVE DISCUSSED SPECIFICATION PROVIDED REF CABLE
VITH GORMAN RUPP, LEADING SUPPLIER OF SMALL DIESEL
DRIVEN IRRIGATION PUMPS AND ONE OF SEVERAL U.S. PUMP
MANUFACTURERS USING PETTER AND LISTER DIESELS PRO-
DUCED IN UK. U.S. BUILT DIESELS THIS SIZE NOT READ-
ILY AVAILABLE, HOWEVER PUMPS WITH UK-MADE ENGINES
USUALLY COMPLY WITH AID COMPONENTRY REQUIREMENTS.

2. GORMAN RUPP ADVISES MOST ENGINES HAVE BEEN SPEED-
ED UP IN RECENT YEARS AND NOW OPERATE AT FROM 2500 TO
3500 R.P.M. IS OF OPINION 1500 R.P.M. COULD BE OB-
TAINED ONLY IN DIESEL CONSTRUCTED ACCORDING TO OBSO-
LETE DESIGN.

3. GORDON RUPP IS FORWARDING BROCHURES ON SEVERAL OF
THEIR SMALL DIESEL POWERED PUMPS FOR CDO REVIEW FOR
SUITABILITY. WILL FORWARD ON RECEIPT. VANCE
BT
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UNCLASSIFIED
Classification

OPTIONAL FORM 161(H)
(Formerly 20-412(H))
January 1973

A waiver of the source and origin restriction on purchases of small, diesel pumps may be requested to permit purchase of these items from Code 935 sources. Initially, an effort to procure pumps in Code 941 countries will be made. To be considered satisfactory, pumps should possess as a minimum the following qualifications:

1. be of a heavy, construction;
2. have a slow speed (suggested not over 1500 r.p.m.)
3. be capable of undergoing several overhauls (possiblity of re-boring cylinders, renovating rather than replacing piston rods, etc.);
4. be thoroughly tried in tropical small-farmer conditions (at least several thousands of pumps of the same model in current operation under [illegible] conditions);
5. be produced by a manufacturer willing to set up a spare parts distribution agency in Mali and to train local diesel mechanics in the particular repairs and maintenance required by these pumps;
6. have a reasonably low cost.

8. Payments:

Payment to the PSA will be made by the Direct Letter of Commitment method. Upon receipt of the PIO/C in AID/W, the letter is sent to AAPC to initiate procurement. When AAPC has completed its purchasing actions, documents are presented to the AID Controller's office in New York, New York for payment.

Local procurement payments will be made upon presentation of documentation presented to the Controller's office AID/Bamako. Regular procedures which have been established will be followed in all such local currency purchase.

9. Delivery: All project commodities imported into Mali will be shipped on the basis of CIF, Bamako. Suppliers will provide all risk marine insurance in the amount of 120 percent of the CIF cost of the commodities and similar insurance for inland freight. AID's marking requirements for overseas shipments will be enforced by the PSA.

on crates or evidence of possible damage losses.

Reports of damages/losses must be made promptly if incoming cargo has been procured in the United States. AAPC must be notified by telegram of the extent of the damages/losses so that AAPC can file a "notice to file a claim". Once AAPC has filed its notice, the carrier must await the filing and adjudication of the claim. This permits the Grantee and the AID/Mali personnel to acquire more information and particulars about the claim. In most cases where damages or losses are noted a picture of the broken box or damaged crate is the best possible evidence that can be presented. Receiving documents, properly annotated, are valuable if damages have been noted; however, this evidence alone is insufficient to settle a claim.

Grantees are required to put into project use all commodities procured for the project uses within one year of receipt. The local AID representative will inspect the Grantee's utilization reports as a matter of course.

Procurement Schedule

Schedule supposes that preliminary work on procurement actions can begin immediately. Target dates are keyed to date of the signing of the grant.

Target Dates	Action to be Taken
+ 15 days	PIO/Cs prepared for procurements not requiring conditions precedent (CP).
+ 30 days	Designate and appoint procurement services agent (PSA). Procurement of local source items begins.
+ 45 days	Non-CP PIO/Cs prepared with CDO assistance.
+ 90 days	Input of non-CP PIO/Cs to PSA.
+ 90-239 days	Procurement and shipment by PSA (AAPC).
+ 240-270 days	Arrival of commodities at West African ports
+ 270-365 days	Arrival of commodities at Bamako, Mali.

ANNEX I TO GRANT AGREEMENT

A. Background: Action Blé was included in the GRM's Five Year Plan (1974-1978) as the three hundred hectare "experimental perimeter of Diré". It was conceived to test the suitability of sugar cane, wheat and forage production on 30 hectares of land and to distribute the remaining hectarage to local farmers for wheat production. The plan at that time was to reconstruct or rehabilitate the former CICONIG farming enterprise site on the Plain of Diré. Irrigation of this large, contiguous area would be from large diesel and solar pumps. French financing was secured based upon a feasibility study conducted by the SCET International in 1975.

Reconstruction of the former irrigation works has proceeded slower than anticipated. Action Blé's technical staff, as a result, was not fully utilized. The staff implemented supplemental projects with small irrigated perimeters in nearby villages. Using small pumps and gravity-fed irrigation systems, the farmers have had good yields and enthusiasm is high. These initial gains enhance the already proven economic viability of wheat production in this area and are the basis of AID's interest in the expansion of the village level irrigation systems.

B. Goal and Purpose: The goal of this project is to decrease the annual wheat flour imports of Mali and increase the production of sorghum in the Sixth Region. The project purpose is to accelerate the development of farmer-owned and managed irrigated perimeters to increase grain production in a manner which maximizes farm income. The following targets have been established:

IRRIGATED HECTARES

	Project Year 1	Project Year 2	Project Year 3	Project Year 4
Wheat	--	620	1520	2420
Sorghum	--	620	1520	2420
Triple Cropped	--	0	100	500

PRODUCTION TARGETS (MTs)

	Project Year 1	Project Year 2	Project Year 3	Project Year 4
Wheat	--	1530	3800	6050
Sorghum	--	930	2280	3630

C. Project Description: --Action Blé-Diré will assist approximately 2,400 small farmers to increase cereal production in Mali's Sixth Region through the provision of: 1) small irrigation pumps; 2) a revolving credit fund; 3) a larger, better trained Action Blé management; and 4) an established pricing policy which will encourage cereal production in the area.

Farmers will be given short- and medium-term credit for agricultural inputs and machinery through a special revolving credit fund managed by Action Blé.

Small diesel pumps (4 HP), capable of irrigating a minimum of four hectares each, will take water from the Farabongo branch of the Niger river and lift it into simple, gravity-fed irrigation systems. These systems will be constructed and maintained by the farmers themselves. Five animal-driven irrigation pumps of a type

well established in Pakistan will be tested during the first year of the project. If these pumps prove successful under local conditions, more "flow pumps" will be ordered and installed.

This system of pumps will permit dry season irrigation of wheat on 2,420 hectares. It will also permit supplemental irrigation of 2,420 hectares of sorghum. Additionally, 500 hectares of land will be targeted for "triple-cropping" with legumes or forage.

The pumps will be jointly owned, operated and maintained by the farmers themselves. Farmers will receive assistance with operation and care of the pumps by a staff of 8 trained mechanics on contract to Action Blé for 3 years. Pumps will be placed on credit to farmers who will sign an agreement pledging joint and several liability for annual repayment of fuel or repair costs, and interest in cash or kind.

The Action Blé staff will be increased and will receive additional training to better supervise the production and market-related activities of the farmers. Three new units will be created and staffed: 1) a <u>mechanical supervision unit</u> for pump maintenance; 2) a <u>credit and marketing unit;</u> and 3) a <u>training unit</u> for farmers and technicians.

D. <u>Elements to be Financed</u>:

1. <u>Technical Assistance</u>

72 person-months of U.S. technical assistance is planned for this project. A project analyst, to work directly under the supervision of the Action Blé Director, will live in Diré to

assist, as needed, in the overall management of the project. A graduate student sociologist will be supported under this project to assist in the collection and analysis of social baseline data.

2. Participant Training

A total of 384 person-months of training is budgeted for in this project. This training includes U.S. academic and non-academic training of 78 months; in-country training of 279 months; and third-country observational visits and training of 27 months.

3. Commodities

Commodity purchases are detailed in the attached budget table and include vehicles, mobilettes and boats to support the mobility requirements of the technicians; irrigation pumps (500 4HP diesels plus animal-driven flow pumps); equipment for a pump repair shop and office supplies and equipment for secteur de base offices.

4. Other Costs

Other costs items are detailed in the attached budget and include funds for 1) construction of staff housing, village level input warehouses and temporary grain storage facilities (cement floors for stacking grain awaiting shipment); 2) action research and evaluation for funding of production-related research; 3) a revolving credit fund for purchase of agricultural inputs and equipment; and 4) necessary operating expenses (fuel for project vehicles, office supplies and primes) in support of this project.

E. Targets for Calendar Year 1979:

1. Installation of 150 diesel pumps.

2. Order and have stored fuel and agricultural inputs for crop year 1979.

3. Complete staffing pattern of Action Blé-Diré.

4. Begin in-country training courses for farmers, technicians and mechanics.

5. Select and nominate candidates for training abroad.

F. GRM Contribution:

The GRM agrees to supply in both cash and kind:

A. Personnel costs in thousands of Mali francs as indicated below:

Project Year 1	Project Year 2	Project Year 3	Project Year 4
28,150	28,150	28,150	28,150

B. Land, buildings or office space not otherwise provided from other sources.

G. AID Contribution: The AID contribution to this project will be provided for expenditures in accordance with the Project Financial Plan to be agreed to, in writing, at a later date.

PROJECT BUDGET SUMMARY

	Component	Total	OBLIGATIONS FY 79	FY 80	FY 81	FY 82
I. Technical Assistance		360,000	60,000	140,000	100,000	60,000
1. Sociologist a/	40,000					
2. On-Site Project Analyst b/	160,000					
3. TDY Technical Assistance c/	200,000					
II. Participant Training d/		225,200	101,800	84,800	39,000	-
1. U.S. (78 pm)	132,000					
2. In-Country (297 pm)	53,000					
3. Third Country (27 pm)	40,200					
III. Commodities d/		1,487,800	554,800	466,500	466,500	-
IV. Other Costs d/		1,000,839	326,080	454,394	199,365	21,000
1. Construction	348,000					
2. Action Research & Evaluation	166,000					
3. Credit Fund	378,500					
4. Operating Expenses e/	108,339					
TOTAL		3,073,839	1,042,680	1,145,294	804,865	81,000
Contigency (20%)		614,768	208,536	229,059	160,973	16,200
Inflation (20%)		737,721	250,243	274,871	193,168	19,440
PROJECT TOTAL		4,426,328	1,501,459	1,649,224	,159,006	116,640

a/ Graduate student research grant.
b/ Personal Services Contract, local hire.
c/ Expertise in agronomy, credit and marketing, pest control, and on-farm irrigation.
d/ See Detailed Budget Sheet.
e/ Represents A.I.D.'s portion of operating expenses to be shared with GRM as detailed on preceding page.

DETAILED BUDGET ANALYSIS: III. COMMODITIES

	Quantity	Unit Price	Cost	OBLIGATIONS (000s U.S.) FY 79	FY 80	FY 81	FY 82
Vehicles			$ 132,000	$132,000			
Boat w/motor	2	2,500	5,000	5			
Light Vehicle (passenger)	1	10,000	10,000	10			
Truck (10-ton)	1	45,000	45,000	45			
4-Wheel Vehicle	4	15,000	60,000	60			
Mobilettes	24	500	12,000	12			
Pumps[a/]			$1,320,000	$ 387	$466,500	$466,500	
4-HP Diesel rumps[b/]	500	2,260	1,130,000	339	395,500	395,500	
Flow Pumps (pilot)[c]	5	6,000	30,000	30			
Flow Pumps	100	1,000	100,000		50	50	
Fuel Barrels (4/pump	2,000	30	60,000	18	21	21	
Generators							
Small, Gasoline Powered Emergency Use	2	1,000	2,000	2,000			
Repair Shop Equipment[d/]			23,440	23,400			
Maintenance Crew							
Tool Kits[e/]	10	150	1,500	1,500			
Office Equipment[f/]			8,860	8,860			
TOTAL			$1,487,800	$554,800	$466,500	$466,500	

a/ Pumps will be extended on strict credit terms. They are not included in the revolving credit fund which detail short-term credit requirements only.
b/ With suction pipes, delivery pipes, spare parts kits, delivered Dire.
c/ Includes air freight shipment and technical assistance installation.
d/ See detailed Equipment List page
e/ Includes two extra kits.
f/ [illegible]

DETAILED BUDGET ANALYSIS: IV OTHER COSTS

REVOLVING CREDIT FUND

	QUANTITY	UNIT PRICE	TOTAL	FY 1979	FY 1980	FY 1981	FY 1982
Diesel Fuel (1 year supply)	800 liters/pump	$ .36/liter	$ 424,800	$ 43,200	$ 93,600	$144,000	$144,000
Lubricants	25 liters/pump	$1.20/liter	44,250	4,500	9,750	15,000	15,000
Certified Wheat Seeds	100 kg/ha	$ .34/kilo	82,300	21,100	30,600	30,600	--
Fertilizers[1/]			221,000	11,000	37,000	75,000	98,000
Wheel barrows	605	$60.00	36,300	9,300	13,500	13,500	--
Hand Tools (picks, shovels, sickles)	2,420	$40.00	96,800	24,800	36,000	36,000	--
Wheel Assemblies (for donkey carts)	150	$150.00	22,500	5,700	8,400	8,400	--
Storage Sacks	1 bag/50 kg		225,600	48,000	56,000	56,000	65,600
			$1,153,550	$167,600	$284,850	$378,500	$322,600
AL CREDIT REQUIREMENTS			$1,153,550	$167,600	$284,850	$378,500	$322,600
CREDIT REQUIREMENTS[2/]			$ 378,500	$167,600	$117,250	$ 93,650	--

ncludes wheat and sorghum needs.
ee Credit Fund Requirements for Fertilizer.

ssumes 100% repayment. Interest rate of 8% p.a., principal and interest earnings from pump loans will assure iability of revolving fund through 1987.

DETAILED BUDGET ANALYSIS: IV OTHER COSTS

OPERATING EXPENSES

	TOTAL	OBLIGATIONS FY 79	FY 80	FY 81	FY 82
OFFICE EXPENSES (Office supplies, communications, fuel for generators)	$ 25,000	$ 4,000	$ 7,000	$ 7,000	$ 7,000
EXTENSION EXPENSES (Field days, materials, training)	14,000	2,000	4,000	4,000	4,000
VEHICLE OPERATION					
4 wheel drive vehicle, 3, 17,500 km/year at $.22/km ($.36/mile)	48,000	12,000	12,000	12,000	12,000
Light vehicle, 1, 17,500 km/year at $.11/km ($.18/mile)	11,450	2,000	3,150	3,150	3,150
Truck, 10 ton, 1, 15,000 km/year at $.44/km ($.72/mile)	22,800	3,000	6,600	6,600	6,600
Mobilettes					
Motor boat fuel and oil	1,800	300	500	500	500
SPECIAL ALLOWANCES FOR GRM PERSONNEL	72,720	18,180	18,180	18,180	18,180
	$195,770	$ 41,480	$ 51,430	$ 51,430	$ 51,430
ID Portion of Operating Expenses	$108,339	$ 41,480	$ 41,144	$ 25,715	

DETAILED BUDGET ANALYSIS: OTHER COSTS

ACTION RESEARCH AND EVALUATION[1]

Activity Areas	Total	By Component	FY 79 US - GRM	FY 80 US - GRM	FY 81 US - GRM	FY 82 US - GRM
Environmental	22					
A. Windbreaks & Reforestation		12			12	
B. Triple Cropping & Crop Rotation		10				10
Social						
Malian Sociologist Support	16		4	4	4	4
Agronomic						
A. On-Farm Testing	28					
1. Varieties		7			7	
2. Fertilizer		7			7	
B. Crop Protection						
1. Bird Control		7		7		
2. On-Farm Storage		7				7
Economics	30					
A. Base Line Data for Evaluation		15	15			
B. Market and Pricing		15		15		
Appropriate Technology	45					
A. Animal Traction		15			15	
B. Small Farm Implements[2]		20		20		
C. Other		10			10	
Women in Development[3]	25				25	
	166	—	19	46	80	21

1. See detailed description.
2. Foot treadle threshers.
3. Gasoline powered grain mills.

DETAILED BUDGET ANALYSIS: IV. OTHER COSTS CONSTRUCTION

	Quantity	Unit Price	Total	OBLIGATION FY 79
1. Staff Housing (including water & electrical connections)	2	15,000	30,000	
2. Pump Repair Shop (including water & electrical connections)	1	20,000	20,000	
3. Cement Floors for Temporary Grain Shortage	12	1,000	12,000	
4. Roofing Material, Doors & Windows for 8 Extension Offices, 8 extensionists Lodgings and 8 Village Level Input Warehouses	24	1,500	36,000	
Total			98,000	98,000

				OBLIGATION FY 80
5. Grain Storage facility	1	250,000	250,000	$ 250,000

DETAILED BUDGET ANALYSIS: COMMODITIES

	Quantity	Unit Price	Total
OFFICE EQUIPMENT			
1. Duplicating Machine	1	2,000	2,000
2. Typewriters	4	500	2,000
3. Desks (metal)	5	130	650
4. Tables	6	75	450
5. Chairs	30	20	600
6. Safes	4	490	1,960
7. Filing Cabinets (metal)	6	100	600
8. Calculators (desk top, battery operated)	6	100	600
TOTAL			8,860

ANNEX XX

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5C(1) - COUNTRY CHECKLIST

Listed below are, first, statutory criteria applicable generally to FAA funds, and then criteria applicable to individual fund sources: Development Assistance and Security Supporting Assistance funds.

A. GENERAL CRITERIA FOR COUNTRY

1. FAA Sec. 116. Can it be demonstrated that contemplated assistance will directly benefit the needy? If not, has the Department of State determined that this government has engaged in consistent pattern of gross violations of internationally recognized human rights?	YES
2. FAA Sec. 481. Has it been determined that the government of recipient country has failed to take adequate steps to prevent narcotics drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the U.S. unlawfully?	NO
3. FAA Sec. 620(b). If assistance is to a government, has the Secretary of State determined that it is not controlled by the international Communist movement?	YES
4. FAA Sec. 620(c). If assistance is to government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government?	NO
5. FAA Sec. 620(e) (1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	NO

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6. FAA Sec. 620(a), 620(f); App. Sec. 107, 114. Is recipient country a Communist country? Will assistance be provided to the Socialist Republic of Vietnam, Cambodia, Laos, Cuba, Uganda, Mozambique, or Angola? — NO

7. FAA Sec. 620(i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression? — NO

8. FAA Sec. 620(j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property? — NO

9. FAA Sec. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason? — NO

10. FAA Sec. 620(o); Fishermen's Protective Act, Sec. 5. If country has seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters, — NA - landlocked

a. has any deduction required by Fishermen's Protective Act been made?

b. has complete denial of assistance been considered by AID Administrator?

11. FAA Sec. 620(q); App. Sec. 503. (a) Is the government of the recipient country in default on interest or principal of any AID loan to the country? (b) Is country in default exceeding one year on interest or principal on U.S. loan under program for which App. Act appropriates funds, unless debt was earlier disputed, or appropriate steps taken to cure default? — NO

12. FAA Sec. 620(s). "If contemplated assistance is development loan (including Alliance loan) or security supporting assistance, has the Administrator taken into account the percentage of the country's budget which is for military expenditures, the amount of foreign exchange spent on military equipment and the amount spent for the purchase of sophisticated weapons systems?" (An affirmative answer may refer to the record of the taking into account, e.g.: "Yes as reported in annual report on implementation of Sec. 620(s)." This report is prepared at the time of approval by the Administrator of the Operational Year Budget. — NA

Upward changes in the Sec. 620(s) factors occuring in the course of the year, of sufficient significance to indicate that an affirmative answer might need review, should still be reported, but the statutory checklist will not normally be the preferred vehicle to do so.)

13. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption? — NO

14. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget? — Payments are current

15. FAA Sec. 620A. Has the country granted sanctuary from prosecution to any individual or group which has committed an act of international terrorism? — NO

16. FAA Sec. 666. Does the country object, on basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. there to carry out economic development program under FAA? — NO

17. *FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? Has it detonated a nuclear device after August 3, 1977 although not a "nuclear-weapon State" under the nonproliferation treaty?* — NO

18. FAA Sec. 901. Has the country denied its citizens the right or opportunity to emigrate? — NO

B. FUNDING CRITERIA FOR COUNTRY

1. Development Assistance Country Criteria

a. FAA Sec. 102(c), (d). Have criteria been established, and taken into account, to assess commitment and progress of country in effectively involving the poor in development, on such indexes as: (1) small-farm labor intensive agriculture, (2) reduced infant mortality, (3) population growth, (4) equality of income distribution, and (5) unemployment. — YES

b. FAA Sec. 104(d)(1). *If appropriate, is this development (including Sahel) activity designed to build motivation for smaller families in programs such as education in and out of school, nutrition, disease control, maternal and child health services, agricultural production, rural development, and assistance to urban poor?*

YES

c. FAA Sec. 201(b)(5), (7) & (8); Sec. 208; 211(a)(4), (7). Describe extent to which country is:

(1) Making appropriate efforts to increase food production and improve means for food storage and distribution.

(2) Creating a favorable climate for foreign and domestic private enterprise and investment.

(3) Increasing the public's role in the developmental process.

(4) (a) Allocating available budgetary resources to development.

(b) Diverting such resources for unnecessary military expenditure and intervention in affairs of other free and independent nations.

(5) Making economic, social, and political reforms such as tax collection improvements and changes in land tenure arrangements, and making progress toward respect for the rule of law, freedom of expression and of the press, and recognizing the importance of individual freedom, initiative, and private enterprise.

(6) Otherwise responding to the vital economic, political, and social concerns of its people, and demonstrating a clear determination to take effective self-help measures.

The GRM has organized itself into special agricultural production zones and given jursidiction over these for rural/agricultural development to semi-autonomous agencies called "operations". The extension of farmer technology and education to produce more is the principal activity of "operation" staff. These "operations" assist, as well, in storage, marketing, and distribution of food in deficit areas.

The GRM encourages private investment and offers incentives (including tax gree privileges) for investment in several areas.

Locally elected village chiefs play a critical role in the rural development strategy and all major decisions are discussed in council with village elders.

To the extent national budget resources permit, GRM funds are allocated to agricultural/rural development.Resources are not diverted for unnecessary expenditures in other sectors.

Land taxes are not collected for agricultural land. Land is not a constraint to agriculture. The system is equitable and fair,following traditional practices, and is available to anyone settling into a village.

The GRM has shown a clear determination to take all available self-help measures.

d. FAA Sec. 201(b), 211(a). Is the country among the 20 countries in which development assistance loans may be made in this fiscal year, or among the 40 in which development assistance grants (other than for self-help projects) may be made?

d. NA

e. FAA Sec. 115. Will country be furnished, in same fiscal year, either security supporting assistance, or Middle East peace funds? If so, *has Congress specifically authorized such use of funds, or* is assistance for population programs, humanitarian aid through international organizations, or regional programs?

NO

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2. Security Supporting Assistance Country Criteria

NA

a. FAA Sec. 502B. Has the country engaged in a consistent pattern of gross violations of internationally recognized human rights? Is program in accordance with policy of this Section?

b. FAA Sec. 531. Is the Assistance to be furnished to a friendly country, organization, or body eligible to receive assistance?

c. FAA Sec. 533(c)(2). *Will assistance under the Southern African Special Requirements fund be provided to Mozambique, Angola, Tanzania, or Zambia? If so, has President determined (and reported to the Congress) that such assistance will further U.S. foreign policy interests?*

d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?

e. App. Sec. 113. *Will security assistance be provided for the purpose of aiding directly the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?*

f. FAA Sec. 620B. *Will security supporting assistance be furnished to Argentina after September 30, 1978?*

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5C(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?

A. GENERAL CRITERIA FOR PROJECT.

1. App. Unnumbered; FAA Sec. 653(b); Sec. 671

(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

An advice of program change will be submitted.

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?

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?

NA

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 *the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973*?

YES, see PP page 74

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 XV

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?

The project purpose is to demonstrate that cereal production on small perimeters can be increased through irrigation system operated and managed by small farmers in a manner which maximizes benefits to these farmers. The accomplishment of this purpose will increase the likelihood of multi-lateral participation.

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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.

The project will encourage private initiative and improve technical efficiency of agriculture.

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).

The purchase of small irrigation pumps for th this project, may, if the bid is awarded to a U.S. firm, encourage US private trade in Mali. The covenant establishing a flour mill could result in importation of American machinery into Mali.

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 GRM is contributing local support costs as permitted by its national budget. No U.S. owned foreign currency available for support of this project.

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

No U.S. owned foreign currency is available for support of this project.

11. *ISA 14. Are any FAA funds for FY 78 being used in this Project to construct, operate, maintain, or supply fuel for, any nuclear powerplant under an agreement for cooperation between the United States and any other country?*

NO.

8. 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?

This project is involving the rural poor in their own development to the fullest extent possible. It provides them a low cost credit source for purchase of agric. inputs to increase farm production and income. It is designed to encourage local participation in management and operation of small irrigated perimters.

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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.] NA

(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;

(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;

(c) research into, and evaluation of, economic development processes and techniques;

(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.

(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)?

NA

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, *or is the recipient country "relatively least developed"?*

NA

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.

The project is in direct support of meeting the country's food needs. The integration of women in development and the strengthening of their participation in the local economy is included in this project.

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.

The project will utilize to the fullest extent possible the capacities of the people of this country.

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? YES

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. NA

2. Development Assistance Project Criteria (Loans only) NA

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

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

b. FAA Sec. 533(c)(1). *Will assistance under the Southern African Special Requirements Fund be used for military, guerrilla, or paramilitary activities?*

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 and recommendations of the Inter-American Committee for the Alliance for Progress (now "CEPCIES," the Permanent Executive Committee of the OAS) in its annual review of national development activities?

5. Additional criteria for Sahel Development Project

How will this assistance contribute to the long-term development of the Sahel region in accordance with a long-term multi-donor development plan?

This project is designed to test small, irrigated perimeter cereal production potential in the northern Niger delta region of Mali. The development of the sizeable potential for grain production will lay the groundwork for similar investments in the near future

small pump irrigation for future multi-donor financing for Mali and similar areas in neighboring Sahel

This project is considered as Phase I to demonstrat

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5C(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 headirgs 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?	Standard AID procurement regulations will be applied
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?	The Grant Agreement will contain appropriate provisions/
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?	NA
5. FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?	YES
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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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, *to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to practice sterilization?* — 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. 105. to pay U.N. assessments? — YES

g. App. Sec. 106. to carry out provisions of FAA Sections 209(d) and 251(h)? (transfer to multilateral organization for lending). — YES

h. App. Sec. 112. *to finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields?* — YES

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

diagram 1: location of the project

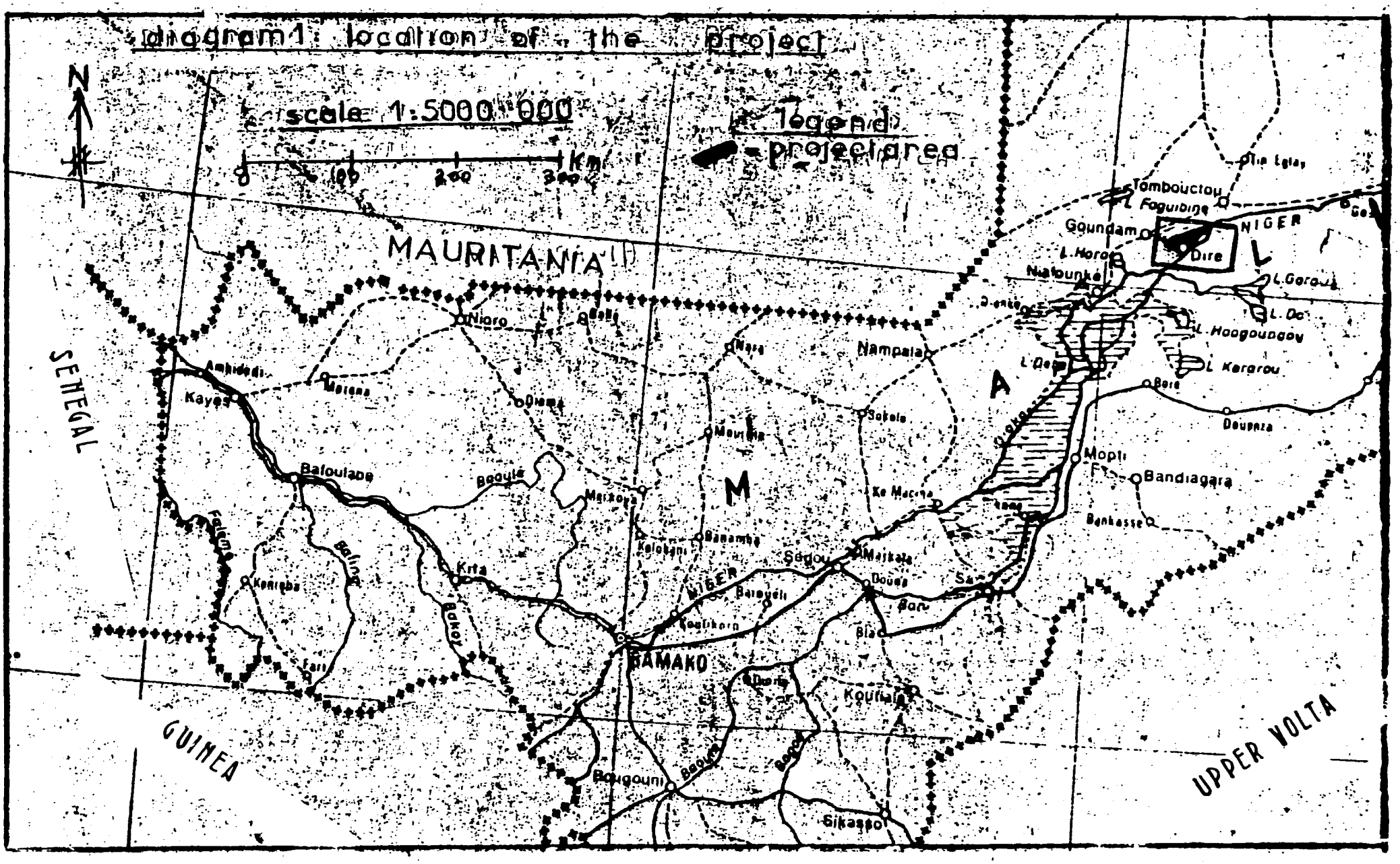


DIAGRAM 2: MAP OF THE PROJECT AREA

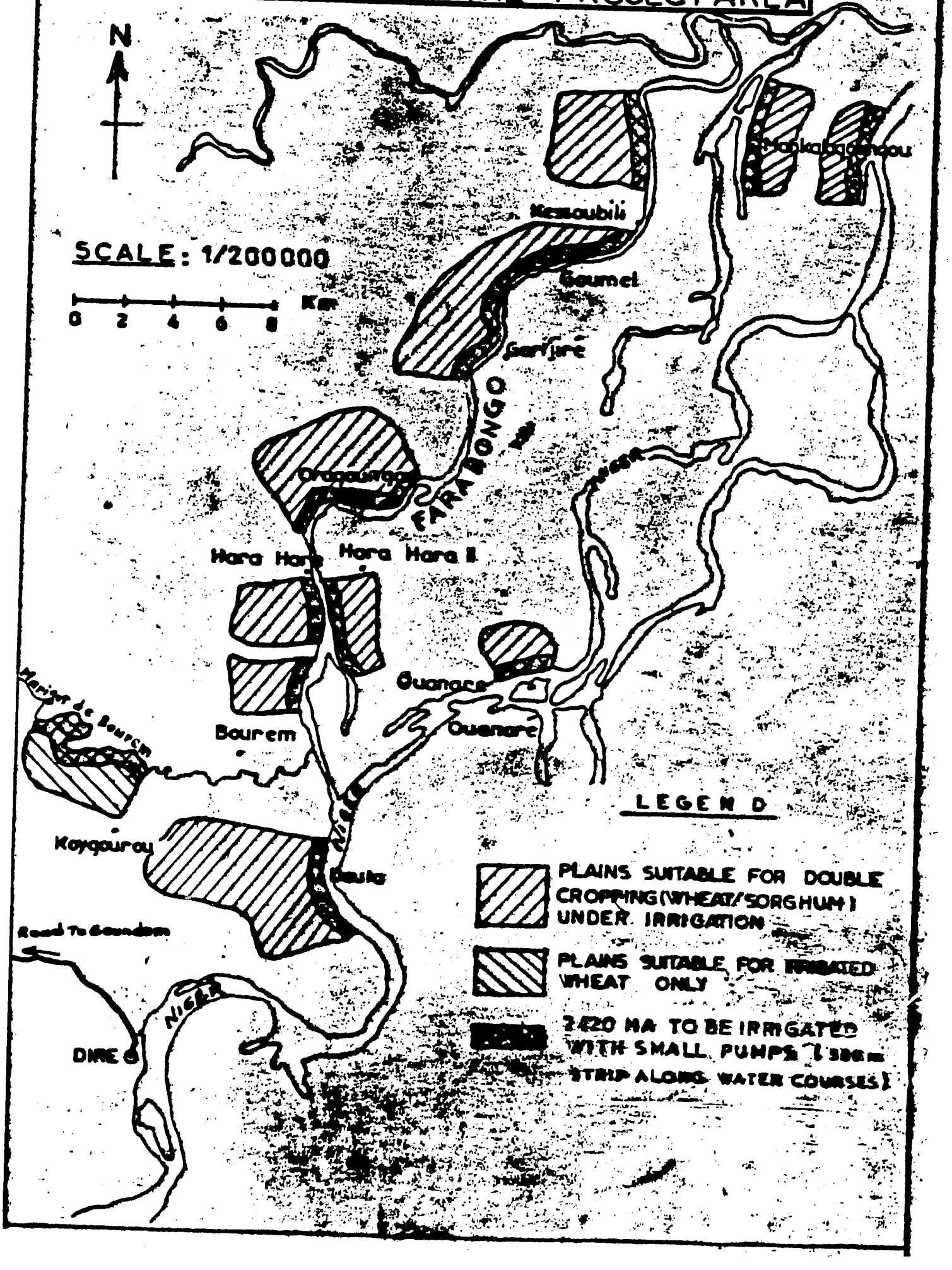


DIAGRAM 3 : TYPICAL LAYOUT OF FARM UNITS

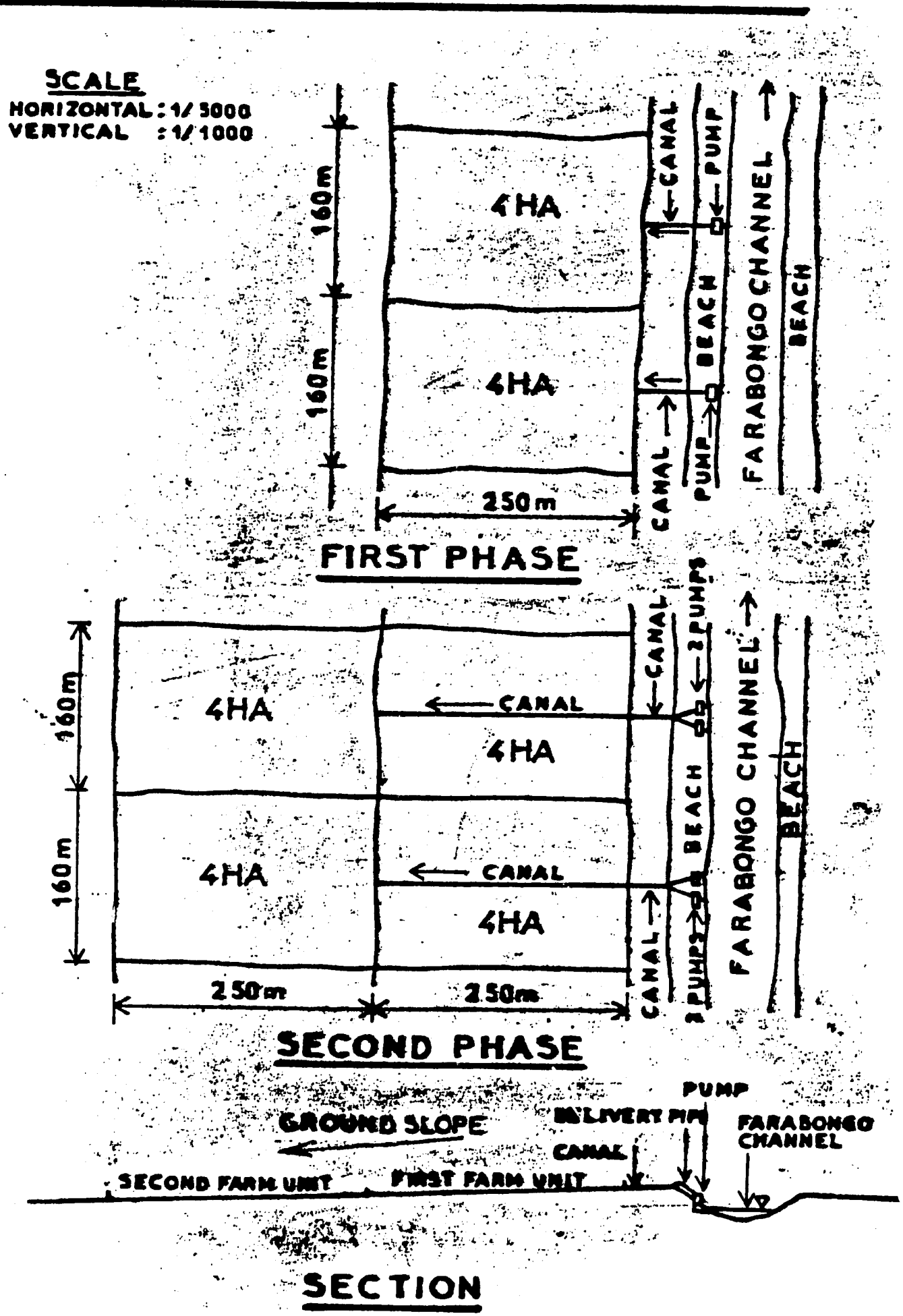
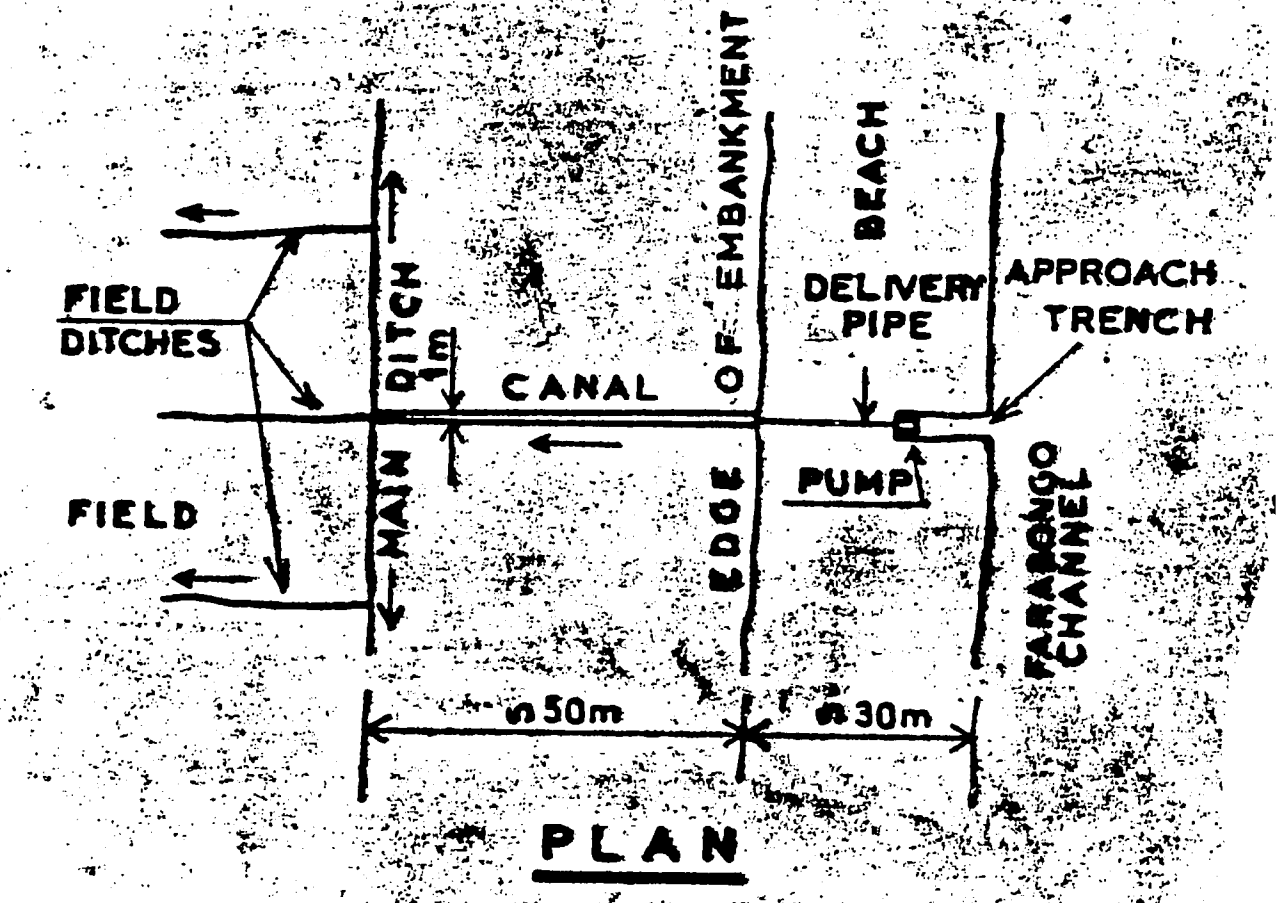
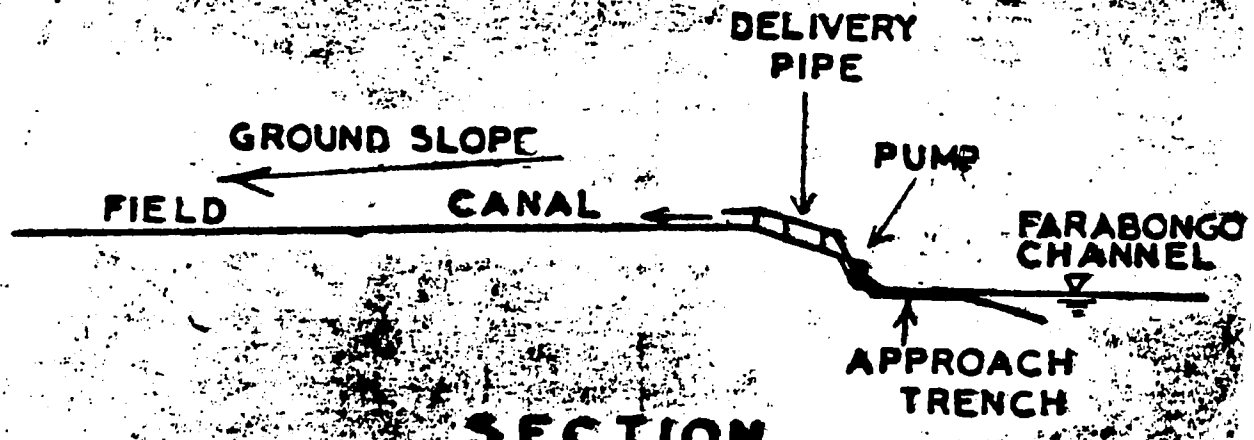


DIAGRAM 4: TYPICAL LAYOUT FOR DIESEL P.U.M.P



PLAN



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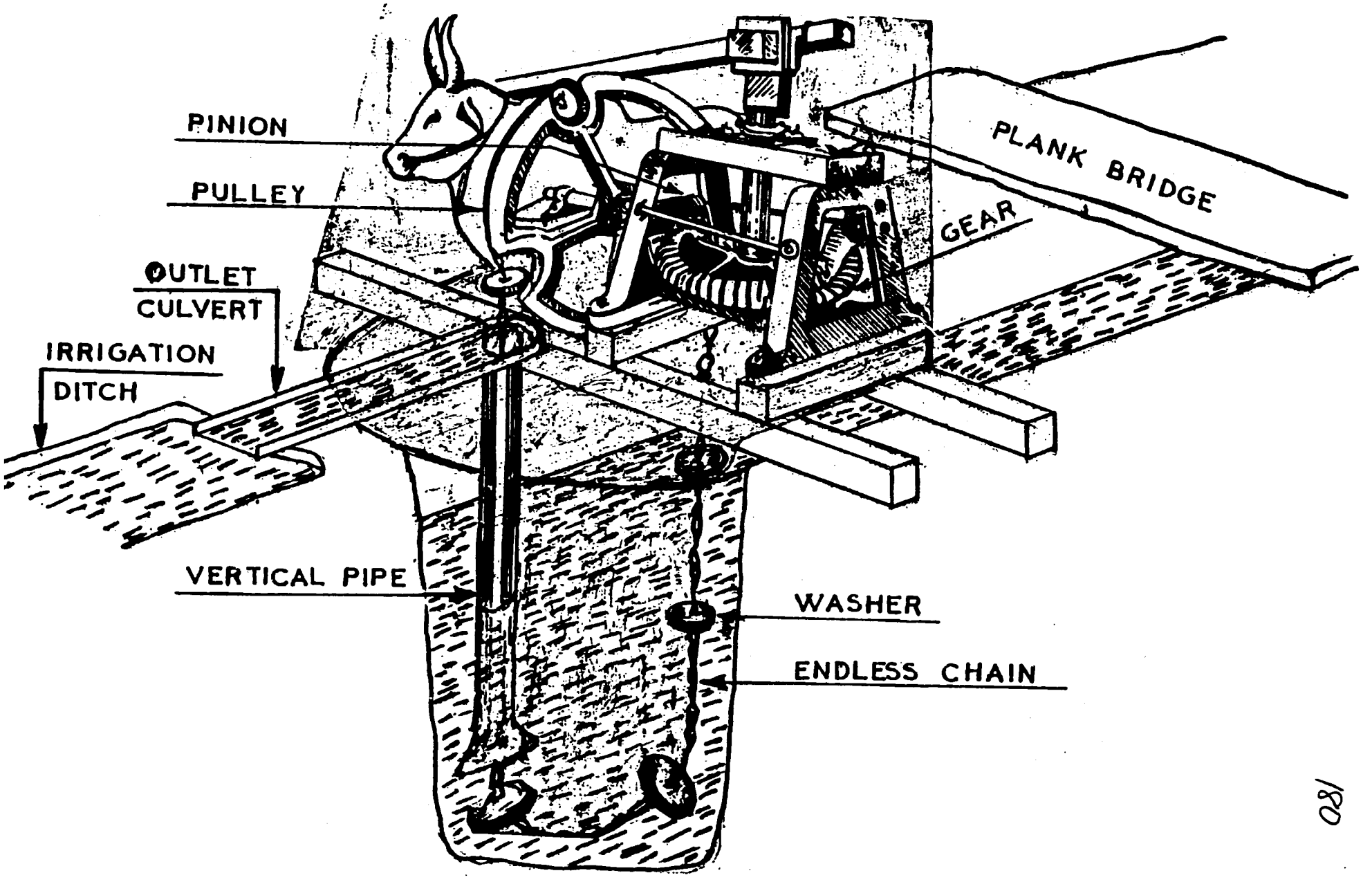
DIAGRAM 5: FLOW PUMP