PROJECT ACTION BLE - DIRE

ECONOMIC ANALYSIS

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SUMMARY

Considering the present conditions, the Action Ble-Dire project is not economically viable.

This conclusion is based on a cost benefit analysis, which has been done to demonstrate that the returns are negative, and most of the farmers are losing money.

A sensitivity analysis also has demonstrated that with higher yields and selling wheat at prices above the present ones, the operation might result in positive returns.

Several recommendations are included in this report to improve the wheat production in the area in the future.

PROJECT ACTION BLÉ

ECONOMIC ANALYSIS

INTRODUCTION

The project area, located around the village of Diré (16°16' latitude North, 3°23' West) encompasses the "Arrondissement Central de Diré et de Dangha". The Diré area is located on the northern bank of the Niger river. Diré is at 957 Km from Bamako, passing through Mopti, where the river Niger has to be crossed by barge. The distance from Bamako to Mopti is 646 Km with a two way traffic road with asphalt. Diré is 311 Km from Mopti and there is no road (which is one of the main constraints of this project). The path followed by transportation vehicles crosses several sandy areas, which can create serious problems if drivers do not have the proper skill to go through sand. Also the path goes through several inundated areas, which creates difficulties if the drivers are not knowledgeable to cross at very specific points.

Tombouctou is the capital of the 6th Region, where the project is located. The distance from Diré is about 100 Km, and no road exists.

The area is relatively heavily populated, with 77265 inhabitants in 1750 Km^2, or 44 inhabitants per Km^2.

The only economic activity is agriculture. The main crops are sorghum, millet, rice and wheat. Some small vegetable gardens can be seen in the area.

This agricultural activity is developed around 70 villages in the "development sectors" of Dangha and Ferrem-Sidi-Amar and 8 villages in the Dire area.[1]

The natural resources of the area, good soils, abundant surface and ground water plus an excellent climate for a great variety of crops (mainly cereals),

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[1] Report of Mr. Badot, 1980/81.

offer an excellent potential for the development of this area.

Three main ethnic groups are in the area: Sonrais, Bellahs and Peulhs.

Most of the transportation is done through the river, which is navigable for about 6-8 months (usually from August to February). In dry years, this period might be shorter. During the rainy season in the forest area where the Niger and Senegal rivers are born, a large area around Diré becomes flooded. Swamps are formed. That creates difficulties for transportation. Some of the flooded areas are used for growing flooded rice.

CLIMATE

The average rainfall of the area is low, between isoyetes of 230 mm to 250 mm. The average rainfall in a 19 year period was 234 mm, with only 23 days of rain per year.

The rainy season starts in June and ends in September.

Concerning temperature, three agricultural seasons can be defined:

A.- A "cold" season, from November to the middle of March, which favors crops such as wheat, vegetables and other temperate zone crops.

B.- From March to June, a "hot" season starts, with strong winds (Harmattant), no rainfall and adverse to most crops.

C.- From July to October, a transition period, also with high temperatures, but suitable for tropical crops (maize, sorghum, millet).

The average evapotranspiration (ETP-TURC) is highest during February (208 mm) and March (226 mm). The minimum average values are in November (159 mm) and December (149 mm).[1,2]

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[1] Report of Mr. Badot, 1980/81.

[2] Projet Inventaire des Resources Terrestres, TAMS, 1982.

SOILS

The soils are alluvial, with a few hardpan areas, silt-clayish or clayish-sandy in structure. The poor drainage might create problems in some areas of low permeability. A more detailed study of soils has been done.[1]

HYDROLOGY

Diré is located close to the end of the drainage of a river basin with a surface of 340,000 Km^2.[2]

Diré is located on the left bank of the Niger river and 17 Km downstream of the confluence of the Barra-Issa river. A knowledge of water flow and inflow of the river basin reveals that the maximum water levels take place during December, with an average river flow of 2350 m^3/second. The average annual flow is about 1180 m^3/second. The lowest flow levels are reached between June 10th to June 20th, although these dates may vary considerably from year to year. During dry years the limnimetric readings at Diré might reach negative values (i.e. in the dry years 1944, 1945, 1948 and 1973). A detailed information concerning water levels is considered necessary for the design of irrigation canals as well as for the precise location of the pumps, assuming that the Mali administration decides to continue developing the area.[2].

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[1] Schema Directeur de la Pleine de Diré, par SCET International, 1975.

[2] Projet Inventaire des Resources Terrestres, TAMS, 1982.

PUMPING COSTS

In order to make precise calculations for the Action Ble Diré (ABD) operation, a whole set of basic figures should have been used. Unfortunately all the necessary figures were not available. Therefore the following calculations are based on information given to the consultant by several persons related to the project (see list of persons interviewed) and also from various reports with data and information concerning the Diré area (see Bibliography at the end of this report).

In order to calculate the pumping costs, data related to "fixed costs", value of the pump, spare parts, pipe and transportation of the equipment to Diré were taken from the original Project Paper, 1978, prepared by USAID (PP). The available figures from this report were converted from Mali Francs (MF) into dollars at the rate mentioned in the PP for 1978, of 500 MF to the dollar. The amortization rate in the PP was 8%. All other calculations were based on the current exchange rate (April 1982) of 625 MF to the dollar.

It is assumed that the pump costs are proportionally distributed among wheat and sorghum. The respective water duties for both crops are: 8000 m^3/Ha. for wheat and 4200 m^3/Ha. for sorghum. Both figures are from the PP report, and considering the climatic conditions of the area, are acceptable.

Although most farmers in the Diré area who have a pump are cultivating rice instead of sorghum, the consultant was unable to find out how much pump water is being used. If the water requirement for rice was all delivered with a pump, the water duty would be in the range of 20,000 up to 25,000 m^3/Ha., an amount which would be too expensive. It is assumed that rice is cultivated during the seasonal floods of the Niger river in the area. If supplemental irrigation is needed, the amount of water supplied by a pump would be very small . The average yield of rice in the area is quite low. Also the price of rice is lower than wheat (price of wheat from 175 to 250 MF/Kg. and rice, 135 MF/Kg.). Therefore the farmer would not be able to make a profit if he irrigated too much by pumping water.

TABLE I

PUMPING COSTS

Fixed Costs (Exch. 500 MF/1$)

5 HP Diesel pump, 7m suction pipe and 3m delivery pipe, CIF Bamako	$1400.00
Spare part kit for 5 year operation - 50% of above	700.00
20m of 80mm delivery pipe @ $7/m	140.00
2 fuel barrels @ $30	60.00
Transport from Bamako to site	20.00
TOTAL COST INSTALLED = 1,160,000 MF =	$2320.00

Annual Fixed Cost/Ha.

Assuming amortization over a 5 year period at 8% interest (in 1978), annual fixed cost = $580 = 290,000 MF

ANNUAL FIXED COST PER HA = 72,500 MF =	$ 145.00

Variable Annual Cost (Exch. 625 MF/1$)

Wheat = 8000 m^3/Ha.

Gasoil 184 liter/Ha[1] @ 365 MF/liter = 67,160 MF =	$ 107.50
Luboil, 6 changes @ 2.5 liter = 15 liters @ 1172 MF/liter = 17,580MF =	28.10
Maintenance(*)	91.80
Repairs (labor), Av. 18,000 MF[2]	37.00
TOTAL VARIABLE COST (WHEAT)	$ 264.40

Sorghum = 4200 m^3/Ha.

Gasoil 97 liters/Ha[1] @ 365 MF/Liter = 35,405 MF =	$ 56.60
Luboil, 4 changes @ 2.5 liters = 10 liters @ 1172 MF/liter = 11,720MF =	18.80
Maintenance(*), proportional wheat	48.20
Repairs (labor), Av. 11,250 MF[2]	22.50
TOTAL VARIABLE COST (SORGHUM)	$ 146.10

(*)Maintenance 10% pump price of $1400 = $140. This amount proportionally distributed to wheat and sorghum. The down-time for repairs is included in this figure.

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(1)Project assumption 500 liters for wheat and 300 liters for sorghum (page 51 - Annex VI). Farmers are using from 141 liters to 425 liters. The consultant considers an average of 184 liters/Ha, for wheat and 97 liters for sorghum.

(2)Figures from USAID Project Report.

PUMPING COSTS
(Cont'd)

SUMMARY FOR WHEAT AND SORGHUM COSTS (Exch. 625 MF/1$)

WHEAT

PUMPING COSTS/HA. (8000 m^3/Ha.)	US$	MF
Annual fixed cost (Distribution of $145)	$ 95.00	59,375
Annual variable cost	$264.40	165,250
SUB-TOTAL	$359.40	224,625
10% contingencies for gasoil and luboil	$ 13.56	8,475
TOTAL ANNUAL COST	$372.96	233,100
COST OF M^3 OF WATER(1)	$0.0466	21.14

SORGHUM

PUMPING COSTS/HA. (4200 m^3/Ha.)		
Annual fixed cost (Distribution of $145)	$ 50.00	31,250
Annual variable cost	$146.10	91,313
SUB-TOTAL	$196.10	122,563
10% contingencies for gasoil and luboil	$ 7.54	4,713
TOTAL ANNUAL COST	$203.64	127,276
COST OF M^3 OF WATER(1)	$0.0485	30.30

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(1) As can be seen, the unit cost per m^3 of water is higher for sorghum than for wheat.

FUEL CONSUMPTION

The characteristics displayed on the tag of one of the pumps are:

Power = 5 HP = 3.75 KW

RPM = 1800

Peak efficiency = 66%

Size = 75 x 65 mm

Total Head = 12.2 meters

Capacity = 15.9 liters/second

Max. power input = 3.1 KW (or 4 HP)

The pump should consume theoretically about 1 liter/hour of gasoil, assuming a 90% pump efficiency.

The water distribution for irrigation is as follows:

Total water needs: 8000 m^3/Ha. for wheat

4200 m^3/Ha. for sorghum

For wheat (110-120 days growth period) irrigation every 6-7 days, and about 12-13 irrigations, with a 10-14 hour irrigation/day, the total amount of water per irrigation, with the above pump capacity of 15.9 liters/second is:

15.9 l/s X 12 hours = 583.2 m^3/12 hours or (rounding off) ~

600 m^3/day irrigation.

Assuming the irrigation takes place 13 times, the total amount of water delivered would be 7800 m^3. A similar calculation can be done for sorghum, considering that the amount of water is 4200 m^3 and the same amount of times for irrigation (12 times average).

Therefore the number of hours for irrigation is 12 X 13 irrigations = 156 hours or 156 liters of gasoil per Ha. of wheat (@ 1 liter/hour), and a proportional amount for sorghum (82 liters), giving a total of 238 liters of gasoil per Ha. per year for both crops.

According to Mr. Lee Hall, there is a great variation among the farmers for fuel consumption. They indicate consumptions from 141 liters/Ha. up to 425 liters/Ha. The original Project Paper (1978) assumes a consumption of 125 liters/Ha. for wheat.

The several factors involved in order to explain this great variation are:

1.- Location of the pump "head" above the surface of the water.

2.- Distribution of water duties versus time during the growing season. It might vary from i.e. 200 m^3/Ha. up to a maximum of 600 m^3/Ha. The curve for consumptive use of water varies versus time according to plant growth.

3.- The evapotranspiration factor, which varies with temperature, wind velocity and relative humidity of the air.

4.- Soil absorption and permeability.

5.- Pump efficiency versus the speed of the engine (RPM).

6.- Farmers supply water in excess, because the soil has not been levelled.

7.- The farmer does not know water management.

Probably no one has explained to the farmers the economic value of all these variables.

For calculation purposes, the consumption of 184 liters/Ha. has been selected. The figures of 500 liters for wheat and 300 liters for sorghum included in the PP are for 4 Ha. per pump, or 125 liters/Ha. and 75 liters /Ha. respectively, figures that the consultant believes are too low.

The calculations for annual pumping costs are shown in Table I.

Several factors, such as maintenance cost and interest on the capital were not included in the PP (1978), probably because Action Ble intended to recover part of these costs through a levy.

The consultant considers that both figures should be included in cost calculations, in order to have a figure that would represent the true cost of producing

wheat in the area.

Maintenance cost for the pump and engine is evaluated at 10% of the capital cost for the pump and diesel engine ($1400). Therefore $140 per Ha. should be added annually and allocated proportionally to wheat and sorghum. For wheat, the figure is $91.80 /Ha. and for sorghum $48.20 /Ha. If another crop is considered, then the distribution should be done according to the amount of water required for such crop.

Capital interest has been assumed to be 8%. It has been calculated as compound interest per year for 5 years, over total investment of $2320, which is the total cost of the pump at Dire. The interest is then allocated annually for 5 years (life of the pump). The interest rate of 8% corresponds to the PP data.

It is important to mention that the life of a pump, with proper maintenance, could be extended to 10 years or more. If such is the case, the farmer could benefit substantially after the 5 year period of operation.

The downtime of a pump caused by needed repairs could become critical, because the whole crop could be lost. In the calculations in this report, downtime has been allocated to the maintenance factor.

To minimize the risks of downtime, some farmers have formed groups, and they use one of the pumps as a stand-by. It is the opinion of the consultant that pumps should be mounted on carts or on boats to facilitate their mobility. Putting pumps on boats would increase their efficiency, because the water head would be low - close to the water level - and this level could be maintained during the whole season independent of the variability of the level of the river water.

If a pump could be operated day and night, its usefulness would increase. If a pump were operated i.e. 20 hours/day, considering 4 hours for repairs and maintenance, the water delivered would amount to: 15.9 liters/second X 20 hours= 15.9 X 60 X 60 X 20 = 1144800 liters = 1144.8 m^3/day. Assuming an efficiency

factor of 75%, the total amount of water delivered per day would be: 858.6 m^3. The wheat growing season is about 120 days. During that period the pump could deliver a maximum total of: 120 days X 858.6 m^3 = 103032 m^3. If the water duty of wheat is 8000 m^3/Ha., then with this amount of water, 12.88 Ha. could be irrigated. Assuming that the pump is operated only 80% of the time, then 10.3 Ha. of wheat could be irrigated. For sorghum, with the same assumptions, 24.53 Ha. could be irrigated per pump, and with an 80% reduction factor, 19.6 Ha.

As can be seen, if the pump cost could be distributed proportionally on 10.3 Ha. for wheat and 19.6 Ha. for sorghum, the cost of the pump per Ha. could be substantially reduced.

With this system the life of the pump (5 years) would be reduced to 2.5 years, at least in theory. In practice, diesel pumps can operate as many as 12000 hours, with proper care and maintenance. Using the pumps to irrigate wheat (8000 m^3/Ha.) and sorghum (4200 m^3/Ha.), the total consumption per year is: (8000 m^3 + 4200 m^3) X 4 Ha. = 48800 m^3 (with one pump per 4 Ha.).

Since a pump can deliver 57.24 m^3/hr, working i.e. 10 hours/day, it would deliver 572.4 m^3/day. Therefore a pump would work 48800 ÷ 572.4 m^3/day = 85.25 days per year, or a total of 852.5 hr/yr. In 5 years the total amount of hours would be: 852.5 X 5 years = 4262.7 hours. If the pump works only 852.5/hr per year, and in practice the pump can work for 12000 hours, that means that it can work for 14.08 years, (10 hours per day of irrigation). If the pump operates 20 hours per day of irrigation, then the practical life would be 14.08 ÷ 2 = 7.04 years.

In summary, if the pumps are properly operated, more hectares could be irrigated, and the life span of the pump could be increased. Also the amortization would vary as follows:

If the life span is 5 years, the annual amortization is $580.-(figure quoted in the PP). Assuming a 14 year life span, then the annual amortization is $281.-.

If the pump works for 20 hours/day of irrigation, then the life span would be 7 years, and the annuities would be $389.9.

The interest rate that the PP applies is 8%. For comparison purposes, the interest rate of 8% has been applied also for 7 years and 14 years.

The annuities with a 10% interest rate would be:

For 5 yr life span, annuity = $612.-

" 7 yr " " " $476.5

" 14 yr " " " $315.-

All of the above calculations are based on a cost of the pump of $2320, according to the PP.

As can be seen, if the farmers were properly advised and organized, savings could be obtained in expanding the capabilities of the pumps as well as in the annual amortization rate. Then the operation could have higher returns than at present. That would have been accomplished if Action Ble Extension Service could have advised the farmers properly.

LABOR FOR REPAIRS

The labor involved for repairs also might vary greatly for each farmer. This variation is a function of the farmer's care. Figures from 11,000 MF ($17.50) up to 50,000 MF ($80.00) have been mentioned to have been paid in 1981 by the farmers, when Action Ble was not in operation. According to Mr. L. Hall, 14,200 MF should be considered average.

For calculation purposes, the figures in the original Project Paper (1978) have been included, even if the consultant considers that such figures are on the low side. These figures are 18,000 MF ($37.00) for wheat and 11,250 MF ($22.50) for sorghum.

ECONOMIC ANALYSIS

On the following pages an economic analysis has been done. Since no precise figures were available, nor statistics from which price trends could be calculated, a sensitivity analysis has been done, in order to determine the range of possible returns.

As can be seen in Tables VIII to XI, most of the figures concerning the returns are negative, at various wheat-sorghum prices and at diverse salary levels, exception made of Table X where the higher wheat yield compensates the costs.

The consultant considers that the main factor for such low returns is the yields. It is apparent from the sensitivity analysis that the returns increase dramatically when 2.5 Tons/Ha. of wheat are reached.

As is explained elsewhere in this report, yields are a function of several factors, the most significant ones being water management and crop operations. Water management is critical because gasoil is expensive, even at official prices. In Table II, the percentage distribution of costs shows that for wheat the major expense is the pump (38.73%), while for sorghum, since water consumption is less than for wheat, the major expense is labor (46.53%).

With proper water management, the yields could be higher and the pump cost would be substantially reduced for both crops.

The labor in the production cost tables for wheat varies considering that if more yield is obtained, more labor would be involved for harvesting operations. More details concerning the production cost tables are included on the following pages.

TABLE II

PERCENTAGE DISTRIBUTION OF COSTS(1)
(IN MALI FRANCS)

	WHEAT (1.5 Ton/Ha)	%	SORGHUM (1.5 Ton/Ha)	%
LABOR	156,740	36.73	138,880	46.53
SEED	17,500	4.10	850	0.28
PUMP FIXED COST	59,375	13.92	31,250	10.47
PUMP VARIABLE COST	165,250	38.73	91,313	30.60
FERTILIZERS	14,967	3.51	28,540	9.56
10% INTEREST ON WORKING CAPITAL	12,855	3.01	7,598	2.56
TOTAL	426,687	100.00	298,431	100.00

(1) These figures are included in Tables III and VI.

TABLE III

PRODUCTION COSTS AND RETURNS PER HECTARE: WHEAT (SINGLE CROP) YIELD: 1.5 TONS/HA.
(Pump irrigation, Traditional varieties, Fertilizers)

INPUTS	LABOR PERSON/DAYS	SALARY @ 940 MF	OTHER INPUT UNITS	PRICE UNIT (MF)	TOTAL INPUTS (MF)	TOTAL PRODUCTION COST (MF)	WHEAT PRODUCTION (MF)
LAND PREPARATION	9	8460				8460	
MAINTENANCE CANALS,DITCHES	8	7520				7520	
SEEDING	4	3760	100 Kg.	175	17500	21260	
IRRIGATION: 8000 m^3							
A.- FIRST IRRIGATION 800 m^3	2	1880				1880	
B.- 12 TIMES @ 600 m^3	18	16920				16920	
PUMP FIXED COST[a]					59375	59375	
PUMP VARIABLE COST[a]					165250	165250	
FERTILIZERS							
A.- TRIPLE SUPERPHOS.	2	1880	33 Kg.	190	6270	8150	
B.- UREA	2	1880	54 Kg.	160	8697	10577	
WEEDING (MANUAL)	23	21620				21620	
GUARDIAN (1 pers.,22 days)	22	20680				20680	
BIRD CONTROL (3 pers./Ha.,30 d)[b]	90	39240				39240	
HARVESTING, CUTTING, BINDING	20	18800				18800	
THRESHING (10 pers./day/Ton)	15	14100				14100	
SUB-TOTALS	215	156740			257092	413832	
10% INTEREST ON FERT.,SEEDS,FUEL FOR SIX MONTHS[c]					12855	12855	
TOTALS		156740			269947	426687	
PRODUCTION: 1.5 TONS @ 175 MF/Kg.							262500
RETURNS[d]							-98313

BREAK-EVEN POINT: 2.438 TONS/HA.[e]

(a) See Table I.

(b) According to a recent survey, 40% are adults and 60% children. It is assumed that children receive a stipend of 100 MF/day.

(c) 10% interest on working capital for six months. It is assumed that the farmer has a bank loan to purchase seed, gasoil and to cover other pump costs, and the fertilizers (all the inputs) for each crop.

(d) Assuming official prices for gasoil and luboil (see Table I). At parallel market prices of 425 - 500 and in some cases 800 MF/liter for gasoil, the returns are even more negative.

(e) Break even point is calculated by dividing the total production cost by the selling price of the crop, which means that is the minimum yield at which the farmer starts making a profit. This figure is approxi- [illegible] with a higher yield, more labor would be required for harvesting and threshing.

TABLE IV

PRODUCTION COSTS AND RETURNS PER HECTARE: WHEAT (SINGLE CROP) YIELD: 2.0 TONS/HA.
(Pump irrigation, Traditional varieties, Fertilizers)

INPUTS[a]	LABOR PERSON/DAYS	SALARY @940 MF	OTHER INPUT UNITS	PRICE UNIT (MF)	TOTAL -INPUTS(MF)	TOTAL PRODUCTION GOST (MF)	WHEAT PRODUCTION (MF)
LAND PREPARATION	9	8460				8460	
MAINTENANCE CANALS,DITCHES	8	7520				7520	
SEEDING	4	3760	100 Kg.	175	17500	21260	
IRRIGATION: 8000 m^3							
A.- FIRST IRRIGATION 800 m^3	2	1880				1880	
B.-12 TIMES @ 600 m^3	18	16920				16920	
PUMP FIXED COST					59375	59375	
PUMP VARIABLE COST					165250	165250	
FERTILIZERS							
A.- TRIPLE SUPERPHOS.	2	1880	33 Kg.	190	6270	8150	
B.- UREA	2	1880	54 Kg.	160	8697	10577	
WEEDING (MANUAL)	23	21620				21620	
GUARDIAN (1 pers.,22 days)	22	20680				20680	
BIRD CONTROL (3 pers./Ha., 30 d)	90	39240				39240	
HARVESTING, CUTTING, BINDING	24	22560				22560	
THRESHING (10 pers./day/Ton)	20	18800				18800	
SUB-TOTALS	224	165200			257092	422292	
10% INTEREST ON FERT., SEEDS, FUEL FOR SIX MONTHS					12855	12855	
TOTALS		165200			269947	435147	
PRODUCTION: 2.0 TONS @ 175 MF/Kg.							350000
RETURNS							-85147

BREAK-EVEN POINT: 2.486 TONS/HA.

[a] See footnotes in Table III.

TABLE V

PRODUCTION COSTS AND RETURNS PER HECTARE: WHEAT (SINGLE CROP) YIELD: 2.5 TONS/HA.
(Pump irrigat'on, Traditional varieties, Fertilizers)

INPUTS[a]	LABOR PERSON/DAYS	SALARY @940 MF	OTHER INPUT UNITS	PRICE UNIT (MF)	TOTAL INPUTS (MF)	TOTAL PRODUCTION COST (MF)	WHEAT PRODUCTION (MF)
LAND PREPARATION	9	8460				8460	
MAINTENANCE CANALS, DITCHES	8	7520				7520	
SEEDING	4	3760	100 Kg.	175	17500	21260	
IRRIGATION: 8000 m^3							
A.- FIRST IRRIGATION 800 m^3	2	1880				1880	
B.- 12 TIMES @ 600 m^3	18	16920				16920	
PUMP FIXED COST					59375	59375	
PUMP VARIABLE COST					165250	165250	
FERTILIZERS							
A.- TRIPLE SUPERPHOS.	2	1880	33 Kg.	190	6270	8150	
B.- UREA	2	1880	54 Kg.	160	8697	10577	
WEEDING (MANUAL)	23	21620				21620	
GUARDIAN (1 pers.,22 days)	22	20680				20680	
BIRD CONTROL (3 pers./Ha.,30 d)	90	39240				39240	
HARVESTING, CUTTING, BINDING	30	28200				28200	
THRESHING (10 pers./day/Ton)	25	23500				23500	
SUB-TOTALS	235	175540			257092	432632	
10% INTEREST ON FERT., SEEDS, FUEL FOR SIX MONTHS					12855	12855	
TOTALS	235	175540			269947	445487	
PRODUCTION: 2.5 TONS @ 175 MF/Kg.							437500
RETURNS							-7987

BREAK-EVEN POINT: 2.546 TONS/HA.

[a] See footnotes in Table III.

TABLE VI

PRODUCTION COSTS AND RETURNS PER HECTARE: SORGHUM (SINGLE CROP) YIELD: 1.5 TONS/HA.
(Pump Irrigation, Traditional Varieties, Fertilizers)

INPUTS[a]	LABOR PERSON/DAYS	SALARY @940 MF	OTHER INPUT UNITS	PRICE UNIT (MF)	TOTAL INPUTS(MF)	TOTAL PRODUCTION COST(MF)	SORGHUM PRODUCTION (MF)
LAND PREPARATION	9	8460				8460	
MAINTENANCE CANALS, DITCHES	8	7520				7520	
SEEDING	6	5640	10 Kg.	85	850	6490	
IRRIGATION: 4200 m^3							
A.- FIRST IRRIGATION 600 m^3	1	940				940	
B.- 9 TIMES @ 400m^3=3600m^3	14	13160				13160	
PUMP FIXED COST					31160	31160	
PUMP VARIABLE COST					91313	91313	
FERTILIZERS							
A.- TRIPLE SUPERPHOS.	2	1880	66 Kg.	190	12540	14420	
B.- UREA	2	1880	100 Kg.	160	16000	17880	
WEEDING (MANUAL)	20	18800				18800	
GUARDIAN (1 pers.,22 days)	22	20680				20680	
BIRD CONTROL (3 pers./Ha.,30 d)	90	39240				39240	
HARVESTING, CUTTING, BINDING	7	6580				6580	
THRESHING (10 pers./day/Ton)	15	14100				14100	
SUB-TOTALS	196	138880			151953	290833	
10% INTEREST ON FERT., SEEDS, FUEL FOR SIX MONTHS					7598	7598	
TOTALS	196	138880			159551	298431	
PRODUCTION: 1.5 TONS @ 85 MF/Kg.							127500
RETURNS							-170931

BREAK-EVEN POINT: 1.705 TONS/HA.

(a) See footnotes in Table III.

TABLE VII

PRODUCTION COSTS AND RETURNS PER HECTARE: RICE YIELD: 2.0 TON/HA.
(No Irrigation, Traditional Varieties, No Fertilizers)

INPUTS[a]	LABOR PERSON/DAYS	SALARY @940 MF	OTHER INPUT UNITS	PRICE UNIT (MF)	TOTAL INPUTS (MF)	TOTAL PRODUCTION COST (MF)	RICE PRODUCTION (MF)
CONSTRUCTION DIKES, DAMS, CANALS	5	4700				4700	
LAND PREPARATION & FORMING PLOTS	13	12220				12220	
SEEDING	5	4700	120 Kg.	135	16200	20900	
IRRIGATION (RIVER FLOW)	19	17860				17860	
SPREADING FERTILIZER	7	6580				6580	
A.- TRIPLE SUPERPHOS.			66 Kg.	190	12540	12540	
B.- UREA			100 Kg.	160	16000	16000	
TRANSPLANTING	2	1880				1880	
WEEDING	15	14100				14100	
THINNING	1	940				940	
HARVESTING	8	7520				7520	
GUARDING FIELDS	60	26160				26160	
THRESHING	11	10340				10340	
WINNOWING	8	7520				7520	
TRANSPORT	2	1880				1880	
SUB-TOTALS	156	116400			44740	161140	
10%INTEREST ON INPUTS(6 Months)					2237	2237	
TOTALS	156	116400			46977	163377	
PRODUCTION: 2.0 TONS @ 135 MF/Kg.							270000
RETURNS							+ 106623

BREAK-EVEN POINT: 1.22 TONS/HA.

(a) See footnotes in Table III.

TABLE VIII

SENSITIVITY ANALYSIS: WHEAT YIELD: 1.5 TONS/HA.

(VARIABLES: SALARIES AND WHEAT MARKET PRICES IN MF)

SALARY LEVEL MF/DAY	LABOR: 175 PERS/DAY	TOTAL LABOR(*)	INPUTS	TOTAL PRODUCTION COST	GROSS RETURN	NET RETURN
	WHEAT PRICE 175 MF/Kg.					
500		85900	269947	355847	262500	- 93347
940		156740	269947	426687	262500	-164187
1500		246900	269947	516847	262500	-254347
	WHEAT PRICE 215 MF/Kg.					
500		85900	269947	355847	322500	- 33347
940		156740	269947	426687	322500	-104187
1500		246900	269947	516847	322500	-194347
	WHEAT PRICE 250 MF/Kg.					
500		85900	269947	355847	375000	+ 19153
940		156740	269947	426687	375000	- 51687
1500		246900	269947	516847	375000	-141847

NOTE: ONLY WITH A PRICE OF WHEAT OF 250 MF/KG. AND SALARIES OF 500 MF/PERS. DAY WOULD THE CROP GIVE A POSITIVE RETURN (19153 MF = $30.60)

(*)Labor includes 54 children with 100 MF stipend per day.

TABLE IX

SENSITIVITY ANALYSIS: WHEAT YIELD: 2.0 TONS/HA.

(VARIABLES: SALARIES AND WHEAT MARKET PRICES IN MF)

SALARY LEVEL MF/DAY	LABOR: 224 PERS./DAY	TOTAL LABOR(*)	INPUTS	TOTAL PRODUCTION COST	GROSS RETURN	NET RETURN
	WHEAT PRICE: 175 MF/Kg.					
500		90400	269947	360347	350000.	- 10347
940		165200	269947	435147	350000	- 85147
1500		260400	269947	530347	350000	-180347
	WHEAT PRICE: 215 MF/Kg.					
500		90400	269947	360347	430000	+ 69653
940		165200	269947	435147	430000	- 5147
1500		260400	269947	530347	430000	-100347
	WHEAT PRICE: 250 MF/Kg.					
500		90400	269947	360347	500000	+139653
940		165200	269947	435147	500000	+ 64853
1500		260400	269947	530347	500000	- 30347

(*)Labor includes 54 children with 100 MF stipend per day.

TABLE X

SENSITIVITY ANALYSIS: WHEAT — YIELD: 2.5 TONS/HA.

(VARIABLES: SALARIES AND WHEAT MARKET PRICES IN MF)

SALARY LEVEL MF/DAY	LABOR: 235 PERS./DAY	TOTAL LABOR(*)	INPUTS	TOTAL PRODUCTION COST	GROSS RETURN	NET RETURN
	WHEAT PRICE: 175 MF/Kg.					
500		95900	269947	365847	437500	+ 71653
940		175540	269947	445487	437500	- 7987
1500		276900	269947	539894	437500	-102394
	WHEAT PRICE: 215 MF/Kg.					
500		95900	269947	365847	537500	+171653
940		175540	269947	445487	537500	+ 92013
1500		276900	269947	539894	537500	- 2394
	WHEAT PRICE: 250 MF/Kg.					
500		95900	269947	365847	625000	+259153
940		175540	269947	445487	625000	+179513
1500		276900	269947	539894	625000	+ 85106

(*) Labor includes 54 children with 100 MF stipend per day.

TABLE XI

SENSITIVITY ANALYSIS: SORGHUM YIELD 1.5 TONS/HA.

(VARIABLES: SALARIES AND SORGHUM MARKET PRICES IN MF)

SALARY LEVEL MF/DAY	LABOR: 196 PERS./DAY	TOTAL LABOR(*)	INPUTS	TOTAL PRODUCTION COST	GROSS RETURN	NET RETURN
	SORGHUM PRICE: 85 MF/Kg.					
500		76400	159551	235951	127500	-108451
940		138880	159551	298431	127500	-170931
1500		218400	159551	377951	127500	-250451
	SORGHUM PRICE: 104 MF/Kg.					
500		76400	159551	235951	156000	- 79951
940		138880	159551	298431	156000	-142431
1500		218400	159551	377951	156000	-221951
	SORGHUM PRICE: 121 MF/Kg.					
500		76400	159551	235951	181500	- 54451
940		138880	159551	298431	181500	-116931
1500		218400	159551	377951	181500	-196451

(*) Labor includes 54 children with 100 MF stipend per day.

LABOR

The cost of labor was not included in the crop budget tables in the original PP. One farmer per Ha. cannot supply all the necessary labor to perform all the agricultural operations required for one crop like wheat. Unless he works on less than one Ha., or has a large family to help him, he must hire labor. Therefore it is considered necessary to consider the cost of labor, even if the farmer doesn't realize that his own work is not paid as wages.

Wages in the area are variable, according to the labor force available at any one time. If the crop looks promising, workers stay in the area, because work will be available for them. If not, most workers immigrate to other regions, to Bamako or to neighboring countries. In such cases the labor force that remains in the area demands high wages, as high as 1750 MF/day, according to several sources.

According to Mr. Lee Hall's report, the average price paid for labor is 940 MF/day. Labor wages might vary,according to season and the available labor force in the area at any particular time,from 500 MF/day up to 1400 MF/day. For calculation purposes, an average wage of 940 MF/day ($1.50/day) is used in the production cost tables.

During the harvesting season, birds are considered a pest and guardians are necessary. According to the PP, a labor force of 120 persons/day is used. Ms. C. Crystal's report uses 60 persons/day. An average figure of 90 persons/day is used in this report for wheat and sorghum, with 60 persons/day for rice.

YIELDS

Insufficient measured data have been obtained in the project area in order for an average figure to be calculated for yields. One farmer in the area has obtained 2.5 Tons/Ha. of wheat, but no official measurements were reported. perhaps the most revealing data are in the following table:(1)

YIELDS (KG/HA)	SEASON 79/80 FARMERS	SEASON 79/80 HECTARES	SEASON 80/81 FARMERS	SEASON 80/81 HECTARES
From 0 to 250			4	5.5
" 250 " 500	1	1	11	13
" 500 " 750			20	24.5
" 750 " 1000	3	4	18	22.25
" 1000 " 1250	9	13	11	16
" 1250 " 1500	7	19.5	10	10.5
" 1500 " 1750	4	5	6	8
" 1750 " 2000	5	6.5		
" 2000 " 2250	5	7		
" 2250 " 2500				
" 2500 " 2750				
" 2750 " 3000	1	1		
+ 3000			1	1
TOTAL	35	47	81	100.5

The average in the frequency table for the 1979/80 season is between 1000 Kg./Ha. and 1500 Kg./Ha. For 1980/81 the average would be between 500 Kg./Ha. and 1000 Kg./Ha.

Of course with only two years of data, and considering the size of the sample, no definite figure could represent an average. For the 1979/80 season, 1250 Kg./Ha. can be adopted for calculation purposes, as well as 750 Kg./Ha. for the 1980/81 season, or for both years an average of 1 Ton/Ha.

According to a recent report from Mr. Lee Hall, assessing the managerial skills of the farmers, 35% were making a profit with an estimated yield of 2 Tons/Ha. or more, 22% had less than 1 Ton/Ha. and 30% were doubtful of making a profit. The remaining 13% were not accounted for.

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(1) Report from Mr. George Badot concerning the Action Ble, 1982.

The PP assumes a yield of 2.5 Tons/Ha. for wheat. Ms. C. Crystal's report assumes a minimum of 700 Kg/Ha. and a maximum of 2 Tons/Ha.

No yields are reported for sorghum, although the PP includes 1500 Kg./Ha. for pump owners and 800 Kg./Ha. for traditional farmers. With such low yields it is doubtful that farmers could have had any profits at all.

In the production cost tables in this report, a sensitivity analysis has been done, including as yields for wheat: 1500 Kg./Ha., 2000 Kg./Ha. and 2500 Kg./Ha. For sorghum only 1500 Kg./Ha. has been considered. For rice an average of 2000 Kg./Ha. is the basis for production cost calculations. Except for rice, which does not include pumping costs, all the other tables show negative returns. In Tables VIII,IX and X the sensitivity analysis demonstrates that for a yield of 2.5 Tons/Ha., lowering the wages and increasing the selling price of the wheat, the farmer could make some profits.

PRICES

Inputs

The main inputs at present are the price of gasoil and the lubricating oil. the official prices are (from Shell Co.):

Gasoil (Bamako) = 350 MF/liter
Gasoil (Diré) = 365 MF/liter

Luboil (Bamako) = 1124 MF/liter
Luboil (Diré) = 1172 MF/liter

During the last season, most farmers could not get the fuel at the official prices, according to Mr. Lee Hall's report. Gasoil was purchased on the parallel market at prices from 400 MF/liter up to 500 MF/liter. Some farmers bought up to 400 liters in Tombouctou before the season started, paying more than 400 MF/liter. Fuel on credit is very expensive. One farmer paid as much as 800 MF/liter last

season.

No fertilizers or chemicals were purchased during 1981, although these items are considered for production cost calculations.

Seeds seldom were purchased. It is assumed that selected seeds have a much higher price than the cash crop sold at farm-gate prices, and the farmer would rather use his own seed than to buy selected seeds. To reduce the risks at harvesting times, most farmers do not use one variety but a mixture of several. Therefore for calculation purposes, the price of seeds is considered to be the same as the cash crop price.

Pesticides and herbicides have not been used in the area.

Outputs

According to Mr. Lee Hall's report, the price paid for wheat last season at Diré market was 175 MF/Kg., and the price for rice from 100 to 130 MF/Kg.

According to the information gathered by Mr. Gerard Achcar, the market price for wheat at present in Bamako is close to 250 MF/Kg.

At the Diré market the price of wheat imported from Abidjan (purchased at 175 MF/Kg., plus 50 MF/Kg. for transport and handling charges) is 225 MF/Kg.

The world market price for wheat is 175 MF/Kg., but according to Mr. Achcar, the GRM should pay a subsidy of 40 MF/Kg. , making the price 215 MF/Kg.

For calculation purposes, a floor price of 175 MF/Kg. is used in the production cost tables as farm gate price.

For sorghum, there is an approximate relationship with wheat prices of 48%. Therefore, a sorghum price of 84 MF/Kg. is used for calculation purposes.

COST BENEFIT ANALYSIS

In Table III, "Production Costs and Returns, Wheat" with a yield of 1.5 Tons/Ha., the result is a deficit of -98313 MF. The major expense is the annual variable cost for the pump, which amounts to 165250 MF. In the PP, it has been assumed that the pump will consume only 125 liters for the wheat crop per Ha. According to the technical characteristics of the pump, the normal consumption is 1 liter of gasoil per hour. The pump delivers 15.9 liters of water per second, or 57.24 m^3 per hour.

In order to deliver 8000 m^3/Ha., the pump should be working for a minimum of 140 hours, assuming an efficiency of 90%, which very seldom can be reached. With an 80% efficiency, the working time would be 175 hours, or 175 liters of gasoil. With 75% efficiency, the gasoil consumption would be 186.6 liters.

After surveying the area and questioning several farmers, Mr. Lee Hall said that the average is 184 liters for the wheat season. This figure has been included in the annual variable cost for the pumping operations.

The annual variable cost has been calculated with gasoil at official prices. Last year the farmers were forced to buy at parallel market prices, paying sometimes as much as 500 MF/liter, and most frequently 400 MF/liter. Apparently last year, according to the consultant's information, Action Ble could not deliver gasoil at official prices. Therefore the negative returns or losses were even greater than those calculated in the Tables, which show that this operation in reality is even less economical.

It is the opinion of the consultant that if the farmer can not have a higher gross return either by obtaining yields higher than 2.5 Tons/Ha., or by getting a much higher market price for wheat (and therefore also for sorghum, since both prices are linked), the operation will give a negative return. It is unlikely

though, that the price of wheat on the international market will be much higher than at present. Therefore, in order for the Action Ble operation to become economical, the farmers should have the necessary technical support -- through a good and efficient Extension Service -- to reach higher yields.

At the IRAT station in the neighboring country of Niger (which has similar ecological conditions as the Dire area), in experimental plots, trying several wheat varieties, the following results were obtained and recorded:(1)

Varieties	Yields in Grain (Tons/Ha)	
	1972/73	1973/74
Florence aurora	4.052	3.164
Dan Bata	5.493	4.545
Tousson Ex An6	6.293	5.318
Lerma Rojo	5.763	5.311
BT 908	5.746	4.993
Tobari	5.959	5.262
Siete Cerros	4.439	5.983
Jori	4.439	5.108

The varieties Tousson Ex An6 and Siete Cerros were the ones with maximum experimental yields. That was in 1972-74. At present, even higher yields have been obtained.

If Action Ble project continues, an Experimental Research Station should be established in the area, where some high yielding new varieties obtained from the CIMMYT in Mexico or from IRAT could be tested. The best ones could then be multiplied and distributed among the farmers. If the farmers can obtain more than 3 Tons/Ha., which is possible with proper agricultural practices and good water management, then high returns can be expected.

It is doubtful if present conditions prevail, that the farmer can make any profits.

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(1) Activites et resultats des travaux de recherches effectues en 1974. IRAT , Republique du Niger, Fevrier1975.

In the production cost tables, the parameters used for labor, seed cost, pumping operation, official prices on gasoil and luboil, fertilizers, and the prices for wheat, sorghum and rice have been computed as being the most realistic figures considering the present conditions at the project. As has been stated before, no precise measurements are available -- not even farm sizes -- for these agricultural operations. The parameters used in calculating the cost benefit per crop are the result of various interviews with local people, USAID personnel, and from reports from Mr. Lee Hall, Ms. Crystal, Mr. Badot and the PP.

In the cost benefit analysis for crops, gasoil and luboil prices were the official ones, i.e. 365 MF/liter for gasoil and 1172 MF/liter for luboil. If prices from the parallel market were used in calculating the above mentioned tables, then the returns would have been even more negative.

A simple analysis shows the impact of gasoil and luboil in the production cost:

184 liters of gasoil/Ha. @ 365 MF/liter	=	67160 MF
15 liters of luboil/Ha. @ 1172 MF/liter	=	17580 MF
TOTAL		84740 MF

The total production cost of 1.5 Tons/Ha. of wheat is 426687 MF (see Table III). Therefore these two inputs represent 19.85% of the total cost.

If parallel market prices were used:

184 liters of gasoil/Ha. @ 475 MF/liter	=	87400 MF
15 liters of luboil/Ha. @ 1325 MF/liter	=	19875 MF
TOTAL		107275 MF

The total production cost is 449222 MF, with the parallel market prices for gasoil and luboil. These figures represent 23.88% of the total production cost. The returns are then 22535 MF more negative. The farmer could not afford such losses, and he would not be able to buy the gasoil and luboil.

Since all the cost benefit analyses show negative results,per crop and per Ha., a cash flow analysis would not be applicable, nor an IRR which obviously would be negative.

MAIN CONSTRAINTS OF THE PROJECT

The main constraints of the project are:

1.- Difficult transportation of main inputs (gasoil, luboil, selected seeds, fertilizers, etc.), because no road exists from Mopti to Diré. Fluvial transportation is available only from August to about December 15th. The area is practically isolated during the rest of the year.

2.- Supplies could have been brought into the project area if proper storage facilities were available. At present there are only two old tanks for gasoil with an approximate capacity of 30000 liters each. The ownership of such tanks is unknown (officially). Transporting gasoil in bulk would require a special pumping station, that should be installed. Besides, the farmers do not have facilities for transporting the gasoil to their pumps.

3.- The farmers need mechanics, or they should have the sufficient mechanical knowledge to repair the pumps by themselves. These skills are not in the area at present.

4.- Spare parts for the pumps should be stored in one location in the project area. There are none at present. Therefore pumps can not be repaired on time.

5.- Assigning only one pump to 4 farmers creates arguments and other problems among the farmers.

6.- Water management together with operating a pump at peak efficiency requires special knowledge, that most farmers do not have. Therefore most of the pumps are supplying excess water, at an excessive cost. Because the pumps are not working under efficient conditions, more gasoil is used than is really necessary.

7.- Since land levelling has not been done on most of the farms, in order to irrigate the fields conpletely, the farmers have to use more water than necessary. Land levelling in some farms might be a costly operation, and the crop would not pay for it.

8.- The sowing operation is done by spreading the seed and using more seed than is really necessary. In some instances farmers are using 140 Kg. when 60 Kg. should be sufficient. These extra kilograms are added to the production cost. Farmers should learn how to sow the seeds in furrows. Small hand-planters should be distributed among farmers. The seeding operation is critical for obtaining better yields. Also land preparation is not done properly, which also affects seed germination.

9.- A good agricultural knowledge is lacking in the area, because the Extension Service from Action Ble failed entirely to train the farmers properly in agricultural practices.

10.- One of the main expenses is the bird control practices, which apparently is a serious problem in the area. Children are involved in such operation, as well as adults. According to the survey recently done by Mr. Lee Hall, 40% of the labor involved in such operation are adults.

11.- The harvesting operation is done by hand with a sickle. If the grain is not properly ripe, substantial amounts of grain are lost on the ground, which is another cause for a reduction in the yields. Losses are estimated at from 10% up to 20%.

12.- Also losses in the winnowing operation are important. If the ground has not been carefully prepared, grain losses are estimated at from 5% up to 15%.

13.- Storage facilities, like silos, are non-existent in the area. The grain is stored in one room of the farmers house or in some primitive facilities (small storage containers) and rodents are a serious cause of losses, sometimes as much as 30%.

14.- The rudimentary transportation available in the area (mainly donkeys) is also a cause for substantial losses. The bags used to transport the grain are second-hand bags which are deteriorating, which is the main cause for grain losses during transportation. Most farmers are not aware of all these losses, and the Extension Service people failed to warn the farmers.

15.- The lack of proper agricultural credit prohibits most farmers from purchasing the main inputs in advance, mainly gasoil. It is not only that the gasoil is not available to all the farmers in the area, but also if available, most farmers do not have cash on hand to pay for it.

16.- The marketing of wheat which could be sold is uncertain. The prices are quite variable in the local markets, and the farmer at the time of seeding does not know at what price the wheat could be sold. Price stability for the various crops that farmers could sell is important. There is a range of wheat prices that goes from 175 MF/Kg. up to 250 MF/Kg., and perhaps even higher. Apparently no effort has been made by the GRM to guarantee the farmer with a rewarding price for his crop.

CONCLUSIONS

From all the above, most of the farmers do not have a positive return. The insecurities of having gasoil available at official prices, lack of mechanics for the pumps, very limited knowledge of operating the pumps as well as water management, lack of proper spare parts, limited knowledge of agricultural practices, lack of proper distribution of selected seeds, poor storage facilities, uncertainty of market prices, etc. leads to a very poor economic situation for the project. The farmers might harvest wheat for their own subsistance and that of their families, and that would be the only profit.

According to the frequency table on yields done by Mr. Badot[1] included in this report (see YIELDS), the average yields of wheat are around 1 Ton/Ha. Only one farmer obtained 3 Tons/Ha. in 1979/80 crop and another obtained more than 3 Tons/Ha. in 1980/81 crop. With average yields so low, the project can not be successful.

RECOMMENDATIONS

A.- Short term recommendations

1.- If the GRM decides to continue with the project, hydrological data should be gathered concerning the limnimetric levels at various locations in the project area and during various seasons.

2.- Due to the great variations of water levels, pumps should be installed on mobile carts, so they can be moved according to the water levels or for pump replacement when repairs are necessary.

3.- In some farms, where the water levels recede through a long slope of the river bank, it would be useful to install a pump on a boat, or on some empty gasoil barrels as a floating platform.

4.- The farmers should be advised that the pumps should work at the highest efficiency rate possible. The power requirement for a pump is proportional to the vertical distance at which the water must be raised. Pipe length, pipe curves and pipe diameters produce friction, and part of the pump energy is lost in friction, lowering the efficiency of the pump.

5.- Good water management is considered essential to achieve an economical operation. Water should be supplied to the fields according to plant growth demands, considering different stages of growth. Moisture content of the soil is a function of soil water retention (soil texture, and other

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(1) Report of Mr. Badot on the Action Ble - Dire, 1980-81.

physical and chemical soil factors) and evapotranspiration. Soil moisture should be regulated by amount of water per irrigation and frequency of irrigations.

6.- To minimize the cost of bird control labor, bearded wheat varieties should be used. As far as is known, no such varieties are used in the project area at present. Action Ble should have provided the farmers with such varieties.

7.- More farmers should be encouraged to plant rice instead of sorghum as a second crop, especially in areas where the seasonal floods permit building of small dikes in order to accumulate water for rice plantings. For this crop the farmer does not need a pump, and therefore, he can obtain substantially higher returns, as can be seen in the production cost for rice in Table VII.

9.- For all of the above, and various other technical details, the farmer,who is not used to pump water for irrigation, needs constant advice from technical personnel (Extension Service) until he can master the irrigation of his field in economic terms.

B.- Long term recommendations

For the success of this project, measures should be taken to correct all the above mentioned flaws. In the consultant's opinion, a proper training of the farmer in water management, pump operation and repair and agricultural practices will lead to higher yields. Credit, storage facilities and marketing are also considered essential for a successful operation.

In order to achieve positive results in a short period of time, three or four small pilot farms should be selected in the area, each one of them representative of different ecological conditions, mainly soils. Selected seed multiplication should be one of the tasks to be performed in these pilot farms. In every one of these pilot farms, records of all the surrounding farmers should be kept,

with accuracy and precision. Every pilot farm should be directed by a highly trained agronomist, with full knowledge of water and farm management, as well as economics. If no local people are available, then expatriates should be recruited.

In every pilot farm proper housing and office facilities should be provided, as well as storage facilities for spare parts for the pumps, gasoil and luboil to be distributed - and monitored - to the farmers under the "radius of influence" for each pilot farm. The pilot farms should have elementary farm machinery for animal-draft, like plows, cultivators, seeding machines and hand operated winnowers.

These farms should have a surface area of from 10 to 20 Ha. in order to have seed testing varieties, seed multiplication fields, testing plots for fertilizer formulations and the necessary equipment for cleaning seeds before delivery to the farmers. The pilot farms should be located in areas where water can be pumped all year around, either from the river or from wells.

The participation of local schools could be of substantial help, especially because the students could participate in agricultural operations and could be a source of low cost labor, while learning (on-the-job training).

A radio communications network among these farms could help to have a good logistic support. One long range radio station should be devoted to have daily contact with a central office in Bamako (USAID perhaps), in order to monitor all the field operations as well as to provide the necessary support in order to be able to send supplies to accomplish all the field operations on a timely basis. Gasoil shipments, some special spare parts, fertilizers, etc. and other requirements necessary to perform precise operations for each pilot farm should be available on time.

Another alternative for development of the area, which would not necessarily

exclude the pilot farms, is to establish a large farming operation managed by a corporation, a farmers' association, a cooperative, etc. With this alternative, the main goal would be to produce wheat for the area at low cost, and perhaps also for export to other Mali regions. In such a scheme, 500 Ha. or more of land would be devoted to mechanized production. Land levelling, land preparation, irrigation canals, cropping patterns, etc. should be done under one well experienced project manager. One pumping station with three large pumps and one main canal to distribute the water to all the irrigation network should be built in a suitable area where no dammage by the Niger river floods is expected. In this way, problems with small pumps would be avoided.

Since this large farm would be properly managed, two or perhaps three crops per year could be obtained. Local labor, as much as is available, should be hired and trained. This labor force should learn all the agricultural and mechanical operations. In the near future, these people might become independent farmers, with farm experience and know-how.

According to the information received, hand labor is not in abundance in the area. Therefore a large mechanized operation could assure the necessary wheat production for the area, since communications are not available and transportation costs are high.

According to economies of scale, the production cost per Ton would be substantially lower. Such large operations, if successful, could expand along the Niger river banks which are not seasonally flooded by the river. In general, the river banks have alluvial soils which with proper agricultural practices could become highly productive. Having large farms under one experienced manager could solve the problem of the production of an important staple food like wheat. These operations could reduce the wheat imports to Mali, saving substantial amounts of hard currency for the country. It is considered essential to organize a strong monitoring system by USAID personnel for all future operations in Mali.

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AN ANALYSIS OF THE SOCIO-ECONOMIC FACTORS WHICH DISTINGUISH INNOVATORS FROM TRADITIONAL FARMERS IN THE ACTION BLE DIRE PROJECT

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PART I - RESUME OF SOCIO-ECONOMIC SURVEY

Purpose

The hiring of an on-site anthropologist was suggested in the Action Ble Project Paper in order to monitor project impact on the target population and inform managerial decisions during the course of the project in order to avoid any harmful consequences.[1]

It was with this purpose in mind that a series of eleven questionnaires was designed. In addition, it was expected that the survey would add to the literature on the Sonrai ethnic group and provide baseline socio-economic data for a final project evaluation.

Background

In 1591, the area around Timbuktu was invaded by Morroccan troops seeking salt mines. Their descendants ruled until 1670, married Sonrai women whose light-skinned children became the noble class, and introduced wheat culture and bread-making to the region.

To the present day, Islam (already prevalent in the area at the time of the Moroccan invasion) rules many aspects of the Sonrais' lives. Laws governing inheritance follow the Koran closely. Attitudes towards fate, women, and interest rates (= usury) are also strongly influenced by religion.

The Sonrai are the dominant ethnic group in the central "arrondissement" of Dire. In 1975 they "constituted 78.5% of the total population of 21,360 (not including the town of Dire), the Peuls 20.2% and the Bellah (economic dependents of the Tuarege) 1.3%."[2] Thus it is not surprising that 95%

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[1] Action Ble Project Paper, Bamako, 1978, Annex IX, p. 110.

[2] Action Ble P.P., ibid., p. 90.

of farmers surveyed were Sonrai.

Transportation is furnished primarily by donkey (-back, carts are less common) or flat-bottomed canoe ("pirogue"). Those more fortunate may pay to ride in the weekly bush taxi; those who lack the means travel on foot.

The role of money in the economy is increasing; however, many local products, and services rendered in particular, may be paid for by barter. Grain is usually traded by the farmer.

Agricultural techniques are quite basic. Apart from the diesel pumps and this year, tractor plowing, no improved techniques are generally known. Only one plow has been observed in the area (other than at the Action Ble office).

Women's agricultural participation is minimal. They generally help with seeding, threshing, and winnowing,but rarely more. Their roles concern household activities, raising the children and weaving mats. The money they earn is their own, but generally spent on the family, if there is need. It is claimed that women may inherit land, but since in that case, her husband would farm it, it was preferred to keep it in her family which was accomplished by bequeathing family land to male descendants.

Since 1968, traditional landholding customs have been reinstated. Mobido Keita's program of "collectivization" created so much resentment among the farmers that Action Ble has avoided any mention of it and encourages traditional authorities to settle any land disputes. The right of land use or usufruct is inherited from father to son. If a new person moves to a village and wishes to farm, he is generally allotted a field from the common village property by the village chief. Land is not generally sold, but is

frequently loaned to other farmers. Permanent exchanges of landholdings must be approved by the village thief.[3]

It was in this context that the designers of the USAID Action Ble project proposed to intervene. Wheat farmers were successful, but the surface area they were able to cultivate was restricted by the inefficiency of their method of cultivation. It was hoped that by introducing diesel pumps to the farmers, the area under cultivation could be greatly increased. Changing only one aspect of farmers' technique, it was supposed, should not cause any adverse social effects and the benefit would be to reduce the grain deficiency in the Sixth Region.

Since Action Ble would be distributing the pumps and assuring extension services to the project, it seemed logical to place the socio-economic survey under the auspices of Action Ble Dire as well in order to coordinate activities where possible. In addition, ABD would provide the necessary administrative and logistic support to the survey effort which would reduce administrative costs to the project.

Goals

The goals which guided the choice of survey design and methodology were the following:

1. To establish a "first-adopter profile" -- an examination of the interrelated socio-economic characteristics which differentiate innovative farmers from those who prefer to "wait and see";

2. To determine the sophistication of farmers' knowledge regarding agricultural techniques, and the extent to which they are practiced;

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[3]For a more in depth discussion of these and other ethnographic factors, consult the Action Ble project paper, ibid., pp. 90-102.

3. To provide data to the extension service allowing it to tailor a program to the particular needs of the area farmers;

4. To reinforce the data gathering infrastructure already established at Action Ble Dire, and to this end, computerize the tabulation process in order to facilitate future surveys;

5. To investigate the state of maternal and child health and identify problem areas which could be positively affected by a Community Development program designed for women.

Methodology

It was felt that it would be more beneficial to the ABD statistics division to cooperate with the personnel there, than to carry out a survey as an individual travelling with an interpreter. The research effort was organized accordingly.

1. Questionnaires

The following questionnaires were elaborated:

1. Demography and Migration; 2. Inventory of Production Goods; 3. Inventory of Village Farming Groups; 4. List of sample fields; 5. Field Identification; 6. Person/days worked; 7. Agricultural Expenditures; 8. Household Expenditures; 9. Market Prices; 10. Grain Trading Routes (Timbuktu); 11. Health and Nutrition. The results of each survey will be discussed under separate headings in Part II of this report.

2. Interviewers

Eleven interviewers were hired after undergoing a month-long training session and passing an oral examination. They were assigned to 10 different villages in the central "arrondissemant" of Dire, the eleventh was sent to Timbuktu to collect weekly grain prices and investigate the trade routes for cereal grains in that area. During their first month in the villages,

the interviewers constructed village maps,[4] drew up lists of all adult males who farmed as a primary or secondary activity, and held informational meetings with the village chiefs and elders. When this was completed, they began the rainy season surveys, visiting each farmer once a week either at home or in his fields.

3. Supervisor

An agent was assigned by the Action Ble Direction to work as supervisor of the socio-economic surveys. Although he had completed three years of agricultural school, he had had no training in survey-taking. He moved to Bourem in September and was provided with a mobylette. He was expected to visit each interviewer once each week.

4. Other Supervision

In addition to the regular trips made by the supervisor to each interviewer, either the head of the research division or the USAID consultant visited each interviewer once a month.

5. Monthly Meetings

A meeting was held in a different village each month which all research personnel attended. The morning session concerned administrative details and discussions of any problems regarding the survey. Lunch was provided by division funds and the afternoon was devoted to a technical exercise or presentation. These meetings more than any other factor, served to maintain high morale among the interviewers and signal any potential problems to the supervisors.

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[4]See Annex No. 2, Map No. 2.

Pretest

The rainy season (June through September 1980) was to serve as a testing ground, not only for the questionnaires, but for the interviewers and supervisors as well. The questionnaires for the 1980-81 wheat season were redesigned on the basis of the experience gained during the pretest. The emphasis of the second training program was changed as well, more attention being paid to actually filling out the forms than on explaining their purpose.

6. Monthly Reports

In addition to filling out their survey questionnaires and graphing market prices, interviewers were requested to write a brief (2 page) report each month treating a different aspect of the village. This idea was dropped at the end of the rainy season when it was evident that the quality of the information collected did not justify the time spent.

7. Sampling

Samples were chosen by random drawing at the beginning of each agricultural season from the lists of farmers drawn up by the interviewers. Few were able to successfully interview the 20 farmers they had been assigned during the rainy season, so for the dry season, the number of farmers was reduced to 15 per interviewer -- 5 pump owners and 10 non pump owners. Interest had been expressed by the extension division in collecting data on pump owners so the two efforts were combined in order to increase the sample. Extension agents were responsible for interviewing pump owners remaining after the interviewers had filled their quota.

This effort failed for four reasons: 1. the survey division supervisor could not adequately control all the questionnaires being filled out and extension personnel had not been trained to supervise them;

2. there was a pervasive lack of commitment on the part of the extension "cadres" once the statistics division became involved; 3. there was a great deal of jealousy on the part of the extension agents because they had never been issued the necessary field equipment which the interviewers had; and finally 4. there was generally very low morale among all personnel because their salaries arrived late and were never brought up-to-date.

Due to the extremely low level of the Niger River at the beginning of the 1980-81 wheat season, many non pump owners chose not to farm. Even though sampling was redone (twice in some cases), it was not possible to maintain 10 non pump owners in the sample for all villages. In most villages, the sample of non pump owners cannot be considered random because it includes only the few calabash farmers who decided to cultivate this year.

An estimated 80% of non pump owners did not cultivate wheat this year due to the low river level. When it was graphed at the end of the wheat season, the level of the Niger River in 1980-81 followed closely the low which occurs on the average, only once every one hundred years.[5]

8. Computer Analysis

It had been planned since the wheat season questionnaires were codified in September to tabulate the survey by computer. For this reason, the first four questionnaire forms had been collected in January 1981 and transported to Bamako so that key punching could begin and the computer analyst/programmer could begin to write and test the program. It was at this point that project funds were suspended and neither the contract with the programmer nor with the Direction Nationale de la Statistique et de

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[5]See graph of Niger River level and O.R.S.T.O.M. table of average levels over one hundred years in Annex No. 4, Tables No.1 and 2.

l'Informatique[6] (both of which had been drafted since October) could be signed. Therefore, tabulation was done manually.

9. Effect of Lack of Research Funds

The serious damage caused to the research effort by a lack of funds will be fully discussed in Part III of this report; however, it must be noted that the lack of research funds seriously affected the collection of market data and wheat production information in addition to resulting in a general reduction of the quality and reliability of all documentation gathered by this survey.

Results Achieved

Of the five goals noted in Part I, only two can be said to have been achieved: the establishment of a "first-adapter profile" and an exploration of the state of farming technology in use in the Action Ble project zone. The results cannot be considered statistically definitive; however, they provide important insights into socio-economic aspects of wheat farmers lives as well as their agricultural practices.

On the negative side, conducting the health survey was postponed (due to lack of interest on the part of the ABD staff) until the dry season 1981 when agricultural activity generally comes to a halt. Given the subsequent course of events, this survey was never conducted, although the questionnaires are presently in Dire. The benefit to the research division from the way the survey was organized is discussed in Part III, Problems Encountered. Finally, the possibility of communicating survey results to the extension service always exists, but efforts at cooperating during the past year have not proved successful.

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[6]DNSI was to provide computer services to the project.

Summary of Conclusions

1. Economic benefits. Pump irrigation was directly responsible for an augmentation of surface area cultivated in wheat (by sample farmers) of 19% over the 1979-1980 season. Given an average production of 1500 kg./ha., each pump owner can expect to earn 806,250 MF gross profit for his 1980-81 wheat crop.

2. Target population. Despite the emphasis placed on selling pumps only to those who earned their livelihood from farming, "marabouts", merchants, school teachers, and fishermen have been sold 21% of Action Ble pumps. Most of the others have been bought by village chiefs or wealthy farmers who are probably descended from noble families. On the other hand, because of their greater wealth and access to means of transportation, these farmers will succeed regardless of Action Ble whereas the poorer farmers who depend on Action Ble for their agricultural inputs are likely to fail. It would be interesting to redo this survey in a few years to determine which farmers are still cultivating successfully with diesel pump irrigation.

3. Social costs. Farmers who continue to irrigate by calabash will probably be worse off because of the project than they were before. In terms of the availability of seed, cost of labor (which has increased since the project paper was written from 400-500 MF per day to 1000-1500 MF/day) and their ability to satisfy various needs through barter, exchange of labor and other flexible social arrangements, non pump owners will be experiencing increasing economic difficulties. Because the market prices of grain were not monitored in the months following the 1981(due to project management difficulties), it is not possible to determine whether wheat prices have been depressed by the additional production due to the project which would further harm non pump owners' economic situation.

Sixty percent of the non pump owners in the 1980-81 sample chose to associate with pump owners. The data demonstrates that their financial burden is so great under the usual arrangements that associated farmers earn little more than calabash farmers.

The gap between the rich and poor farmers will increase, the latter finding it more and more difficult to afford basic agricultural inputs.

Cash will be increasingly demanded in economic exchanges, barter and "arrangements" will decline in importance. This augmenting need for liquidity may force more and more non pump owner's family members into exodus thereby reducing the wheat hectarage cultivated due to loss of the labor force.

On the other hand, depending on the profitability of growing pump irrigated wheat as compared with unskilled jobs in urban centers, those members of pump owners' families who left for economic reasons may be increasingly called back to farm.

4. General recommendations. A. The training of extension agents should be improved (more practical exercises) and the effectiveness of the "paysan pilote" or model farmer method reevaluated and changed if necessary. B. The possiblity of broadcasting programs on agricultural topics in Somrai should be investigated. Radios are a status symbol often brought back to the villages by young men returning from urban centers. C. Care should be taken in the introduction of new techniques that the farmer is able to support the financial burden placed upon him. It is no aid to advance credits to the point that he can never repay them.

5. Recommendations concerning survey administration. A. If a contractor is responsible to USAID for the quality of the survey results, she/he should also be responsible for the control of all necessary funds. B. Secretarial assistance should be provided for, explicitly, in the researcher's contract,

either furnished by USAID or the necessary funds allotted for that purpose. C. Interviewers should have a minimum of a 9th grade education (D.E.F.) D. The supervisors should have some background in survey-taking, and speak the language of the area under study. E. It would be a good idea to hire an administrative assistant who could help with on-site office work as well as travel to Bamako to purchase supplies and obtain salaries for the field personnel. This would reduce the amount of time the contractor was forced to spend away from the on-going research.

PART II - ANALYSIS OF SURVEY RESULTS

At a time when the thrust of USAID policy is purportedly to improve the lot of "the poorest of the poor", the question which naturally arises is, "Which group of people do AID projects, in fact, affect?"

This question will be examined within the context of a "first-adopter profile", a contrast of demographic characteristics and agricultural techniques of pump owners and non pump owners in order to identify the salient factors differentiating the two groups.

* * *

First Adopter Profile

First, the socio-economic traits most likely to characterize an innovator will be identified then, pump owners and non-pump owners will be compared with this standard in order to describe the population segment which fit this description, or most closely resembled it. Finally, this group will be contrasted with the target population and the differences noted. The significance in terms of the project are discussed in the conclusions of this section.

Hypothetical Innovator

It was supposed that the farmer likely to try out a new agricultural technique would be young, 35 to 45 years old, and a descendant of a village

founder, He would have ample land (Action Ble required a minimum of 4 contiguous hectares before agreeing to sell a farmer a diesel pump on credit) and be financially able to survive in case the experiment failed. The innovator would tend to be educated in a state rather than Koranic school; he would also have lived outside the region long enough to have learned a second language. Tools used by a progressive farmer would be relatively new (2 years old) and he would be likely to own some means of transportation.

The innovator's family would be larger than that of a traditional farmer in order to assure an adequate work force. The active family members would outnumber the unproductive members: both men and women would participate in secondary activities, the proceeds would be contributed to the family. This additional disposable income would then be spent on food (especially meat), agricultural inputs, medicine, education and luxury items. It is to be assumed that cattle, sheep or goats would also be purchased, but this question was outside the domaine of the present survey.

Regarding land, not only would the innovator control a greater surface area than a calabash farmer, but the fields would be closer to the village and bordering the river (the most dependable source of irrigation water). In addition, the land use rights would have been inherited from a village founder rather than obtained through the village chief.[7]

It was with these factors in mind that pump owners and non pump owners were compared in the sections which follow.

Ethnic Group of Concession Head

The question posed in the survey sought only to differentiate between

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[7]See discussion of "gandakoy" and "lasal" land rights in the Action Ble project paper (Annex 11, p. 94). It is a question here of "gandakoy" land.

ethnic groups, but did not distinguish between castes in the same ethnic group. This detail would allow a more precise description of the system of land distribution as it exists today, twenty years after Independence and the abolition of slavery.

The majority of both pump owners and non pump owners in the sample were Sonrai: 86% of pump owners and 100% of non pump owners. The other 14% of pump owners is composed of Bellahs (the former slaves of the Tuaregs) and Bozos. The latter in general seem to earn enough from fishing and river transport that they can easily afford the initial down payment of 25,000 to 50,000 MF. The Bellahs as a group are much poorer, and tended to wait until the pump advance requested by Action Ble was reduced to 10,000 to 15,000 MF.[8]

Other ethnic groups which traditionally practice other professions (e.g. Tuaregs and Peulhs - herding) have, on the whole, evinced little interest in participating in the Action Ble project.

The ethnic group to which a farmer belongs, apart from economic factors, has no influence on whether he would tend to be a pump owner or non pump owner.

Age of the Concession Chief

A comparison of the ages of heads of concession for pump owning families and non pump owning families has shown that a slightly higher percentage of pump owners fall into the 35 to 44 age group than non pump owners.

Age	PO*	NPO[9]
15-24	-	-
25-34	4%	6%

[8]This change of policy permitted poorer farmers to purchase pumps; at the same time, the ability to make the down payment no longer indicated the financial capability of meeting future expenses.

[9]"PO" and "NPO" will be used throughout the remainder of this report to indicate "pump owners" and "non pump owners"; likewise "POF" and "NPOF" designate "pump owning families" and "non pump owning families".

Age	PO*	NPO
35-44	36%	24%
45-54	25%	37%
55-64	21%	29%
65+	18%	4%

It would be inaccurate to conclude that pump owners are generally younger than non pump owners, because there are 14% more PO in the oldest age group than NPO while there are only 8% more PO than NPO in the youngest age group. The majority of pump owners (62%) are 45 and older; 70% of NPO are over 45 years old. A partial explanation for this would be that the oldest male member of the family is usually considered to be the head of the concession, even if money earned by a son or younger brother permitted the purchase of a pump. In any case, age cannot be considered a significant factor in an innovator's decision to purchase a pump.

Education

It was found that in the sample drawn, so few concession heads had attended public school that education could not be considered a factor in pump owners' willingness to take risks. The extent of both groups religious training was similar. Only one pump owner was an "Ancien Combattant." On the other hand, many more POF children attended public school than NPOF children in like age groups.

Educational Level	POF	NPOF
Concession Head		
Public school:		
Grades 1-6	7%	-
Grades 7-12	-	2% (1)
"Ancien Combattant"	4% (1)	-
Koranic school:		

Education Level	POF	NPOF
1-4 years	89%	75%
5+ years	21%	10%
Functional Literacy Class	4% (1)	-

Since primary education is, in theory, required until sixth grade, a certain percentage of children from both groups will be attending the village schools. The differences between the two groups, though, 21% more POF children attending the primary grades and 15% more in the advanced years, are dramatic enough to indicate a difference in parental attitudes towards the value of education. School fees (.500 MF/student in Dire) are minimal; if the family considers it important, the money can be found. It is certain that the financial advantages of having an educated family member, whether in the civil service or in commerce, have been noted by pump owners.

The greater presence of religious teachers and leaders in the pump owning group tends to argue against the idea that religion, in this instance, is a brake on progress. To the contrary, it appears that whatever financial or other advantages the religious teachers enjoy (e.g. village labor as a religious duty), they have turned them to earthly purposes.

For the purposes of this survey, travel was considered to be a valuable educational experience indicated by a person's ability to speak a second language.[10] The percentage of pump owning family members (including concession heads) who speak a second language is triple the number of NPOF members in Bambara, and 42% more in French.

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[10]This hypothesis was born out by the dramatic example of 2 Bozo fishermen who during a trip to Segou observed a cattle-drawn plow and purchased one to try it near Dangha. Other than the Actic Ble plow (which is not in working condition) it is the only plow to anyone's knowledge in the Dire "Cercle". The farmers speak Bambara and Sonrai in addition to their mother tongue.

Second Languages Spoken by Concession Members:	POF	NPOF
Bambara	1.5 people/concession	53%
French	54%	12%
Peulh	4%	4%
Other	7%	7%

The presence of the Peulh language in this table may indicate either travel to the Mopti region, which is frequent, or intermarriage with women of Peulh origin which would not be surprising given the history of the area.

An ability to speak rudimentary French could be a result of public school or travel outside of Mali where neither Sonrai nor Bambara can be used as a lingua franca. As there is not a large Bambara population in the Sixth Region, it is unlikely that Bambara is learned other than by travelling to other regions of Mali, and staying long enough (whether visiting relatives or working) to learn the language. Since 88% of the Sonrai in exodus from the sample families have chosen to remain in Mali, this is the most likely explanation.

Although men who have studied the Koran for more than five years can generally read and write Arabic, it is not a spoken language.

Active vs. Inactive Population

What proportion of the population consumes without producing for the general good?

This survey considered the active population or "bras valids" to be those family members between the ages of 15 and 64. Although family members older and younger contribute to the economic well-being of the family, they are not generally capable of performing a full day's labor comparable to that of a healthy adult.

In all three samples, non-producers constituted only one fourth of the population: rainy season - 24.87%; dry season PO - 25.5%, and NPO - 22.6%.

The slight differences between PO and NPO here cannot be considered significant given the relatively small size of the sample. In any case, these figures show that three-fourths of the sample population is in the productive age group.[11] There is not an excessive burden on the active members to support those who consume but cannot produce.

Secondary Activities - Males

What differences, if any, could be observed in the division of labor in a pump owning family versus a non pump owning family?

It was assumed that members of pump owning families in general, would perform more secondary activities than non pump owning families. This factor would then explain in part the additional income at their disposal (to make the down payment on the pump, for example). This is born out by the data for the heads of concessions, as well as for other family members.

Secondary Activities - Males (Ages 15-64)

(wheat season only)

Head of Compound	PO	NPO
Agriculture as primary activity	79%	92%
Other primary activity	21%	10%
Secondary activity	46%	31%
Other Compound Members		
Agriculture as primary activity	1.6/compound	1.2/compound
Other primary activity	71%	18%
Secondary activity	79%	31%

[11] Family members within this age group who suffered from crippling diseases were not included in the calculations.

Fifteen percent more POs than NPOs perform a secondary activity, while 48% more of POF members do so than NPOF members. Whether because the financial means exist or as a result of technical skills, perhaps gained during their travels, pump owners supplement their farm income significantly more than do non pump owners. Additionally, varying the sources of family income minimizes the risk of a poor harvest. The 21% of pump owners whose primary economic activity was not farming (three fishermen and three marabouts), were not theoretically eligible to be issued pumps according to the project paper. They were to be granted only to those whose primary economic activity was agriculture. Obviously, a certain amount of political pressure was used.

Non Agricultural Economic Activities of Females in the Productive Age Bracket: 15 to 64

Due to the fact that feminine activities were not spelled out as specifically as masculin activities, on the questionnaires, women's economic contributions to their families has been underestimated by this survey. In a society where women's work is undervalued in comparison with the contribution of men, male interviewers asked to observe females and note their activities easily overlooked sources of household income furnished by women.

Although codes were established for breadmaking, pottery-making, hairdressing and field guardian, the meager figures returned indicate carelessness on the part of the interviewers. Judging by the number of women who bake bread, even in the smallest village it is obvious that the numbers have been underestimated. The number of women making pottery is fairly limited, as it is a more specialized occupation, but mat making, bead work and bread baking are activities performed by virtually all rural Sonrai women.

Hairdressing can be a lucrative profession for both young and older women. "Coiffures", depending on their complexity, may range in price from .300 MF to 2.000 MF. Two women over 64 who were in the sample claimed that hairdressing was their primary activity.

Few girls continue their studies past sixth grade as that would mean moving to Dire, away from the family's watchful eye. Four girls in the sample attended school: two from pump owning families and two from non pump owning families.

A Sonrai woman living in a rural village performs a variety of remunerative activities. The money she earns is her own property to spend as she chooses, but will be contributed to the family, if need be. Depending on the enterprising spirit of the individual woman (and time allowed by her other duties) her economic activities may constitute a welcome source of supplemental income to a family which is supported only by subsistence agriculture.

There were no significant differences in activities noted between women of pump owning families and those of non pump owning families.

Household Expenditures

This questionnaire inquired only about family expenditures because it was felt that accurate income data would be virtually impossible to obtain given the extent of bartering and the reticence of the Sonrai to import this type of information to outsiders.

It was discovered that expense data was equally difficult to collect: of nine interviewers, only three returned any data, of which little appeared accurate. In addition, the time span over which the data had been collected was a week rather than the entire wheat season of six months. This survey suffered greatly from inadequate supervision due to a lack of gasoline for the supervisor's mobylette.

Given the situation, it is impossible to draw any valid conclusions from the available data. On the other hand, several tendencies were indicated which were born out by other data and observation.

With the exception of pump related materials, the expenditures of pump owners and non pump owners do not differ qualitatively. Pump owners may spend less on transportation than non pump owners because they own more donkeys and pirogues, but in general, greater wealth is indicated by owning or consuming more of the same items.

Although tea drinking may be a leisure activity, tea is not considered a luxury. When the amount of money spent on food (sauce ingredients) is compared with that allotted to tea and sugar, it becomes obvious that strong, sweet tea is considered a staple food. When food stocks run low, and even during periods of the year when food supplies are adequate, the calories and theine compensate for insufficient cereal carbohydrates and keep the workers active in 90° F (32 C) heat.[12]

Educational expenses in the village are minimal, restricted to basic writing materials (no textbooks are available) and a small school fee. If children continue their studies past the sixth grade,[13] they are usually sent to live with a relative in Dire which reduces the financial burden on the child's nuclear family.

Expenditues on medicines constitute an insignificant element of the family budget despite their exceedingly high cost. This is easily understood when one considers the inadequacy of the drug supplies in the Dire zone and the unfamiliarity of villagers with modern medical techniques.

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[12]Temperatures ranging from 30 C to 35 C (86 F to 95 F) were not uncommon during the wheat season.

[13]Village schools in the area include grades one through six.

males in POFs have an occupation other than agriculture while only 18% of males in NPOFs can be spared from agricultural work. This difference suggests that pump owning families have more disposable income than non pump owning families. The survey on household expenditues indicated that this was the case, but could not be verified due to incomplete data.

Rural Exodus

The term rural exodus refers to a long term or permanent out-migration of young men (generally aged 15 to 30) from the villages to urban centers. Not only does this population movement cause labor shortages in the villages, but also housing shortages in the cities as well as an increasing unemployment rate of semi-skilled and unskilled workers. In many developing countries, the lack of traditional authority structures in the cities combined with the rising expectations of the new arrivals has led to social destabilization and a rising crime rate.

Since the drought which hit Malis Sixth Region hardest in 1973, the rural exodus has increased. Both young boys aged 15 to 30 seeking their bride price, and older men unable to support their families from farming along leave the area and look for work in urban centers further south. The money they send back to their families is an important supplement to farm incomes; in some families, it may constitute the major source of cash income.

It was suggested in the Action Ble project paper that the rural exodus would be reduced by the increased availability of work in the project area.[14] This is to be hoped for, particularly in the case of older men whose absence places an additional workload on those men and women who remain.

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[14]See Action Ble P.P., op. cit., Annex II, P. 104.

TABLE I. SUMMARY DATA FROM FARMER SURVEYS

Interviewers Numbers	Wheat Last Season	Rainy Season Crop				Wheat 1981/82 season					Pump conditons
		Other Crop	Rice	Other	Ha.	Ha	Fuel	Fuel Price	Labor price	Pump repair	
1	Yes		Yes		1	4[1/]	614[1/]	375/500	1,000	13,295	G
2	Yes		Yes		(1)[6/]	1	425	400	1,250/ 1,000	100,000	B
3	No										
4	Yes		Yes		1	2	340	400/500	1,000	3,360	G
5	Yes		Yes		1	1	200	365	700	10,250	B
6	Yes		Yes		(1	3	425	350/375	1,400/ 1,000	3,400	G
7	No	Garden	No	G				370		6,000	G
8	No										
9	Yes					0.9	240[2/]	500		6,800	G
10	Yes	Garden	Yes		4	1.5	400[2/]	500	1,000	1,770	G
11	Yes		No			2	530	350/380	1,000	21,000	G
12	No										
13	Yes		Yes		4	4	580	420/500	750	150,000	B
14	Yes					2	350	380/400	600	0	G
15	Yes[3/]		No								B
17	Yes		Yes		1/2	1.25	200	425/500	500	0	
18	No		Yes		(1)						
19	Yes					2.5	400	365/400	500	8,410	B
20	No		Yes		(1)						G
21	Yes	Garden	Yes		3	2.0	660[2/]	500	1,500	42,800	G
22	No										

1/ Total for two pumps
2/ Includes garden
3/ Pump not repairable; farmer lost crop
4/ Did not plant due to land tenure problems
5/ Did not plant due to lack of irrigation pipe
6/ Assumed as one hectare when farmers had no idea of

TABLE 1. SUMMARY DATA FROM FARMER SURVEYS

Rainy Season Crop				Wheat 1981/82 season								
Other Crop	Rice	Other	Ha.	Ha	Fuel	Fuel Price	Labor price	Pump repair	Pump conditons	Pump Age	Producer Ratin	Wheat Yield (rating)
	Yes		1	4[1/]	614[1/]	375/500	1,000	13,295	G	2	G	
	Yes		(1)[6/]	1	425	400	1,250/ 1,000	10,000	B	2	M	H
										2		
	Yes		1	2	340	400/500	1,000	3,360	G	2	M	M
	Yes		1	1	200	365	700	10,250	B	2	B	L
	Yes		(1	3	425	350	1,400/ 1,000	3,400	G	2	G	H
Garden	No	G				370		6,000	G	2	B	
										2		
				0.9	240[2/]	500		6,800	G	1	M	L
Garden	Yes		4	1.5	400[2/]	500	1,000	1,770	G	1	G	M
	No			2	530	350/380	1,000	21,000	G	3	G	M
	Yes		4	4	580	420/500	750	150,000	B	2	M	
				2	350	380/400	600	0	G	1	G	
	No								B	2	B	
	Yes		1/2	1.25	200	425/500	500	0		2	M	
	Yes		(1)							2	B	
				2.5	400	365/400	500	8,410	B	2	M	H
	Yes		(1)						G	1		
Garden	Yes		3	2.0	660[2/]	500	1,500	42,800	G	2	G	M

[4/] Did not plant due to land tenure problems
[5/] Did not plant due to lack of irrigattion pipe
[6/] Assessed as one hectare when farmers had no idea of size

farmer lost crop

Assessment of interview results

1. Probable life of pump

The PP assumes a life of five years. Action Blé offers credit of equal payments over a four year period. Farmers who were asked either did not know or expected the pump to last longer than five years. One person, who was not in the sample, but is an educated farmer whose opinions are regarded highly by ABD personnel, said that the pump could easily last 10 years with proper maintenance. The economic life of a pump can be defined as the point when (1) expected down-time will not allow for efficient crop production or (2) cost of annual repairs become greater than amortization plus repairs on a new machine. There is a tendency among African farmers to cultivate land on a group basis, usually at the village level. Most sites visited revealed farmers growing wheat adjacent to each other. There were often several pumps at the same site. Farmers indicated that in case of one pump failure another pump is used in its place until repairs can be made. This probability of pump down-time damaging a crop is minimized. (Note: Such farmer groupings of more than two pumps should be discussed as possible prerequisite to buying pumps in order to reduce risk of crop failure due to pump disorder. One farmer did have a problem with possible pump failure and did not have a field immediately adjacent to another's/ He limited the field size to one hectare but had one of the highest estimated yields of any farmer).

Total cost of the pump to farmers is 700,000 FM. The annual amortization is 140,000 FM per year. With the exception of two pumps whose repair cost was over 100,000 FM, the annual repair cost was less than 50,000 FM with an average of 14,200 FM. In most cases this did not include mechanics' salary and may not reflect actual parts cost. It is usually estimated that repair (and maintenance) costs will be about 10% of original cost per year, 70,000 FM for the pumps in question. Thus the pumps will remain economically functional until repair and maintenance cost exceed 210,000 FM per year if pumps life is assumed five years. If the life of the pump is assumed to be ten years, then the point of pump replacement is when annual repairs and maintenance exceed 140,000 FM per year. It appears that after two years,

most pumps are operating well within the limits considered plausible (consistent) with the five year life assumption and perhaps for a period longer than five years.

2. Quantity and cost of fuel

The economic analysis in the PP assumed that the pumps would use 125 lt. of fuel per hectare for a wheat season and that the cost per liter was _____

The farmers indicated that they used from 141 l/ha to 425 l/ha. with an average of 184 l/ha. The fuel usage estimate was based on farmers recall as to the quantity of fuel bought and an estimate of the wheat field size made by the interviewers. There were several reasons given for a variance in fuel efficiency among pumps; care and maintenance of pump, condition of water distribution system, planting time, distance from field to water, soil type and management capability of the farmer. It is believed by the interviewers that some of the variance was due to information withheld by some of the farmers, particularly regarding hectarage serviced by the pump. The farmer who indicated the highest fuel usage had the highest estimated yield; however, the farmer with the second highest estimated yield (very close to the first) indicated the lowest fuel usage per hectare. The average actual fuel usage per hectare is probably between 150 and 200 liters,. The figure is considerably above the PP estimate.

The price of fuel varied from 350 FM/l to 500 FM/l for cash transaction depending upon quantity purchased, shipping arrangements, etc. Most farmers bought a large quantity (about 400 l) in Timbouctou before the crop began. They arranged transport, etc. themselves and paid about 350 FM/l. Fuel purchased in Diré was much more expensive. The price of fuel assumed in the PP was 19,500 F.cf. If the average price is assumed to be 425 FM/l and avergge usage at 184 l/ha. then the fuel cost per hectare would be about 78,200 FM.

3. Quantity and Cost of hired labor

The quantity of hired labor was kept at a minimum by farmer; the average being 31 man-days per crop (or about 15 per hectare). The PP estimated _____ man-days per hectare. The price of labor varied from 500 FM/day in the

most remote village to 1,400 FM/day for the most difficult labor (clearing trees). The most frequently quoted price was 1,000 FM/day; double the PP assumption. Hired labor represents less than 10% total costs and is not likely to be immediate production constraint.

4. Cost of repairs/estimated down-time

Actual cost outlay by the farmer for repairs has been minimal. The occasional excessive repair costs of some pumps has been attributed to farmer misuse of the pump or manufacturer's defect. Excepting these cases, average repair costs were 11,000 for two-year old pumps. The average repair cost for one year old pumps were 3,1000. These costs represent actual farmer outlay with no, or minimal, payment for mechanic services and likely subsidized spare parts. Two farmers surveyed contracted with mechanic to service their pump during the growing season for about 25,000 FM. If 25,000 FM is included for mechanic services, 10,000 FM is added for lubricating oil, the actual repair/maintenance cost would be 46,000 FM per wheat crop for two year old pumps. The rainy season crop, usually rice, would require less maintenance because the pump is used only to supplement rainfall. Thus total annual maintenance costs would be less than twice those costs incurred during wheat season. This compares with the standard maintenance assumption of 70,000 FM per year, 10% of purchase price.

Pump down-time could be a very critical factor considering the remoteness of some farmers, lack of transportation for mechanics and the inability of mechanics to carry a complete set of parts (one trip to the pump for assessment of parts needed and another trip out to bring the necessary parts). Some of the farmers reduce the potential down-time hazard by [illegible] farmers together with two or more pumps. When one pump is down, the other can carry the remaining portion. This might be the most constraining factor on hectarage cultivated. For example, if the absolute limit on a pump is 6 hectares, two pumps could irrigate a maximum of 6 hectares, under the assumption of minimizing risk of crop damage from pump failure, three pumps for twelve hectares, etc. allowing for one pump to be down at any point in time.

5. Yields

The PP assumed average yields of 2.5 tons per hectare in order to economically justify the project. A contractor's report showed yield samples averages of 300 kg/ha and 2,000 kg/ha. Due to time and logistics consideration an attempt was made only to estimate one global yields figure in the following fashion. One or two one-square meter plots were somewhat randomly selected from each farmer's plot who had not yet harvested. The area of the field to be sampled was chosen from the area mature enough to harvest. When the plot was selected and marked off, those pinnacles which were harvestable were counted and three pinnacles were randomly chosen among those counted for grain weighing. About 10 to 20% of pinnacles are too immature at harvest time and are abandoned in the field.

The number of mature pinnacles per square meter ranged from a low of _____ to a high of 537, with an average of _____. A total of _____ pinnacles were selected for threshing and grain weighing. The grain weighed _____ or _____ per average pinnacles. Thus the average yield was estimated to be _____.

6. Total land irrigated per pump

a) Wheat Crop

It was foreseen in the PP that each pump would irrigate four hectares of bhd wheat. The size of all plots shown to the interviewers was estimated by pacing and subtracting those areas within the plot not in production. It is believed that the estimates are on the high side of actual. The estimated hectares per pump ranged from 0.9 to 4 for an average of 2.1. Except in those cases where a pump substituted for one temporarily down for repairs, these plots were avowed to be the only plots irrigated. Every farmer interviewed stated that he did not rent his pump. This conflicts with Crystal's report concerning pump rental; however, the information in Crystal's report was obtained from renters, (renters were not represented in this sample). In some cases, it appeared that farmers were giving misleading information about the plot size.

It is important to analyze fully the situation of men who have left in order to determine the potential of Action Ble to alter it. This will be accomplished through an examination of the following questions:

1. Why do the men leave?
2. Where do they go?
3. What kinds of work do they do?
4. What time of year do they leave?
5. How long do they stay and do they return?
6. What are their families feelings about it?

Why Do They Leave?

The Sonrai to whom the first question was posed gave a singular answer: to look for money. This is undoubtedly the primary reason, although Rouch suggests that otherfactors may influence mens' decisions to seek work elsewhere: a free choice of jobs, the opportunity to acquire goods unavailable elsewhere (i.e., in the Sixth Region), and a taste for adventure.[15]

The project will only affect those men who leave for economic reasons. Those who wish to escape the domination of the family head, to work at something other than agriculture cannot do so by staying at home. The status associated with a $400.00 radio-cassette player is also an attractive feature of venturing into the big city or even travelling to anothercountry. Money is earned much faster in the city than on the farm.

Where Do They Go?

In order of importance, the centers which attract Sonrai laborers are:[16]

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[15]Rouch, Jean, Les Songhay, Monographes Ethnologiques Africaines, (Paris: Institut International Africain de Londres, Presses Universitaires de France, 1954), p. 52.

[16]All three samples have been combined. Refer to Annex No. 6, Table No. 11.

Bamako	52%
Elsewhere in Mali (except Mopti)	19%
Ivory Coast	11%
Mopti	10%
Other Countries in West Africa (except Niger)	4%
Niger	3%
Other	1%
Total	100%

The chart shows that 81% of Sonrai prefer to seek jobs within the country while only 19% cross over international borders in search of employment. This results from two main factors: First, that not everyone can obtain an I.D. card and/or laissey-passer which allows legal entry into foreign countries; and secondly, that travel is expensive and the cost of living high in urban centers such as Abidjan and Dakar, about twice the cost of living in Bamako. In addition, in these cities the Sonrai must compete with other West Africans for jobs.

Saving money is easier in Mali because many Sonrai from the Dire area have relatives in the cities with whom they can live which reduces expenses considerably. Maintaining close contact with his family is generally important -- the further a Sonrai travels to work, the more expensive a return trip to the village.

What Kinds of Jobs Do They Find?

Once in the city, what kinds of jobs do Sonrai accept?

Merchant/Street Vendor	20%
Student	14%
Day Laborer (incl. docker)	10%
Transporter (incl. river transport)	6%
Koranic student ("garibou")	6%

Trades	5%
Domestic	4%
Government Employee	3%
Other/Don't Know	32%
Total[17]	100%

From this table, it is evident that the majority of occupations practiced by Sonrai are unskilled or semi-skilled; only 17% (students and government employees) are definitely literate. If students are not considered with wage earners, the percentage of literate Sonrai drops to 3%. These are the people who would be earning a relatively lucrative government salary; the others would earn the minimum daily wage if a day laborer, possibly more if an enterprising tailor, or less if a street vendor.

The fact that men leave their families to compete for minimum wage jobs only serves to underline the severity of the economic situation in the "Cercle" of Dire. Even relatively low-paid jobs are a welcome source of outside revenue to families who would find themselves on the brink of starvation in the event of a poor harvest.

Most of the men left with no idea in mind as to the kind of jobs they wanted; when the question was posed, "debrouillard" was the answer frequently given,"he'll get by." The job they were able to find depended to a large extent on the resources of the relative with whom they were lodging.

It is not uncommon for boys between the ages of ten and fifteen to be sent to live with a "marabout" for a few years to learn the Koran. In some cases, the son may remain with the "marabout" and become a religious teacher himself; in others, he would return to the family at the age of fourteen or fifteen and begin working in the fields. The advantage to this system is

[17]All three samples have been combined. Refer to Annex No. 6 Table No. 11.

that, not only does a farmer do his religious duty by educating his son, he also rids his household of an unproductive mouth. While the boy lives with the "marabout", his food, lodging and upbringing are entirely the responsibility of the religious teacher. By the time he returns to the family (if he does), the son is already capable of performing an adult's day's work.

When Do They Leave? How Long Do They Stay?

The percentage of young men leaving the Dire zone during the rainy season was twice as high as those leaving during the dry season. During the sorghum and rice seasons, 41% of the households interviewed noted a family member (in the productive 15 to 64 age bracket) absent. The wheat season found "bras valides" absent in 20.5% of sample pump owners' families, and in 18.5% of non pump owners' families.[18]

The slight difference in percentages between POPs and NPOPs cannot be considered significant in the ensemble. On the other hand, it is interesting to note that the village of Korigour which experienced the highest rate of rural exodus indicated a labor shortage was a major production constraint.

When the figures from the project area are compared with those of the 1976 census for Mali and the Dire "Cercle", it appears that they underestimate the extent of the rural exodus:

Men Absent Ages 15 to 34 [19]	
in Mali	28%
in Dire "Cercle"	34%

Based on observation and experience in the project area, the minimum or wheat season level of exodus should be approximately 10% for men ages 15 to 34.

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[18] See Annex No. 6, Table No. 10.

[19] See Annex No. 7, Table Nos. 3, 4, and 5.

The relatively small sample size may account for an underestimation of this phenomena. The rainy season data was taken from a larger sample and notes accordingly a higher rate of emigration.

In general, this relationship indicates a seasonal migration of agricultural workers -- they leave during the rainy season and return for the dry season. In this case, though, the extent cannot be measured because of the uncertainty of the figures. It is likely that since (until the advent of the pumps) sorghum and rice crops depended entirely on rainfall which was unreliable, it was considered advisable to send a family member to the city to earn some cash in case the crop failed. In addition, the rainy season crops are much less labor intensive than wheat thus fewer hands would be required.

The data indicates that young men leave most often for a period of one to four years. Their migration is temporary rather than permanent, in most cases.

Family Member Absent:	Less than 1 year	1-4 years	5 years[20]
Rainy season	38%	57%	5%
Dry season:			
Pump owners	13%	88%	-
Non pump owners	36%	64%	-

Due to the wording of the question, it was not possible to determine whether those family members who had been absent less than one year planned to return before the next agricultural season, or whether their departure marked the start of a longer absence.

Family Attitudes Towards the Rural Exodus

Everyone interviewed would have preferred that his child remain at home and work with the family; however, all recognized the economic necessity of

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[20]See Annex No. 6, Table No. 9.

their leaving. Only those children who left and sent back no money were resented when the family was short-handed in the fields.

Conclusions

Given that the outmigration of young men in the productive age bracket (15-64) has increased since the 1973 drought, one of the Action Ble project objectives was to reverse this trend by augmenting the profitability of wheat growing through the introduction of pump irrigation. In order to determine the project's potential for affecting the rural exodus, the underlying reasons which prompt men to leave must first be examined.

It has been shown that men primarily leave in search of the economic opportunities afforded by the urban centers. Young men leave to earn their bride prices while older men may be unable to support their families on income from marginally productive land. Eighty-one percent of the men who had left the sample families chose to remain in Mali. The rainy season data indicated that in 41% of the sample families, a male was in exodus while the same was true in only 20% of the dry season sample. It is likely that the rate of emigration is higher during the rainy season; however,the question did not specify whether those who had left planned to return before the upcoming wheat season. Sonrai's in exodus accept a variety of jobs, mostly unskilled or semi-skilled (day laborer, street vendor). Students account for only 14% of those in exodus. Most often, the person will return to the Sixth Region within four years.

Families prefer that their children remain at home, but recognize the economic necessity of their leaving.

Land Ownership Patterns

The average sizes of households and compounds are the following:[21]

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[21]See Active vs. Inactive Population, Annex No. 6, Table No. 2.

	Household	Compound
Dry Season:		
Pump Owners	5.5	10.2
Non Pump Owners	4.9	7.5

Although there is not a great difference in the size of the household or nuclear family, the average pump owner counts almost three more people in his compound than the non pump owner: i.e., at least two more family members in the productive age bracket are contributing their labor to POF than is available to NPOP.[22] This factor explains to a large extent the non pump owners' dependence on various labor exchange arrangements, and the potentially detrimental effect of rising labor costs on their ability to continue farming.

What surface area does each group control?

Hectares per crop:	Wheat	Sorghum	Kobe	Floating	Total
Dry Season:					
Pump Owners	2.6	1.1	1.0	2.3	7.0
Non Pump Owners	.5	1.5	.4	(.4)[23]	2.8[24]

In this case, the difference between PO and NPO landholdings is striking. Pump owners control more than twice as much land as non pump owners, in fact, over 70% more. This fact has both economic and demographic significance.

The economic advantages are obvious, given that the labor force exists to exploit the land; the preceding chart indicates that it does. Pump owning

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[22]Given that the ratio of active to inactive members is 3 to 1 or 75% active, of three additional family members, two are likely to be active (60%). This category includes "familles associees", former captives who have remained with the family.

[23]No figures were available, but .4 ha. is a reasonable estimate.

[24]Includes estimated surface area for floating rice.

families dispose of .69 hectares per person as contrasted with .37 ha./ person in non pump owning families.

In terms of demography, the larger land holdings of the pump owners indicate that they are generally descendants of the village founders and probably of noble birth. It is unlikely that captives freed in 1960 would control 70% of village lands by 1980, especially since 88% were gained through inheritance.[25]

Mode of Acquisition

Through what system of distribution were present farmers granted their land?[26]

1980-81 Listed fields:	PO	NPO
Inherited	88%	88%
Purchased	-	2%
Village Chief	10%	4%
GRM allocation	-	-
Other (Third Party)	2%	6%

These figures show that almost 90% of the fields controlled by sample farmers were inherited. Both pump owners and non pump owners obtained most of their land in the same way which indicates that both groups are descended from long-time village residents, if not village founders. This point then argues against the possibility of non pump owners being slaves' descendants. On the other hand, their fathers might have been relative latecomers to the village which would explain why their landholdings are substantially less than those of pump owners whose fathers were probably village founders.

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[25]See Annex Nos. 8, 9, 10, 11, Table No. 3.

[26]See Annex Nos. 8, 9, 10, 11, Table No. 3.

To the present day, the village chief is responsible for allocating unused village lands to newcomers or other village residents who wish to farm additional land. It is possible that the four hectare minimum obliged some pump owners to request increased hectarage suitable for wheat cultivation from the village chief which would explain the 10% of fields obtained from the village chief.

Of the remaining three options, only farming land belonging to a third party is a viable one. Land is not purchased; any change of "ownership" must be approved by the village chief and council of elders. There is no exchange of land title and money as in the west. The land belongs to the state and is administered by the village chief. The traditional practice of inheritance of usufruct or land use rights was reinstated after the unsuccessful attempt by Modibo Keita to collectivize farming. The small percentage shown in the chart for purchased land is more likely to be a form of rent payment to another farmer for the loan of his field. Pump owners who, themselves, have substantial cultivable land would obviously have less need for renting[27] or borrowing land from a third person.

Four hundred hectares of previously uncultivated land were made available to project area farmers in 1980 through the intervention of Action Ble Dire. A cutting permit was obtained from "Eaux et Forets" which permitted farmers to clear virgin land and build fences around their fields without fear of the stiff fines routinely imposed by this agency. This event serves to highlight the additional land potentially arable by pump irrigation if the GRM agencies are supportive of the project.

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[27] "Renting" here includes all forms of payment in exchange for the use of another farmer's field: money payments, share cropping, labor exchange, etc.

Number of Years Cultivated by the Same Farmer

This question was designed to furnish an estimate of the surface area which, through the intervention of Action Ble, was brought under cultivation for the first time in 1980-81. It was supposed that innovators would have older landholdings, having inherited them from their fathers while unprogressive farmers would be relatively new arrivals controlling fields recently granted them by the village chief.

No. Years Fields Controlled by Present Farmer:[28]	PO	NPO
First Year	36%	17%
2 to 5 years	31%	11%
6 to 10 years	24%	8%
11 to 20 years	3%	15%
21 + years	7%	49%

This table indicates the opposite, that 64% of NPO fields have been cultivated for ten years or more while only 10% of PO fields have been used over the same period of time. Sixty-six percent of PO land has been brought under cultivation during the last five years while NPOs have broken new ground for only 28% of their fields. What factors explain this phenomenon, so different from the expected results?

Two points should be considered. First, in terms of demography, it was shown that non pump owners tend to be older than pump owners. This would account for fields being controlled by the patriarch rather than being passed down at his death to younger male family members. The latter would have taken the agricultural decisions over a much shorter time span.

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[28]See Annex Nos: 8, 9, 10, 11, Table No. 3.

Secondly, the preceeding section noted that pump owners control twice as much land as non pump owners. Before the arrival of the pumps, they were working under the same production constraints as the NPOs and were probably unable to exploit all the fields available to them so they left some land uncultivated. With the arrival of the pumps, not only could POs irrigate land formerly too far from the river to be reached by calebash,[29] but also the total surface area which could be irrigated was seven times as great.[30] If the increase in NPO land (17%) is subtracted from the increase in new fields formed by PO (36%) as a control for variable factors, pump irrigation can be said to be directly responsible for an augmentation of 19% over the surface area cultivated in 1980-81.

Which crops accounted for this increase in farmland? The number of years each crop has been grown in the present fields is shown below.[31]

Years field cultivated:	Wheat	Sorghum	Kobe	Floating
1-5 years	50%	20%	16%	19%
6-10 years	10%	4%	14%	14%
11-21 + years	40%	76%	70%	67%

The case for a major increase in hectarage devoted to wheat is made fairly clear above, but if one considers only the fields that have been cultivated for the first time in 1980-81, the evidence is even stronger in favor of the impact of Action Ble:

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[29]The time required to dig the lead in canal was long, and labor was short both for canal digging and later, irrigation.

[30]A calabash farmer irrigates an average of .3 to .5 ha, while a pump is capable of irrigating as much as 4 or 5 hectares.

[31]All samples combined.

	Wheat	Sorghum	Kobe	Floating
First year cultivated	31%	8%	4%	1%

Field Distance from Village

It was believed that pump owners' fields in general would be closer to the village than NPO's fields assuming that NPOs were relative newcomers and would have been allocated village land further from the village center than the descendants of village founders.

The data demonstrated the contrary, that more NPO fields were closer to the village than PO fields although for both groups, three-fourths of all fields were no more than one kilometer from the village.

All crops, distance of fields from village[32]

	PO	NPO
0-.5 km.	49%	55%
.51-1 km.	26%	33%
1.1-5 km.	16%	10%
5.1 + km.	8%	2%

In the sample villages then, there seems to be adequate land for the present population. Most of the fields are just a short walk away. The rural exodus may act as a control valve in this instance; when several sons are eligible to inherit their father's land which is not sufficient to support them all, one or two leave.

Water Source

The most dependable source of irrigation water is the main channel of the Niger River. Second in reliability are river branches or flood-filled ponds which can be dammed as the river recedes. Last in dependability are plains or ponds in the bush filled solely by rainfall. Only four rains

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[32]See Annex Nos. 8, 9, 10, 11, Table No. 2.

fell in the Dire "Cercle" during the 1980 rainy season.

The water source varied according to crop, but no significant differences were noted between pump owners and non pump owners.

Results from the dry season survey indicated that wheat was most often planted by the main river channel, (75% of the time) or beside a river-filled pond (22%). Sorghum fields were watered by the main river channel in 42% of the cases while 54% were planted in pond bottoms flooded by the river.[33] Ninety percent of Kobe rice fields were situated in pond bottoms while 69% of floating rice was planted in or beside the main river channel and 23% beside secondary river branches.

Conclusions

The only factor highlighted by this section which can be said to differentiate pump owners from non pump owners is that of the surface area cultivated by the two groups. Pump owners control over twice as much land as non pump owners.

Other points are interesting in that they describe the land situation in the project area; however, they shed no light on the characteristics of an innovative farmer.

Production Goods

This is an area in which there are substantial differences between pump owners and non pump owners. In general, POs as a group own more of practically every item mentioned on the questionnaire. When the numbers are converted to percentages, the results are even more startling. A few examples have been chosen to illustrate this point.

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[33]It is a question here of "decrue" sorghum, a variety planted as the water recedes which utilizes residual moisture.

Average Number of Articles Per Compound[34]

(1980-81 dry season)

	PO	NPO
"pirogue"	.2[35]	36
donkey	.4	.2
"daba"	5.0	1.9
granary	1.0	.2
woven grass sacs	4.6	3.6
radio/cassette player	.3	***
flashlight	1.0	.4

In every category, transportation, agricultural tools, storage facilities, and other, NPOs dispose of considerably fewer articles than POs which leads to the conclusion that their financial resources -- both in capital and income -- are substantially less than those of pump owners.

It is important to note that no improved implements other than pumps were used by sample farmers. A need may be created for such equipment as plows and seeders in the next few years as the surface area cultivated by individual farmers increases due to pump irrigation. At the present time, though, all farming techniques used by POs and NPOs are identical.

Storage facilities are quite basic. All but one pump owner in the sample had a granary while most non pump owners use a room in the house in which they store their grain. The grain is stored in mat sacs woven by the women of the compound and placed on the dirt floor. This avoids the expense of plastic or jute sacs which may cost as much as .500 MF a piece. Since

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[34]See Annex No. 12, Table No. 1

[35]Rounded to nearest one-tenth

[36]Less than 0.1

farmers have not experienced serious losses during storage, they are generally not interested in changing to more expensive methods of storing grain.

Farmers, both POs and NPOs were on the whole unwilling to disclose the number of grain sacs stored in their compounds. Not only did they fear what Action Ble might do with the information (resulting in increased taxes), but they were also concerned that their neighbors not find out because they would, so they said, immediately be besieged by people asking for hand-outs. In some cases, not even the women in the compound would know how much grain was stored, the amount needed daily for the family would be obtained by an older male from a locked granary. This reticence to communicate accurate figures may have caused an underestimation of grain sacs (i.e. stocks) by as much as 30%.

Regarding radio/cassette players, although the number of NPOs who own one is negligible at present, they are an article which confers status upon the owner. Many of the young men returning from rural exodus bring a radio as a gift for a family member. The distribution of this item should be monitored in order to provide some idea of the audience which could be reached by agricultural radio programs broadcast in Sonrai. There is already a potential for using this means of non-formal education with pump owners since one in three owns a radio/cassette player.

Two other points which differentiate POs from NPOs where production goods are concerned are the age of farm equipment, and the distance travelled by the farmer to purchase it.

Age of Farm Equipment[37]

Years since purchase:	PO	NPO
0-2	83%	66%
3-5	10%	21%

[37] Includes transportation, tools, and storage goods but does not include other items having agricultural uses. See Annex No. 12, Table No. 2.

Years since purchase:	PO	NPO
6-9	2%	6%
10+	7%	7%

P .- owners have purchased 17% more equipment in the last two years than non pump owners, and obtained or replaced 93% of their inventory with the last five years. Non pump owners have purchased 88% of their present tools within the last five years. This chart demonstrates that much of the equipment must be replaced at relatively short intervals, based on the NPO's expenses. Nevertheless, either the need to buy tools for a larger labor force or simply the availability of funds has encouraged pump owners to invest more heavily in farm equipment than non pump owners.

Another indicator of the availability of financial means is the distance a farmer travels to purchase agricultural tools or other items.

Distance Travelled to Purchase All Items[38]

(pump equipment excluded)

	PO	NPO
Villages	47.1%	56%
Long bush market	21.3%	21.3%
Dire	13.1%	13.4%
Mopti	6.1%	1.7%
Bamako	8.2%	7.1%
Other	4.1%	-

Non pump owners purchase 90.7% of their equipment in the Dire "Cercle" while only 81.5% of PO's farm implements are purchased locally. Though the majority of purchases are made within a 25 kilometer radius of the farm, pump owners buy almost 20% of their production goods in urban centers at least 400 kilometers away. Only nine percent of non pump owners manage to

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[38]See Annex No. 12, Table No. 3..

travel as far.

Conclusions

Based on the sheer numbers of articles in each category, one is easily led to conclude that pump owners dispose of much greater financial resources than do non pump owners. Their farm equipment is relatively newer than non pump owners, although most of it (over 80%) has been purchased or replaced within the last five years by both groups. Pump owners are able to travel farther than non pump owners to purchase their tools; however, 80% of both groups purchase their farm equipment either in a small village, at a large bush market or in Dire, all within a radius of 25 kilometers from their homes. Apart from the pumps, there is no difference in the type of agricultural implements used by pump owners and by non pump owners.

PRODUCTION DATA - 1980-81 WHEAT SEASON

Although diesel pumps have only been sold in the project area on a broad basis for the past two years, in 1980-81, 78%[39] of the sample wheat fields were pump irrigated. Due to the extremely low river level in 1980 -- a one hundred year low[40] -- an estimated 80% of non pump owners either did not seed at all, or abandoned their fields within the first two months. Despite two and even three random drawings of names, the final sample of non pump owners in most villages consisted of the few non pump owners in the village who continued to cultivate. Of these, 60% made some type of arrangement with pump owners to have their fields irrigated by pump. There were exceptionally few calabash farmers during the 1980-81 season. This situation emphasizes the crucial role pump irrigation has to play in agriculturally marginal regions such as the Dire "Cercle".

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[39]Includes pump irrigated fields of non pump owners.

[40]See chart of averages and graph, Annex No. 4, Tables No. 1 and 2.

Harvest data

The collection of this information was seriously affected by the financial and management problems which plagued the project. Only estimates can be offered here based on data which is scanty at best.

Production Results for 1980-81 Wheat Season

	PO (extension div. results)	PO (stat. div.)	NPO
Total measured production	880300 kg.	4950 kg.	6141 kg.
Average production per hectage	2071 kg./ha.	732.2 kg./ha.	2013.4 kg./ha.
Estimated total production for sample	20.9 tons[41]	7.4 tons	2.5 tons

The actual production per hectare for pump owners is probably lower than the extension division estimate,[42] but closer to 2,000 kg./ha. than the 732.2 kg./ha. proposed by the statistics division. Because of the more intensive cultivation of the NPO's fields, they have a higher productivity per hectare than PO's fields which cover a greater surface area.

Agricultural Expenditures and Receipts[43]

Nineteen pump owners spent a total of 1.046.285 MF for seed, hired labor, fungicide, chemical fertilizer and tractor plowing. Twenty non pump owners spent 585.975 MF for the same inputs (minus tractor plowing). Before adding any pump related costs, the pump owners' investment in farming is already 60% greater than that of non pump owners.

The investment in pump irrigation can be broken down as follows:

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[41]Metric tons - 1,000 kg. or 2,200 lbs.

[42]Extension service data tends to be overestimated.

[43]See Crop Budgets A & B pp. 18-19 in Annex 1 to the Action Ble project paper.

Irrigation Related Expenditures - Totals

	PO[19]	Associated Farmers[10]
Pump equipment	3,438,270 MF	490,000 MF[44]
Operating costs[45]	1,927,825 MF	439,720 MF
Total	5,366,095 MF	929,720 MF

Average investments for each group are[46]:

Calabash farmers	29,300 MF
Associated farmers	92,970 MF
Pump owners	337,495 MF

Pump owners are investing 11.5 times what "celebasse" farmers spend on their crops; associated farmers spend 3.2 times as much. Do their returns justify their expenditures?

Taking an average of Bourem wheat prices over the 1980-81 year,[47] the following equations show the profitability of the crop for the non pump

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[44]An estimate derived from dividing the total pump payment (175.000 MF) by the average number of hectares cultivated (2.5) and multiplying by the average field size of associated farmers (.7 ha.) multiplied by the number of associated farmers (10). Pump owners did simpler calculations, usually dividing costs by the number of farmers with some attention paid to surface area irrigated by each (e.g. if four farmers shared the pump and cultivated 2 ha., 1 ha., and 1 ha., their respective shares in the costs would be 87,500 MF, 43,750 MF and 43,750 MF, plus fuel).

[45]These figures are underestimated because farmers refused to communicate the amount of diesel fuel purchased from private merchants.

[46]See Annex No. 13, Table No. 1.

[47]The high was ,235 MF, the low ,165 MF, and the average ,215 MF.

owning farmers.

"Calebassiers" 2013.4 kg./ha. x .215 MF x .5 ha.[48] = 216,440 MF

Associates 2013.4 kg./ha. x .215 MF x .7 ha.= 303,015 MF

The net profit for "calebassiers" is thus 187,140 MF and 210,045 MF for associated farmers. Calabash farmers have increased their investment sevenfold while associated farmers have earned almost two and a half times what they spent. These are both respectable rates of return although it is important to note that the cost of the farmer's own labor and that of his family members has not been included in this equation. If this hidden cost were included, the new totals would be considerably less.

	Cost	Profit
"Calebassiers"	120,900 MF[49]	95,540 MF
Associated Farmers	178,615 MF	124,400 MF

When family labor costs are considered, there is little advantage to being an associated farmer.

The cost-benefit ratio for pump owners will be shown at three different production levels to give a more realistic view of their harvest. A reasonable estimate of average production is 1,500 kg./ha.

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[48]This figure is slightly overestimated in the sample. It is closer to .3 ha. which would mean a gross profit of 129,865 MF or 100,565 MF net profit for calabash farmers.

[49]For .5 ha., "calebassiers" worked 183.2 person/days. Associated farmers' work days were included in the general NPO calculation for person/days worked. An estimation for their labor time has been obtained by averaging the person/days worked per hectare for POs and NPOs (244.7) and multiplying by .7 ha. The minimum wage of .500 MF per day is used in these calculations. See Person/Days Worked, Annex No. 14, Table No. 1.

732.2 kg/ha. x ,215 MF x 2.5 ha. = 393,560 MF

1,500 kg./ha. x ,215 MF x 2.5 ha. = 806,250 MF

2,071 kg./ha. x ,215 MF x 2.5 ha. = 1,113,160 MF

If the costs are then subtracted, the profits at each level of production are as follows:

For 2.5 ha.:	Profit A (in MF) (excluding cost of family labor)	Profit B[50] (in MF) (including cost of family labor)
732.2 kg./ha.	56,065	97,685
1,500 kg./ha.	468,755	315,005
2,071 kg./ha.	775,665	621,915

It is evident from these figures that a harvest of 732.2 kg. per hectare is not profitable, given the expenses, particularly if the value of family labor is taken into consideration. Even a harvest of 1,000 kg./ha.[51] which seems to be reasonably profitable when excluding the cost of family labor (200,005 MF) is hardly so when it is included (46,255 MF). A minimum production figure of 1,500 kg./ha. on a surface area of 2.5 hectares assures a reasonable profit at an average price of 0,215 MF/kg.

If farmers were to cultivate four hectares per pump as planned in the project paper, the results would be the following:

Cost-Benefit Ratio for 4 Hectares[52] (in MF)

	Gross Profit	Profit A	Profit B
732.2 kg./ha.	629,690	183,865	-72,335

[50] POs worked 307.5 person/days on 2.5 hectares.

[51] 1,000 kg./ha. x .215 MF x 2.5 ha. = 537,500 MF.

[52] Average price is maintained at ,215 MF/kg.; operating costs have been increased to 270,825 for 4 ha., the pump payment remains the same for a total of 445,825 MF. Labor costs are increased to 256,200 MF.

	Gross Profit	Profit A	Profit B
1,500 kg./ha.	1,290,000	844,175	587,975
2,071 kg./ha.	1,781,060	1,335,235	1,079,035

Before the arrival of the diesel pumps, farmers did not pay much attention to their production costs. Most farmers saved their seed from one year to the next, paid any hired laborers in food or kind, and met their other needs through various arrangements with their neighbors. If they sold their wheat for 216,440 MF, they had earned a lot of money.

The expenses associated with owning a pump have forced farmers to begin to think differently. Although they do not yet add up all their costs (particularly those paid in kind rather than in currency), they do know that they need to harvest enough grain to make the payment on their pump and pay for fuel and other related costs. They can then determine if they have a lot left over or not as much as they would like. To most area farmers, 468,755 MF is a great deal of money to have remaining after credits have been repaid. It will be interesting to note in the future whether pump owners attempt to increase their hectarage, or remain satisfied with the sums they are presently earning on 2.4 hectares.

As more money begins to circulate in the project area, it is likely that payment for services will be demanded more frequently in currency than in kind; however, if grain shortages remain acute, people may prefer to maintain grain stocks for the day when grain is so scarce, money can't buy it.

Associated farmers are enabled to cultivate a larger surface area than calabash farmers through the aid of pump irrigation, but their costs are so high that the benefit from additional production is lost. In effect, they are paying pump owners an exceedingly high rent for the use of their pump. Not only do they pay for operating costs, but they share in the pump principal as well. The pump owner makes out quite well, but associated farmers earn

very little profit. The major advantage this year was being able to remain in the Dire region and farm, rather than be forced into exodus because of the low river level.

Person/Days Worked

One of the most dramatic effects of pump irrigation is the reduction in work time as compared with calabash irrigation.[53] A pump owner's field of 2.5 hectares required an average of 378.1 person/days from ground preparation through stocking the grain in the granary; non pump owners spent 241.8 person/days for their .5 ha. fields. When these results are converted to a per hectare rate, the difference is even more pronounced:

Pump owners	157.5 person/days per hectare
Non pump owners	483.6 person/days per hectare

The non pump owner spends three times as much time producing his wheat as the pumpowner. What factors other than pump irrigation could explain this great difference?

The time required to walk to the fields is not a possible explanation because it has already been established that NPOs' fields are closer to the village than POs' fields.[54]

The laborers in an NPO's field may be less productive than a PO's workers for a variety of reasons: 1. the compound head is older than his PO counterpart and his physical abilities may be declining; 2. given that they have less land to cultivate, they may work slower than POPs who have five times as much land to prepare in the same span of time; and 3. POs hire women to thresh and

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[53]See full table divided by in Annex No. 14, Table No. 1.

[54]See discussion of Field Distance from Village p. 29.

winnow their wheat who are paid 3.2 kilos of grain forevery 30 to 40 they process. NPOs' grain is more often threshed by women in the family. Since they are not paid, it is natural that they would work slower.

The construction of irrigation canals is a much more arduous and time-consuming task for non pump owners than for pump owners. The latter need only construct shallow (5 to 10 cm. deep) troughs to lead the water from the crown of the hill where the pump has lifted it to the fields. In contrast, farmers irrigating by calabash, must dig canals to their fields, frequently as deep as two meters by a meter wide and as long as 300 to 500 meters. The time spent on this activity by individuals depends on the number of cooperating farmers; it can easily take a month.

Four pump owners paid a tractor to plow their fields, but this was not averaged into PO labor time, thus does not account for fewer person/days in this category.

The number of days spent guarding the fields was practically identical, in fact POFs spent an average of four days more.

The NPOFs are noted as having spent nine times the amount of time needed by POFs to harvest their crop. Tours of the area at harvest time indicated that NPOs would have higher yields per hectare than POs, but the larger surface area cultivated by POs would mean that their total production would be greater than non pump owners. The production per hectare, then, could not be said to have necessitated more time spent by NPOs to harvest their crops than POs.

An important consideration which must be discussed here is interviewer error. In several cases this was corrected when discovered, but it is likely that some error exists in the final results. Both for harvesting and fertilizing, some interviewers recorded the entire time period over which the task had been

accomplished, rather than the actual time spent in the activity itself. In this instance, the margin of error should be considered to be 15%.[55]

The various reasons cited above which might explain the difference in person/days worked by pump owners and non pump owners can be accepted as contributing factors, but the central explanation is undoubtedly the reduction in work time afforded by pump irrigation.

Production Constraints

Various events occurring over the course of the cropping season may seriously reduce production. These may be due either to natural forces or controlled by man.

By far the most commonly mentioned problem[56] was the inadequate supply of water. Farmers who had chosen not to cultivate in 1979-80 cited this reason in 44% of all responses. A large number of non pump owners did not farm the 1980-81 season due to the low river level at planting time, and most of the sample farmers when asked whether they would cultivate next year s answered that it would depend on the water supply.

For the pump owners cultivating this year, the incompentence of the Action Ble staff constituted by far their most serious constraint on production. The failure to provide promised seed, lateness in obtaining cutting permits, insufficient quantities of motor oil and diesel fuel delivered at planting time reduced hectarage planted by an estimated 30% and delayed planting by as much as two months in some villages. Further, a diesel fuel shortage at the critical

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[55]The fertilizing data was discarded for this reason. An estimate 6f 7 days per hectare was applied to both samples which were then calculated according to surface area.

[56]See Annex No. 8, Table No. 4.

moment of wheat maturity (the milky stage) threatened the fecundity and nutritional quality of the developing seed, at the same time reducing the total production of those farmers unable to obtain fuel from other sources. Although the latter group was a relatively small percentage of the total,[57] the anger and profound distrust of Action Ble which developed during this period may plague extension activities for many years to come.

Crop Damage

What kinds of diseases and animal pests reduce wheat production?

Little or no disease in wheat fields has been noted, although "charbon" or smut is a prevalent disease of barley, according to area farmers.

The most serious threat to wheat culture was felt by 55% of sample farmers to be posed by birds. Although an OCLALAV noise machine has been tried in the area, it has proven to be ineffective. Posting family members in the wheat fields for one to two months as harvest time approaches is the method used by all area farmers.

Second in importance was damage caused by domestic animals wandering into the fields and trampling or eating the young shoots. Seventeen percent of the respondants cited this reason. When asked why they didn't build fences around their fields they replied that they were unable to obtain cutting permits from "Eaux et Forets."

Rodents were considered by 14% of the farmers to be a major problem, while insects and lack of water were each cited by 7% of the sample. Although they were not mentioned by many farmers to be of particular concern wild pigs ("phacochere") also cause damage in unfenced fields.

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[57] All pump owners complained about the shortage but only an estimated 10 to 15% experienced as much as 25% losses (based on observation).

For the present time since disease does not appear to be a major problem, basic measures could be taken such as obtaining cutting permits to allow farmers to fence their fields and introducing a more effective method of bird control.

Traditional Farming Techniques

With the exception of the length of time fields are left in fallow, there is no significant difference in the traditional farming techniques used by pump owners and non pump owners.[58] Because of their larger landholdings, pump owners can leave their fields in fallow longer while NPOs are obliged to farm their land more intensively.

The decision to weed or fertilize a field is more an individual preference than a group characteristic. Fields which are situated near a migratory path of cattle will receive more manure than those which are not, a question more of location than a conscious choice on the part of the farmer.

Wheat is seeded by the broadcast method and usually watered the same day for the first time.[59] The force of the water entering the "cuvette" inevitably pushes the seed to the far corner of the plot augmenting the plant density there while leaving the area nearest the irrigation gate almost bare. To compensate for this effect, pockets of seed are planted in the raised edges of the plots and transplanted after a month to fill in the bare spots.

It will be important to follow the rates of adoption of improved techniques for the two groups. An interesting case in point is the decision taken by four pump owners to have their fields plowed by tractor. This choice

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[58] See Annex No. 8, Table No. 6.

[59] This is why the person/days worked for these activities are combined.

could be a result of either available funds or a growing appreciation of the value of machines, both of which may have been influenced by the Action Ble project.[60]

Improved Techniques

Action Ble classifies "planting date" as an improved technique although most farmers know when the ideal planting date is (between 15 October and 15 November). If they do not plant at this time, it is due to other causes — field preparation incomplete due to late sorghum harvest, inadequate seed supply, etc.

Several tons of chemical fertilizer were stocked at the Action Ble office, but little was distributed during the 1980-81 wheat season. Less than a ton[61] was transported to the Dangha Sector, and that much only because of the direct intervention of the sector chief.

In terms of insecticides, both HCH and DDT are available in Diré, but not widely used on crops by either PDs or MPDs. Nothing about the hazards or cautions which should be observed while using them is known by farmers, and little or nothing by ADO extension agents.

No farmers were observed draining their fields. Due to the high clay content of the soil, water often stands in the wheat fields as long as three days. Although no serious problems with straw rot have been reported (it is likely the local varieties have adapted to this condition) the threat is gone to the crop remains and should be monitored.

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[60]At the same time, relying on a tractor increases farmers' dependence on factors outside their control: fuel prices, availability of spare parts (the I.F.E.G. Tractor is a German model for which all spare parts must be imported) etc.

[61]Metric Ton.

Apart from the four farmers mentioned in the sections on Agricultural Expenditures and Tradditional Farming Techniques who hired a tractor to plow their fields, and the use of pump irrigation, no other improved agricultural techniques are used by sample farmers in the project area.

Despite the five years Action Ble has been in existence, most farmers, when asked why they did not use improved techniques replied that they did not know of any. This situation does not recommend the effectiveness of the ABO extension service. It is to be assumed that the model farmers ("paysans pilotes") who theoretically work closely with the extension agents have at least heard about various improved techniques, even though the data shows they have not adopted any.

Due to the inadequate data supplied for non pump owners in this table, rainy season figures will be substituted in order to provide a contrast with the information for pump owners.

Reasons Improved Techniques Not Used[62]

	PO	Rainy Season
Don't know any	43%	83%
Don't find them advantageous	-	-
Don't understand them	26%	8%
None are available	9%	10%
Too expensive	22%	-
Other	-	-

Only 31% of the pump owners gave an answer which definitely indicates that they know what improved techniques are. Twenty-six percent claimed they didn't understand them which either means that they were poorly explained, or

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[62]See Annex Nos. 8, 9, 10, 11, Table No. 7.

that the farmers didn't understand the question being asked, i.e., they don't know what improved techniques are. Forty-three percent stated plainly that they were unfamiliar with any improved methods of farming, other than pump irrigation. Sixty-nine percent of the POs with whom the extension agents spent most of their time over the past two years declared that they either did not know or did not understand any improved techniques and 83% of non pump owners[63] made the same statement. Not only is one forced to conclude that the ABD extension service is not effective in communicating with model farmers, but also that the dissemination of this information to other groups has not occurred as described by the "paysan pilote" method.

It is not to be expected that all farmers can be reached by the Action Ble Extension Program within the first two years; however, if no shift is observed in the reasons given for not using improved techniques (e.g. from "don't know any" to "none are available") over the next few years, the choice of extension method should be reevaluated.

Uses of Wheat Straw

Not only does wheat provide the Sonrai with an important food and cash crop, but the straw is also used to manufacture various household items and may be an important food supplement to village livestock.

Although pump owners grow more wheat and thus produce more straw, non pump owning families make much greater use of it. This situation could be a result of having less money available to buy these items from someone else, or that the NPOPs are exploiting the economic potential therein.

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[63]The rainy season sample was composed entirely of non pump owners.

	POF	NPOF
Matmaking	10%	29%
Mud bricks	3%	-
Manufacture of Household Items[64]	-	21%
Grazing	3%	33%
Other	-	-
None	84%	17%

It is likely that more fields are grazed than those noted above, but neither POs nor NPOs noted this for their own animals. Either they did not consider village animals grazing in harvested wheat fields a "use" of the straw in the same sense as weaving mats of it, or they chose to cache the existence of their herds. Only one farmer noted that he transported wheat straw back to the compound to feed to his animals.

What is particularly striking about these figures is that 50% of NPOFs utilize their wheat straw to construct various household items while only 13% of POFs do so. Most pump owners, 84%, ignore the economic value of their wheat straw.

Women's Agricultural Contribution

In comparison with the Bambara, Sonrai women contribute very little to agriculture. In the Segou Region, it is common to see Bambara women working alongside men in the fields throughout the rainy season, whereas in the Sixth Region, one rarely sees women in the fields except at harvest time. A Bambara woman may tend a small vegetable garden to provide ingredients for her sauces as well as selling vegetables in the market to earn some money for herself. In contrast, there are few vegetable gardens in the north and most are cultivated

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[64]Such as baskets, mattresses, etc. See Annex No. 8, Table No. 8.

by men. This being the case, what contribution do Sonrai women make to the production of wheat?

Agricultural Activities Performed by Women[65]
(POFs and NPOFs combined)

Seeding	29.6%
Transplanting	1.9%
Thinning	1.9%
Guarding	3.7%
Harvesting	3.7%
Threshing	29.6%
Winnowing	29.6%

Thus of all the functions performed by women, seeding, threshing and winnowing are the most important, accounting for almost 90% of their agricultural participation. At seeding time, the entire surface area of the fields must be planted in a short period of time so that the wheat ripens as early as possible (while there is adequate water and before the main onslaught of birds). This means that every available hand may be called in to help. The techniques used to thresh and winnow grain closely resemble those of routine food preparation which explains why these activities are traditionally considered "women's work".

There is no significant difference between POFs and NPOFs in the jobs women are expected to perform; however, 42.9% of pump owners paid non family members to accomplish them while only 25% of NPOs could afford to hire outside women.

Conclusions

Pump owners' average production was estimated at 1,500 kg./ha. while non pump owners harvested 2013.4 kg./ha., on the average. Before adding pump

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[65]See Annex No. 15, Table No. 1.

related costs, pump owners' investment in t eir fields was 60% greater than that of non pump owners. The net profit for calabash farmers (excluding the value of family labor) was estimated at 187,140 MF, for non pump owners who arranged to have their fields irrigated by pump, 178,700 MF and for pump owners, 468,755 MF. If the cost of family labor is considered, the relative profits are 95,540 MF for "calebassiers", 92,150 MF for associated farmers, and 315,005 MF for pump owners. It is obvious from these figures that a farmer who associates with a pump owner is earning only one third as much, and possibly even less than a calabash farmer. The advantage is that in a year such as this one when the river level is quite low, he may stay in the area and cultivate, rather than being forced into exodus like so many calabash farmers were. Pump owners, on the other hand, are finding the experiment quite profitable. If they were to cultivate 4 hectares as planned in the Action Ble project paper, they would earn (labor costs included) 587,917 MF. The arrival of the pumps and the fixed costs associated with them have encouraged farmers to begin thinking about the costs involved in wheat cultivation.

Pump irrigation has resulted in a drastic reduction of person/days needed to produce a crop of wheat. The data showed 151.2 p/d per hectare for pump owners and 483.6 p/d per ha. for non pump owners.

The natural obstacle farmers face in the project area is the adequacy of the water supply. The most serious problem in the 1980-81 wheat season was the incompetence of the Action Ble staff.

Birds are the most serious pests, accounting for field losses of 30% in severe cases. They are chased from the fields by women and children who generally guard the fields for two weeks to a month preceding the harvest.

Traditional farming techniques used are: knowledge of the seeding date, calabash irrigation, spreading of organic fertilizer, and transplanting (kobe rice).

Improved techniques apart from pump irrigation are not widely known. There is some familiarity with insecticides and chemical fertilizer, but it is rare. Four pump owners hired a tractor to plow their wheat fields this year.

When asked why they did not employ improved techniques (other than pump irrigation), 69% of POs replied that they either were not familiar with any or did not understand them while 83% of NPOs gave the same response. This situation does not recommend the effectiveness of the Action Ble extension service.

Although wheat straw is adapted to the manufacturing of household items, only 50% of NPOs said they used the straw while 84% of POs made no use at all of the straw.

Sonrai women do not play a large role in the cultivation of wheat. They participate only at seeding time and to thresh and winnow the grain after it has been harvested. If possible, non family members are hired to do this chore: 42.9% of pump owners hired outside women in 1981 while only 25% of non pump owners could afford to do the same.

Market Survey

Goals

The market survey[66] was designed with three aims in mind: first, to chart baseline prices of various commodities in order to allow future comparisons

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[66]Official prices are controlled in the Dire outlet of "Somiex" and grain stocks distributed through "OPAM"; however, since supplies of staples sent to Dire are either inadequate, purchased immediately by merchants and resold at higher prices, or reserved for government employees, most farmers do not benefit from these institutions. Therefore, the following discussion refers to the black market or "marche parallel".

to be drawn; second, to determine seasonal price fluctuations which will allow the identification of any effect on market prices due to the project; finally, to determine an approximate rate of inflation.

Method

It was planned to conduct the survey in seven markets of varying importance: Timbuktu and Dire representing the towns, Bourem, Dangha and Kirchamba are major bush markets, and Tyesson and Katua are small village markets. An interviewer was assigned to each market to collect price information every 15 days at the weekly markets. They were then expected to maintain a graph of each food type: cereal grains, oils, meat and other protein sources, vegetables, seasonings, energy needs, food prepared for market day (fritters, etc.), snacks, luxury goods, personal items, and animals on the hoof.

Problems

This survey progressed well through the 1980 rainy season but started on its decline in September. The interviewer who had been posted in Timbuktu solely for the market survey quit because several of the merchants he had interviewed complained to his family that he was a spy.[67] In October, all the interviewers were notified that the market survey would be taken over by an interviewer assigned to do only that, starting in November. As soon as funds were obtained, he would begin his weeklong tours of four village markets. In February, when funds still had not been made available to the statistics division to assure his transportation, the other interviewers were asked to begin collecting market data again. By this time, there was no money left to pay for

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[67]He was the only interviewer assigned to his natal village in an effort to prevent exactly this type of intervention by the family.

transportation for those interviewers who needed to cross a river branch to reach the market, nor for those who were obliged to purchase various items before the vendor would disclose their price. No gasoline was made available to the supervisor so that he could make his weekly rounds during this time.

Given these circumstances, it is not surprising that only three markets were followed with any continuity, Bourem, Tyesson and Dire. These three locations still provide prices for a town, a large bush market, and a small village market.[68]

Market Trends

Despite the problems encountered during the course of this survey, some interesting trends were illuminated.

Manufactured goods imported from south of the Mopti delta become increasingly expensive the further into the bush one travels, thus a charge for transportation is added on to the merchandise as well as a profit margin.

Items produced in the villages or entering Dire from the north (milk, salt) are less expensive in the bush markets than in the town of Dire.

There is a general inflationary trend, but some items are more affected than others. Notable price increases were seen for such items as sugar, which rose 26.6% in Tyessou from June 1980 to March 1981, salt and coffee which both rose 18% over the year, and kerosene which rose 33.6% over a years time. The prices of food items produced in the area vary principally according to seasonal availability, although residents have noted a definite upward trend over the last few years.

The grain market acts much like any free market system. Grain prices are highest at planting time when demand is high and seed stocks are low. They decline gradually over the wheat season and drop abruptly when grain floods

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[68] See Annex No. , Table No. .

the market at harvest time. Prices are depressed for a few months after harvest due to easy availability, then as stocks are depleted, the price rises gradually until planting time when it increases sharply and remains high for approximately two months.

Conclusions

Apart from these brief generalizations, few definite conclusions may be drawn from the data collected by the market survey, due to its incompleteness. Nonetheless, it should provide planners with a general idea of price ranges for various commodities found in the area and an indication of the nature of the grain market.

PART III - PROBLEMS ENCOUNTERED

This section attempts to explain why the results achieved were different from those anticipated. First, the personnel at all levels was not adequately trained or motivated. Secondly, the means were not available either to organize an efficient office, nor to maintain effective interviewers in the field. Finally, decisions affecting the conduct of the survey were taken by an uninterested direction rather than the researcher who was, in theory, responsible for the quality of the results.

The problems encountered fall under four main headings: 1. Administrative Support; 2. Research Division Personnel; 3. Cooperation with the Extension Service and 4. Computer Tabulation of Results. Recommendations will be discussed in Part IV.

1. ADMINISTRATIVE SUPPORT

The lack of administrative support from Action Ble Dire was directly responsible for the loss of labor data in six villages, the ending of market data in November 1980 and a general reduction inthe accuracy and completeness of the remaining information which was analyzed for this report. The missing

items were all so basic it is difficult to prioritize them; however they may all be classified under "lack of financial committment".

The research division was allotted 350,000 MF (U.S. $700.00) to conduct 11 different surveys over a period of 13 months. Adequately maintaining ten people in the field (over this time period on such a limited funds was impossible.[69]

Operating Funds

The day to day functioning of all divisions was hapered in the long-run by a lack of money budgeted for specific purposes and in the short-term by the absence of petty cash funds. Whenever division chiefs required small sums of money as little as 500 MF, they were obliged to ask the director. It was impossible to plan expenditures; items were purchased on a piecemeal basis. Not only was this situation demoralizing to the division heads, but it also undermined their authority with the agents who, after a time, never discussed problems with their hierarchical chief before going in to talk to the director. No funds were set aside for expenses incurred during the director's absence which effectively paralyzed ABD opertions until his return. The use of repaid pump credits to assure the functioning of the ZERs was the only factor that prevented the total collapse of the extension service during the 1980-81 wheat season. Normal operation of the statistics division depended on the disbursement of the USAID contractor's personal funds.

After September 1980, no more funds were distributed to the research division by the direction of ABD. By economizing, a training program was conducted in October for the wheat season questionnaires, but supplies were paid for out of the researcher's pocket. No more funds were available for

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[69]See division budget in Annex No. 18, Table Nos. 1 and 2.

the continuation of the market survey nor for transportation for interviewers who needed to cross the river to reach farmers' fields. Neither gasoline nor money to purchase it locally was available to enable the supervisor to conduct his weekly control visits. Monthly reunions of the interviewers were stopped for lack of funds.

Payment of Personnel

Salary payments were one month late from April through June 1980; two months late through October, and at the present writing in May 1981 the interviewers have not been paid for the past six months.

In June, 1980 the research division drew up pay sheets for the interviewers and suggested that research personnel could assure the accounting duties for that division. Despite the fact that the Action Ble accountant was frequently absent, this suggestion was refused.

In September and December, letters were written to the direction pointing out the effect that late payments could have on the quality of the data and urging that back salaries be paid as soon as possible.[70]

This factor alone has seriously compromised the quality of data collected at Action Ble Dire. Interviewing is a tiring job which must be adequately compensated if interviewers are to be motivated enough to do the work. Since they were hired by the issuance of a "Note de Service", their salary was determined by the GRM pay scale for civil servants. Action Ble interviewers received 27,270 MF per month from which 5,270 was subtracted monthly to repay bicycle loans. If in addition to receiving a relatively low salary for the work they were expected to do, interviewers were not paid regularly, it should not have been surprising that motivation decreased and carelessnes increased after a time.

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[70] See Annex No. 3, Letters No. 1 and No. 2.

Office Space and Equipment

Although the research arrived in Dire in December 1979, office space was not made available until June 1980, and then only in a makeshift manner. Equipment such as a desk with locking drawers, a typewriter, and desk top calculator were requested in writing in February 1980 and never received.

Pocket calculators were purchased for the research division in June, but all division typing was done on the researcher's personal typewriter or in Bamako by USAID secretaries.

Action Ble Dire Secretaries

The secretaries did not work under ideal conditions. The main office was dirty and dusty, buzzing with flies and incessant coming and going of people. During the hot season, the office was stifling by 10 a.m. During the cold season the windows were kept shut to keep out the wind and people worked in virtual darkness. Entering the office at midday, it was literally impossible to recognize people until one's eyes had adjusted to the dark. Frequent shortages of typing supplies, the lack of any type of corrector, the inadequacy and disorder of filing facilities all led to the careless attitude soon held by the Action Ble secretaries about their work. It was to their credit then, that they accomplished any work at all.

By June 1980, because of the amount of typing requested and insistence on accuracy, the Action Ble secretaries refused to do anymore typing for the research division. From that time on all the typing was done by the researcher herself or by the secretaries at AID/Bamako. It was equally necessary to do all the reproduction of survey forms without the aid of the ABD secretaries as they refused to learn how to operate the stencil machine. If it hadn't been for the reproduction services of AID/Bamako, the 1980-81 wheat season survey could never have started on time.

Transportation

When the order for an International Harvestor Scout which was to provide transportation for the contractor was cancelled by AID, an oral agreement was reached between the USAID Project Manager and the Malian Project Director to reserve a project vehicle for the needs of the research division. This arrangement proved satisfactory until the other AID vehicles broke down and the vehicle in question was needed for the general operation of the Action. At first, the loss of the Toyota was not seen as a serious obstacle to the continuation of the survey since two Honda 100s had been ordered in February to assure supervision in the project zone during the flood season. When the Hondas were requested, emphasis was placed on the mileage the survey supervisors would be required to cover in order to adequately control the interviewers. Despite this consideration, the cheapest model of mobylette was purchased and the research division informed that it would be sufficient for the purposes of the survey. No spare parts for this model were available in Dire - even inner tubes had to be purchased in Bamako. In addition, when the researcher returned from vacation in September, she was informed that the second mobylette had been given to the Sector Chief of Bourem because his needs were considered more pressing than those of the research division.

Thus, the Toyota pick up and Action Ble "pirogues" became the only means of transporation available to the contractor from September 1980 on. This presented several difficulties: first, that only the first 12 kilometers of the project area were accessible to 4-wheel vehicles during the flood season (15 October through 15 March) which corresponds with the wheat season; secondly, the only functioning project vehicle did not have a battery and therefore could only drop people off, it could not wait for the return as it needed a push from another vehicle to restart. (The Action Ble Landcruiser ran smoothly, but on gasoline which was not available); finally, since the outboard motors

ordered by USAID still had not arrived by February 1981, the "pirogues" were poled by employees of Action Ble. Like other ABD employees, they had not been paid for several months but unlike them in one respect, they would not work without a minimum of payment. Although the effort needed to propel these boats was obvious and the "piroguiers" claim valid, for divisions which had no operating funds, finding the necessary cash to pay for a boat trip in order to continue normal operations was not easy.

The researcher made the last two field trips on foot over a distance of 70 kilometers.[71]

Bicycles arrived at the same time as the mobylettes in order to provide transportation to the interviewers. The ABD chauffeurs were requested to mount the bicycles which they did incorrectly on purpose. Within a week, pedals were broken on 8 out of 10 bikes and had to be soldered back on at cost to the individuals.

In Dire, spare parts cost 2 or 3 times the price in Bamako. In order to reduce the cost to theinterviewers, a list of "most needed" spare parts was made up (as well as one for the BBCT mobylette) and communicated to the direction so that they could be purchased in Bamako and resold to the interviewers at cost. No action was taken.

2. RESEARCH DIVISION STAFF

There were two possible approaches to data collection at Action Ble Dire: one was as an independent researcher; the second was working in conjunction with the existing research division. The latter alternative was chosen as it promised to benefit the research staff more than would an outside survey unconnected to Action Ble.

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[71] See Annex No. 17.1.

Division Chief

The head of the "Division de la Recherche, agricole des Etudes, et de la Statistique", proposed the design of the pretest questionnaire based on survey material available in Dire. He initiated the interviewer based on survey material available in Dire. He initiated the interviewer training program and went on frequent "tournees" during the rainy season to check on the interviewers and the survey supervisor. He also participated in the second training session, held in October, although since then his motivation has been diminished by late salary payments and the lack of gasoline for bush travel by mobylette. Mr. Samba Guindo's primary interest is in agronomic research.

Socio-economic Survey Supervisor

Mr. Abdoulaye Sissoko was assigned the job of socio-economic survey supervisor by the direction of Action Ble. Very cooperative, he attended the training program designed for the interviewers and educated a few classes in geometry. He willingly moved out to Bourem and was prepared to spend most of his time on a mobylette travelling from one interviewer's village to the next. He began learning Sonrai. Only one critical observation can be made about his work: after a year of working closely with the researcher on the survey, he is still unable to identify mistakes on the questionnaires.

Inquiries were made in November to the Center for Economic and Sociological Studies in Bobo-Diolasso and IER regarding training workshops, but the program in Bobo-Dialasso was designed to train rural animators in Community Development and IER had none planned in the immediate future.

Interviewers

The training division selected the candidates who were eligible for the preliminary aptitude test given at the start of the interviewer training program. Those candidates who had passed their DEF (signifies completion of the

9th grade) were discouraged from applying, those who had failed, encouraged. It was felt that the successful students would leave Action Ble in the fall when school started again. Girls were not allowed to take the entrance exam, being told that the work would be strictly male-oriented. (It was at this time that the health/nutrition survey was postponed since female interviewers had been specifically requested). The announcement for the "concours" was posted in Dire a few days before the examination was to take place, but not publicized in the surrounding villages which would have allowed young people to apply who were more sympathetic to farmers and their problems than "city kids".

Of eleven interviewers who were hired, only three have shown themselves to be capable of producing accurate and complete data.[72] The others either did not have a literacy level sufficient to the task, or did not understand the instructions, or decided that since the supervision was somewhat lax they could easily make up data without being detected.

The amount of supervision which the interviewers would require was underestimated, but the situation was exacerbated by the lack of fuel for the supervisor's mobylette.

Coordination Among Research Division Personnel

Despite frequent meetings and discussions with the division chief and survey supervisor, misunderstandings about the method to be used in filling out the survey forms were common. Interviewers complained that each time a different supervisor would review their questionnaires, they would be given different instructions. This resulted in a great deal of confusion and unnecessary work for the interviewers. Each time the problem was brought to the researcher's

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[72]Oumar Sicko of Bourem, Cheick Sallah Coulibaly of Hara Hara I, and Aboubacrine Hamidou of Tyesson Koreye.

attention, she would call a meeting and review the correct method with the other staff members. The situation was much improved in the wheat season after the experience gained in the pretest, but didn't entirely end until a single individual was giving instructions to the interviewers: when the gasoline ran out only the contractor was willing to make field trips on foot.

3. COOPERATION WITH THE EXTENSION SERVICE

In July, the Sector Chief of Bourem elaborated a workbook for extension agents which was very similar to the questionnaires of the research division. It was agreed to substitute research division questionnaires for those areas in the workbook which were similar. In that way, the answers would be in a form which both divisions could use, and would avoid repeating the same questions if a pump owner happened to be in the sample of both interviewer and extension agent. In addition, collaboration of the two divisions on the survey was seen as a simple way of increasing the 1980-81 wheat season sample of pump owners.

All the members of the extension service, including the division head participated in the October training session for the wheat season questionnaires.[73] The research division furnished the extension agents with the necessary office supplies and the interviewers were instructed to share their field equipment with their counterparts, which most of them had been doing anyway. It was hoped that ZER chiefs, because of their increased familiarity with the aims of the survey gained through participation in the training session, would exert more pressure over the extension agents to complete and return their questionnaires than had been the case during the rainy season. In addition, interviewers were placed under the authority of the ZER chief and were required to obtain a letter of permission from the latter before they could leave their posts. This

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[73] See Annex No. 5.1.

was previously the area of most conflict between the interviewers and the ZER chiefs. The research division supervisor would be responsible for controlling the extension agents questionnaires at the same time that he visited the interviewers.[74]

In the end, the effort furnished by the extension agents depended to a large extent on the commitment of the ZER. Chief: the two ZERs having the best completion rates were Koura and Tyessou. In the other ZERs, there was never much commitment on either the part of the ZER chiefs or the extension agents. Despite the fact that the surveys were an integral part of an extension agent's job, they were not perceived as such by the cadres of the extension division. Before the training sessions, few extension agents understood the utility of the survey. Afterwards, they claimed to have understood but judging from their subsequent attitudes and cooperation it is questionable to what extent. Some made up answers, others demanded bicycles or "primes" before they would do the work. Only three out of sixteen extension agents turned in completed questionnaires. The staff of the extension division lost interest in the survey once the research division became involved, and did not encourage the extension agents to complete their questionnaires. It was forgotten that the idea that extension agents participate in the survey had originated with the extension division.

4. COMPUTER TABULATION OF SURVEY RESULTS

Working towards the goal of organizing the data collection effort so that it would be simple to continue after the departure of the USAID contractor, it was planned to hire a computer programmer analyst. He would design

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[74]The head of the research division requested a second survey supervisor from the direction. An agent was assigned for three days and then transferred to another division.

the questionnaires for easy keypunching, facilitate coordination between USAID, Action Ble Dire and the DNSI computer center (Direction Nationale de l'Informatique et de la Statistique) as well as designing a program which would tabulate frequencies and do cross tabulations on all the surveys which were being conducted in the field. This would eliminate the delays and reduce the costs involved in sending data to the U.S. for tabulation.

Several factors combined to prevent this plan from being realized. First, was the lack of genuine interest on the part of the direction of Action Ble. Secondly, the Fortran Compiler needed for the tabulation arrived late in-country and a backlog of work coupled with power and mechanical failures delayed DNSI's schedule to the point where it left insufficient time before the end of the researcher's contract to do the analysis. Third, the 1980-81 sample was greatly reduced due to the low river level which encouraged much out-migration of area farmers thus reducing the immediate need for computer tabulation and placing the emphasis of the program's contribution on surveys to be conducted in future years. In the course of discussions with the computer programmer, it became clear that the analysis of data could not be done by computer, only the tabulation of data, and that someone of Action Ble would have to be capable of analyzing the data even after the program had been set up. Given the present personnel, this did not appear likely, thus the main justification for the expense had been lost. Finally, the financial problems within Action Ble reached a crisis point and all further funding was suspended. Since neither the programmer's contract nor that with DNSI had been signed, no further action could be taken until the project status was changed. This did not occur before the termination of the researcher's contract.

PART IV - RECOMMENDATIONS

It is obvious that many of the problems outlined above were specific to the Action Ble project and may not reoccur; however, certain considerations may aid someone designing a similar type of socio-economic survey. Recommendations will touch on the following points: 1. Cooperation with Existing Structures vs. Researcher Control of Survey Inputs; 2. Personnel; and 3. In-country Computer Tabulation of Survey Results.

Cooperation with Existing Structures vs. Researcher Control of Survey Inputs

The intent in working closely with the research division at ABD was to improve the existing capability for collecting, processing and publishing survey results. This presupposed a certain foundation: educational background and experience of the staff, materials and funding for the day to day operations of the survey, and finally, interest and support of the direction in the conduct of the survey and publication of data and the uses made of it within the other divisions at Action Ble. None of these conditions obtained at ABD.

In theory, the connection between the research effort and Action Ble should have aided in allaying the farmers' suspicions about the uses to be made of the information collected. In fact, it was found early in the season that pump owners and farmers who wanted pumps were more cooperative with interviewers than non pump owners. Pump owners feared that if they didn't cooperate their pumps would be repossessed while those who wanted a pump thought that cooperation would assure them one. Farmers who received no benefits from Action Ble were not generally cooperative.

Later in the season, when the lack of diesel fuel was becoming serious, identification of the survey effort with Action Ble was a definite disadvantage. One interviewer was told by a farmer to "get the hell out of my field and don't come back until you bring some diesel fuel"! even after he had explained that his job responsibilities did not include procurement of diesel fuel.

Given the farmers' reasoning, if the project were successful, it would probably be an advantage for the survey to be connected with it vis-a-vis the farmer. Relating interviewers to people they know (extension agents) farmers would be less suspicious of interviewers than if they were an outside group with no local references.

In the case of Action Ble, the researcher depended on the project management for inputs and yet was responsible to USAID for the results. This was a highly frustrating situation as the survey could not be conducted in the way the researcher would have liked.

Before hiring a researcher, the USAID project management should decide whether a Malian agency is to control the inputs in which case the results should be acceptable only to them; or whether USAID is to judge the results in which case a contract should be signed between the researcher and USAID in which all necessary materials for the duration of the survey are provided directly to the individual. There should be a sole responsible agent for the conduct and outcome of the survey. It is important as well to obtain access to USAID office equipment and supplies, secretaries and reproduction services, specifically, in the contract signed by the researcher with USAID.

Personnel

It is difficult to build a qualified data collection unit when its members have had little or no previous experience with conducting surveys. It is virtually impossible if they lack the basic education, or the motivation to concentrate on the myriad of details which mean the difference between collecting useful data and wasting resources.

Interviewers

Interviewers should have successfully completed the 9th grade (have their D.E.F.). Ninth grade should be considered the minimum educational level acceptable, because those who failed the D.E.F., whether from lack of ability

or motivation; in general, experience serious difficulties reading and writing.

Interviewers who are over 30 years old are more likely to be accepted by the population than younger people, although a younger person who is respectful can develop a productive relationship with older villagers.

Interviewers should not be assigned to their home village. This creates unnecessary pressures on the individual and in the case of younger people prevents them from being taken seriously by people their parent's age who consider them only as children.

Interviewers should be placed by twos in the villages if possible. Growing up in large families, the Sonrai are not used to living alone. This suggestion was agreed to by all the Action Ble interviewers, even though they would be obligated to travel to other villages to collect data.

Interviewers should be adequately compensated for their efforts and the difficult conditions under which they live. The GRM pay scale applied to the interviewers by Action Ble allowed only 27,270 MF per month, from which 5,270 MF was deducted to repay their bicycle loans. A more consistent effort could be demanded, assuming they were paid regularly, if they were netting 10,000 MF to 40,000 MF per month.

Supervisors

The composition of the supervisory teams in the ongoing USAID Renewable Energy project shows great potential for success. Teams of two, an I.E.R. student and a Peace Corps Volunteer follow ten interviewers in a relatively small geographic area. Not only have the I.E.R. students two or three years background in survey taking goals and methods, but they, as well as the volunteers, have received specific training in controlling the Renewable Energy questionnaires. Thus the two team members complement each other in background and experience in addition to providing each other with moral and professional support - an intangible factor but one which can make all the difference.

Supervisors (at least one on each team) should speak the language of the area where the survey is being conducted.

Administrative Assistant

Another staff member who could facilitate the survey is an administrative assistant or "secretaire-comptable". The administrative assistant would assure that on-site typing for the division, as well as travel to Bamako to withdraw funds needed for salaries and operating costs, and to purchase supplies. This would reduce the time the researcher was obligated to spend away from the field.

Sociologist Counterpart

A Malian counterpart could share supervisory responsibilities with the researcher. She/he would have input into policy/methodology decisions to advise on cultural questions; however, the researcher would make the final decisions if she/he were responsible to USAID for the results. This arrangement would also reduce confusion in the instructions given out to interviewers. A trained Malian would have a better chance of continuing a well-organized survey, than an agricultural agent assigned to the job, but bearing little interest toward the work. It is equally more valuable to train a Malian in a successful survey, even though the original design is conceived by an expatriot expert, than to involve inexperienced people at every level which may threaten the eventual success of the survey. The person responsible for the outcome of the survey should have the sole responsibility for the choice of personnel at all levels.

Computer Programming

Mr. Trey Richardson, the proposed computer analyst/programmer for the ABD surveys, suggested that it would be economical for USAID/Bamako to purchase a standard SPSS program (Statistical Package for the Social Sciences) which runs most of the tabulations necessary for socio-economic research. If it were made available to all the USAID/Bamako projects, it could substantially

reduce computer costs and would encourage the computerization of all project material in Bamako.

Roger Simmons

ECONOMIC ASSESSMENT OF PUMP IRRIGATION

IN THE AED ZONE OF OPERATION

The purpose of the analysis was to determine the economic viability of pumps for irrigating wheat and sorghum as anticipated by project design.

There have been two USAID attempts to estimate the economic viability of pumps in the AED zone. One estimate appears in the AED project paper (see Annex I). A second study on economic viability was undertaken by a contractor as a part of an overall assessment of socio/economic constraints facing farm families in the zone (see Annex II). The contractor managed to obtain some good empirical data on wheat production using the AED pumps.

A question remains as to whether the farmers are economically better off with the pumps. This exercise examined the validity of the most critical assumptions necessary to analyzing pump irrigating profitability. Upon reviewing the previous economic analyses, the following assumptions about farmer inputs/outputs were considered to be most critical to determining long-run on-farm profitability of pump irrigation.

1) Probable life of pump
2) Quantity/cost of fuel
3) Total land irrigated (all season) i) for owner
   ii) rental
4) Cost of repairs/estimated down-time.
5) Yields
6) Quantity and cost of hired labor.

During conducting interviews it was decided that an assessment of farmer managerial capability would also be desirable.

A random sample of 22 pumps were selected from a total of 269 pumps placed in the sectors of Bourem, Dangha and Diré. The sample was to have been 30 but

several interviews were not undertaken for various reasons. There are 25 pumps placed outside of the three zones which were excluded from sampling A brief summary of the interviews is given in Annex III. Table I gives a summary of the information gleaned from the interviews.

The following is an assessment of the average farmer composed from the interview results. For the wheat crop 1981/82, 64% of the farmers bought variable inputs without credit from ABD and planted wheat. 68% used the pump. 22% did not use pump because ABD did not provide credit. 10% did not use the pump for other reasons. One of the farmers bought inputs and grew other crops. The remainder 32% did not use the pump this season. The average size of wheat plot was estimated to be 2.1 hectares*. 72% of farms using pumps will grow an average of 1.7 ha. of rice during the rainy season, using the pump to supplement rainfall. The range of pump usage (number of growing seasons worked) was from 1 to 3 years. The farmers used 3,997 liters of fuel to irrigate 21.7 hectares at an average cost of 425 FM per liter. The average price paid for labor was 940 FM per man-day. (Note: Labor price ranged from 500 FM to 1,400 FM per man-day depending on locality and type of work performed). The pump repair costs was 31,425 FM including any payment to mechanic. (Note. This exàludes a 25,000 FM fee for pump maintenance to pump owners and a mechanic). 72% of the pumps were assessed to be in good condition (i.e. trustworthy for starting a new crop). 35% of the farmers were assessed to be good managers (i.e. likely to be making a profit). 30% were assessed as definitely not making a profit. The remainder were questionable. 33% of fields viewed were estimated to have yields of two tons or more. 22% of field were estimated to have less than one ton per hectare yields.

*It is believed that this figure is a low estimate because some farmers may not have indicated the entire parcel irrigated, especially when more than one pump was working on a contiguous plot.

When farmers were asked the most limiting factor to increasing hectarage, usual first resp se was a lack of resources. When asked to elaborate, the answers become varied. Most limited their plots size because they were afraid of not being able to obtain sufficient fuel either due to lack of cash, credit or a complete rupture in supply. When pressed about historical evidence concerning fuel procurement, only two revealed an instance where he was totally refused credit. No one could remember a total supply rupture. All indicated cash shortages. (Note fuel on credit is very expensive, about 800 FM/l. Not all farmers were asked these questions). Land and labor were mentioned as being most limiting factors.only one each.

Whatever the reason, the average size of wheat plot of those farmers growing wheat is about two hectares, half the size required by the PP economic analysis. (Note.The assumption in the PP was that four farmers would own a pump jointly and cultivate one hectare each. It is doubtful that this assumption ever received, nor necessarily merited, serious consideration at the project implementation level.

b) Other winter crops

In addition to the wheat crops, almost every farmer had small garden plots for home consumption. Most frequently grown were onions and tobacco. One farmer in the Bourem sector and one in Diré cultivated wheat plus commercial quantities of onions, tomatoes,atobacco and other vegetables. No attempt was made to estimate value of vegetables grown in Diré. Any assessment made will use standard IER estimates.

c) c) Off season cultures

The PP anticipated that the farmers would use the pumps to supplement rainfall on four hectares of millet during the rainy season. Almost all the farmers indicated their intention to use the pump to supplement rainfall for growing rice during the rainy season. One farmer stated he would grow both rice and sorghum. Rice is timely preferred because it probably has a higher return on investment than sorghum. It is also likely that rice will be grown because it is eaten by farmers more

than sorghum.

When questioned about probable size of rice plot, most farmers indicated less hectarage would be grown than wheat. Most responded it would be about one-half the wheat area. The limiting factor was again available resources.

Little is known about the economic aspects of growing this type of rice (Kobé). It is traditionally grown in dry lake beds that will be flooded by rainfall run-off from surrounding areas. Kobé is not a floating rice. The lake beds form natural depressions which collect rainfall run-off. The farmers construct a dike around a portion of the lake bed which allows them to control water level within the interior of the dikes. Rainfall often is not sufficiently regular to provide adequate water. The pumps will be used to ensure a supply of water. The pumps will allow farmers to cultivate without supplemental irrigation, Kobé rice in areas other than lake bottoms. Kobé rice is a high risk enterprise and it is likely that size of area cultivated tended to be small. The pumps will allow an increase in hectarage and minimize risk.

There are conflicting stories on details of rice culture. Some farmers reported that the cost of pumping would be less than for wheat because it would be supplementing rainfall. Others indicated that pumping requirements would be greater because the rice needs more water than wheat. Both statements may be true. In the case of the lake beds, the rainfall run-off from surrounding areas would likely generate enough water so that pumping would be minimum. However, lake bed area suitable for growing rice is limited. Any considerable expansion of rice cultivation will have to occur on other types of land.

There is not much information available on yield. One person who keeps this kind of information said that yields of Kobé rice on his farm average 3 tons per hectare. Another person grew a different kind of rice in the same condition (pump irrigation) and indicated yields of about 1.2 tons per hectare. The latter was a type of rice that is drought resistant

and supposedly can go for 2 weeks without water. The Kobé rice needs water every two days. All farmers indicated that they believed rice to be more profitable than sorghum and most believed it to be more profitable than wheat. In the absence of other data, the analysis will assume that pumping requirements for rice are 50% of wheat but that other factors are the same.

7. Other Considerations

a) Market prices of cereals paid to farmers

I did not take the time to do a price survey. However, one farmer, noted for detailed record keeping, offered the following. The value of rice to farmers (paddy) has varied, over the past year, from 100 FM per kilogram to 130 FM per kilogram depending upon season. This was the price farmers received in the city market of Diré. Wheat was priced at 175 FM per kilogram before the recent harvest and now is about 150 FM per kilogram. If a farmer were to prdduce 4 tons of wheat on 2 hectares in a good year but had to sell the crop to pay debts immediately after harvest he would receive 100,000 FM less than if he could hold the wheat off the market for several months. Total revenue would be 600,000 versus 700,000 FM. If he had 4 hectares of wheat with the same yield the price differential would generate sufficient revenue to pay the outstanding credit to ABD for the pump.

b) Spare parts and mechanics

During the past wheat season, the Action did not have the resources to pay the mechanics. Two of the farmers in the survey paid about the equivalent of 25,000 FM as a contract for maintenance services for the duration of the crop cycle. In absence of other data, this figure will be used as actual cost of mechanic services.

The cost figure for spare parts will be the average outlay by all pump owners in the sample. This will include pumps not in use. The Action uses a standard price list to charge for spare parts. It is not clear if the price list is based on replacement cost, including transport and handling.

c. Land Tenure

This question did not arise until late in the survey. There appears to be sufficient quantities of land in the area which is not under cultivation such that the subject of land cost would not enter into the analysis to any significant extent. It was revealed through an interview that land tenure is quite often a problem. Apparently, there exists a class of nobles (Songhrai) who govern the use of all land in the area. The nobles seldom cultivate land. Anyone using the land must pay a fee to the noble in control of the parcel in question. In some cases, the charges can be quite high. There was not enough time to estimate an average fee for land rental, so this factor will be omitted.

8. Summary

Tables 2 and 3 give a summary of information obtained in the interviews shown in a cost/return format. Any information concerning wheat production not obtained in interviews was taken from Crystal's report. Estimate concerning rice and vegetable culture were based on impressions. Table 2 presents an average of eleven farmers who grew wheat this season. Those farmers who grew wheat were omitted from averages in this table because costs for vegetables culture could not be separated from wheat costs. Seed cost for both wheat and rice are assumed to be the same and are based on estimates in Crystal's report. Hired labor was based on cash outlay reported farmers for this item does not include food and tea provided workers by a farmers nor threshing/winning costs which are paid for in kind (10% quantity threshed). Fuel cost is based on 184 l/ha at 425 FM/l as determined by interviews. Lube oil usage was 15 l per pump per wheat season at an average price of 1,250 FM. The cost of spare parts for the pumps in Table 2 are based upon actual costs recorded in interviews with the exclusion of the two repair costs over 100,000 FM. Table 3 includes repair cost of all pumps. The amount given for mechanic services is an assessed amount based on a flat rate charge paid by two farmers interviewed. Pump depreciation is listed as 140,000 FM per year for a five-year life and 70,000 for a 10 year life life. Winnowing and threshing is paid for in kind; the rate is 10% of total threshed. The returns to farmers were reduced 9% to account for this factor, reflecting the ratio of hired to family labor for this task in the Crystal report. The value of family labor is assessed at 500 FM/day based

TABLE 2. COSTS AND RETURNS FOR WHEAT/RICE CULTURE [1]

Costs	Wheat [2]	Rice [2]
Seed [3]	23,528	11,204
Hired labor	31,500	15,000
Fuel	164,220	39,100
Oil	18,000	4,235
Spare parts	11,000	2,700
Mechanic Services	25,000	6,000
Sub-total	273,252	78,240
Winnowing & threshing [4]	49,613	17,550
Family labor	134,500	64,000
Total costs	457,365	159,790

Returns	Wheat	Rice
Quantity	3,150 kg	1,500 kg
Unit value	175	130
Total value	551,250	195,000
		?
Less costs	457,365	159,790
Net	93,885	35,210
Available pump amortization		129,095 FM

Amortization	
5 years	140,000
7 years	100,000
10 years	70,000

1/ Based on average costs and returns of 11 farmers who produced wheat this season with the pump

2/ Average of 2.1 ha. wheat and 1.0 ha. rice

3/ Seed cost based on Crystal report

4/ Calculated at 9% harvest.

TABLE 3. ECONOMICS OF AVERAGE PUMP DURING WHEAT SEASON 1981/82 ABD [1]

Costs	Wheat [2]	Rice [2]	Veg. [2]
Seed	13,728	8,404	
Hired labor	18,400	11,250	
Fuel	96,186	29,325	
Oil	10,542	3,375	
Spare parts	17,100	2,025	
Mechanic Services	25,000	4,500	
Subtotal	181,006	58,538	350,000
Winnowing/threshing [3]	25,059	13,162	
Family labor	78,720	48,000	12,800
Total costs	298,785	119,700	362,800

Returns	Wheat	Rice	Veg.
Quantity (kg)	1.845	1,125	
Unit value (FM/kg)	175	138	
Total value (FM)	322,875	146,250	400,000
Less costs	298,785	119,700	362,800
Net	24,090	26,550	37,200
Available for amortization of pump			87,840

Amortisation [4]

5 years	117,600
7 years	84,000
10 years	58,800

1/ Global estimate based on 22 pumps.

2/ 1.23 ha. wheat; 0.75 ha. rice; veg. 0.1 ha./season

3/ Calculated at 9% grain harvest

4/ 32% of pumps not being used amortized at 50% other pumps

volume recorded by Crystal. Unless otherwise specified, the same parameter are used for rice or wheat. Yields are assumed to be 1,500 kilograms per hectare. Market value is measured at last seasons high point.

Table 3 is basically the same as table 2 except all 22 pumps in the sample were considered to obtain the average. Table 2 is more likely what farmers can do once they decide to finance the credit themselves. Table 3 is closer to what actually phappened over the past season. Given both cases (Tables 2 & 3) farmers are not making sufficient returns to pay pump credit with pump profits alone.

9. Conclusions

i) Pump life cost

If the cost of spare parts and mechanic services paid by farmers are close to actual costs then it appears that, judged by activity of two year old pumps, the life of the pump could go beyond five years. Amortization of pumps over five years is difficult to accomplish given current economic environment of farmers.

ii) Fuel

The per unit cost of fuel has increased threefold, from 156 FM/l to 425 FM/l. The quantity of fuel used per hectare appears to be greater than projected. Since fuel is one of the major cost factors, efforts should be made to see if the use could be reduced.

iii) Hectarage

a) The average surface cultivated per pump is less than half projected by the project paper. It seemed that the most critical factor limiting surface exploited is the risk of possible crop loss due to pump failure. Some farmers interviewed appeared to have reduced the risk factor by exploiting adjoining plots of land with interlinking canal systems. Three pumps on about 12 hectares appeared several several times.

b) The majority of farmers did not intend to cultivate the same land on a continuous basis. This fact, plus the land tenure problem which became known late in the exercise, may have some bearing on surface cultivated.

iv) Cost of repairs and maintenance of pumps does not appear excessive, assuming that prices paid by farmers reflect actual costs. Given the remoteness of farms and the lack of motorized transportation for mechanics, pump down-time will continue to present a risk hazard to farmers.

v) Labor

The quantity of hired labor used by farmers appears to be about the same as projected. The average price of labor paid last season was 940 FM per man-day, about twice the price anticipated in the project paper. A part of this increase reflects the effects of inflation. The outlay of hired labor remains about 10% of total variable costs and is not considered a factor limiting marginal increases in production.

vi) Yields

An attempt was made to measure yields. However, only on 6 out of 22 farms were there wheat to be measured since harvest was well underway. This was not considered large enough of a sample to make an accurate projection. The analysis herein used the average yield given in Crystal's report.

ANNEX III: INTERVIEWS

1. Mahamma Alidji of Sadjilambo

This person has two pumps operating on one plot of about 4ha. The second pump is under the name of another family member. The two pumps offer added security: when one is broken, the other can irrigate the entire plot. He used 614 l of fuel for both pumps for which he paid 375 FM/l for 400 l. He bought in Timbouctou and shipped himself (the price includes transport cost). The remaining 214 l he bought from a merchant in a nearby town for 500 FM/l. Total cost of fuel was 257,000 FM for 4ha. A total of 45,000 FM was paid out at 1,000 FM/day for labor. That does not include harvesting which was paid for with wheat which he did not measure. He has already completed harvest so no yield sample could be taken. He will re-plant next year on the same plot but will shift land the following year. For the pump in question which he has had for two crop years, he spent 13,295 FM for repairs. He did not rent his pump. In the rainy season he will use the pump to grow about one ha. of Kobe rice: last season he used 280 l of fuel on rice. (The rice plot will be different from the wheat plot for all farmers).

2. Aboubacrine Bongo of Sadjilambo

He has had his pump for two wheat seasons and insists he loses money each season and yet intends to use the pump next season. He claims to have had money repair peoblem with the pump (agreed by extension agents) and paid out almost 100,000 FM in repairs alone. He also ran out of fuel with no money for more fuel (most farmers can get credit). I could not find an obvious section of the field that was lost due to water shortage. He has about one ha. under cultivation, claims to have used 425 l of fuel. His yields are going to be higher than average. I counted 537 pinnacles per sqr. m. He will use the pump to cultivate Kobe rice in the rainy season.

3. Ibrihim Sidi of Douta

Since Action Blé did not provide fuel on credit, this farmer did not use the pumps. He has had the pump two years.

4. Alhoussaine Hamadoum of Koïgourou

This farmer has had his pump for two years with remarkably little problem. Last season repairs cost him 3,630 FM. He has about two hectares on which he spent 27,000 FM for labor (not included harvest). He spent 153,000 FM for fuel (200 l at 415 FM/l and 140 last 500 FM/l). He did not rent his pump but loaned a neighbor his pump (free) when the neighbor's pump broke. He will plant millet and Kobe rice on about one ha. during rainy season. Two samples showed 350 and 260 pinnacles/sqr. meter. Yields did not appear high. He has no problem finding fuel or credit for fuel (250 l) but does not like to pay such a high price.

5. Abdrhamane Garba of Bani

Bani is the most remote village in the Bourem sector. We left at about 8:30 and arrived at the farmer's about noon. He has had the pump for two years. This year he only planted one ha. of wheat because of lack of credit for fuel. (Note. The one ha. shown to the interviewer was a part of field of about 10 hac There was supposedly one other pump in the village but it was permanently broken.) He did not rent the pump and did not let others use it. His pump is supposedly in bad shape but he only spent 10,250 FM for repairs. He will plant about one ha. of Kobe rice in rainy season. 255 pinnacles/sqr. meter. Used 200 l fuel at 365 MF/l. (Note. He is close to Timbouctou.) Labor cost 700 FM/day.

6. Aladijou Maiget Af Talahait of Gartjiré

He has had pump two years. He cultivated about 3 ha. of wheat this season and his had a good yield, perhaps 2 tons/ha. His fuel costs were as follows:

225 l at 350 FM/l and 5,000 FM transport
200 l at 375 FM/l and 5,000 " "

Labor:

14,000 FM for 10 people one day
20,000 FM " 20 " " "
22,000 FM " 22 " " "

He paid 3,400 FM in repairs for pump. He also paid a mechanic 25,000 FM to maintain his pump for the season. He will cultivate rice if fuel is available. He did not rent pump. Comment: it appears that this farmer is doing well with his pump: 300 pinnacles per sqr. meter.

7. Hama Ahmadou of Katua

Has had the pump two years. Since Action Blé did not provide fuel on credit this year, he did not grow wheat. He bought 60 liters of fuel at 370 FM/l and made a vegetable garden. He has spent about 12,000 FM in repairs for the two years. He has about one half ha. of Tobacco, manioc, corn, sweet potatoes and several mango and papaya trees. He has about one half ha. prepared to plant. (Note. The garden did not appear very efficient.)

8. Mahama Sahanou of Bourem

He has had pump two years. He did not grow wheat because of no inputs from Action Blé.

9. Bokar Bourema of Yoné

He received the pump this year. He has about 0.9 of ha. planted. It was planted late and will have reduced yields. He did not cultivate more because he did not have cash to buy fuel oil. He bought 240 l at 500 FM/l = 120,000 FM for fuel.
Pump repairs were 6,800 FM. He did not rent his pump. Wheat too immature to estimate yields.

10. Akalifa Talata of Bourem

He has had pump one year. He cultivated 4 ha. rice last season and plans to cultivate rice again this rainy season. He currently has 1.5 ha. of wheat in production. He is also growing the following for home consumption: tomato, beet, lettuce, onion, cukes and tobacco. He bought 400 l fuel at 500 FM/l. He also spent 37,500 FM to have land prepared by animal traction. Spent 24,000 on labor and 11,770 FM on pump repairs.

11. Mahamane Adama of Tangassane

He has had the pump three years. He bought 400 l at 350 FM/l fuel early at beginning of season and 130 l at 380 FM/l later. He spent 10,000 FM labor and 21,000 to repair pump. The farmer showed us a field which was supposed to be his of about two hectares. This field was planted late and yields would be low. There were 276 pinnacles per sqr. meter. Note. The parcel shown was adjacent to a large field which would be about 12-15 ha. including

the one shown to us. Supposedly there were three pumps (including this farmer) for the entire area. I feel the farmer did not show the correct field. He says he will not grow anything off season with the pump. He did not rent the pump or let anyone else use it.

12. Kaga Hamadoun of Niambougou

He did not use the pump this year. I did not interview him.

Sector of Dongha

13. Agali N'Tobourou of Kortesao

He is the first Touareg to be interviewed. He has had the pump two years. He used 580 l of fuel to irrigate 4 hectares and paid 420 F/l for 200 l and 500 F/l for 380 l for a total of 274,000 FM. He used 40 l of lubricating oil at a cost of 60,000 FM. He hired 70 person/day of labor at 750 FM per day for a total of 52,500 FM. (Note: the Touareg also have Bella working for them in something less than a commercial labor market situation. The Bella used to be slavessof the Touareg and retain a dependent relationship with them today. This farmer was no exception.)

His pump has given him quite a few problems. It costed 100-150,000 FM to repair during the season. Almost every moving part had to be changed. The pump is currently working; the farmer did not lose his crop due to down-time. (Note: there were three pumps irrigating a plot of about 10-12 hectares. I was told that one of the three pumps was not repairable due to broken crankshaft. The problem of broken crankshaft appeared several times in the Dongha sector. This is one replaceable part the manufacturer did not send as spares.)

He planted rice last rainy season and will again this year. He will plant about 4 ha. but would prefer to plant more if he had the resources. Pump repairs will reduce any profits from this year's wheat crop. He believes that potential profits are higher in rice due to reduced irrigation costs.

This farmer paid the mechanic 20,000 FM plus some wheat for maintaining his pump for the season. The farmer did not have any receipts for repair. Apparently, none are given to any farmer.

14. Hamidou Bouba of Hondabouma

This farmer is listed in one village but farms in another village several kilometers downstream and across the river. This was a common situation in Dengha, the sector where farmers are more remote.

He received the pump in time for this wheat season. He completed the crop with no repairs to the pump at all. The pump is currently in working order. He spent 136,000 FM on fuel -200 l at 380/l and 150 at 400/l. He used 3l of lube oil at 1,000 FM/l; the pump has a small oil leak.

I did not see the farm as it was across therriver. There would not have been much to see; the harvest was already completed and the pump was in the village where he lived. I did see the pump. From discussions it appeared that the farm was about two hectares. He could not remember the quantity of labor used but the price was 300 FM for a half day. (Note: this farmer is located about five hours from Dângha by 4-wheel drive vehicle. He is outside of the ABD zone in another Arrondissement.) The ABD personnel do not have transportation, except a non-motorized pirogue. According to the Diré headquarters they are supposed to have three pirogues and two outboard motors. Three Dânghâ ABD personnel were accompanying us to see the farmer, none of them had ever been in this area before. It is quite difficult to provide farmer services in such cases. The Action should either increase its ability to deliver services, reduce the geographical zone where it provides services, or a combination of both. If a farmer takes his pump outside of the zone, the Action should not be held responsible to provide support services.

15. Mahamed El Maouloud of Bourem

This farmer is listed in Bourem but was found in the same village as Hamidou Bouba. He is the former ABD sector chief in Bourem. His pump broke down in mid-season, could not be repaired and the crop was a total loss.

16. Oumar Garba of Hondobouma

He received the pump in Sept. 1981 but did not use it the past season. He selected a plot of land and began preparations but was compelled to leave due to a land tenure dispute with livestocks herders. He selected another plot but not in time to have a crop. The pump is in operating condition.

He will have a rainy season crop but is not sure at this time of which crop he will cultivate. He was very concerned about the prospect of not being provided fuel from the Action on credit.

17. Ibrahim Mahamane of Kacondji

He has had the pump for two years and this is his second wheat crop. The farmer no longer lives in Kacondji; he has moved to Sorétao, a considerable distance away.

The farmer bought 200 l of fuel; 40 l at 500 FM/l and 160l at 425 FM/l for a total of 88,000 FM. He bought 16 l of oil at 1,000 FM/l. He hired 25 people over a four-day period at 500 FM/day. It is estimated that he planted between 1 and 1.5 hectare. Last year he planted a much larger farm but lost most of it due to intermittent problems with the pump. He does not have the confidence to make a large farm. He will cultivate about one half hectare of rice during the rainy season.

The farmer mentioned three important factors which could cause variance in the quantity of fuel oil necessary for a wheat crop.

1) Planting time - Late planting will require more water when the season changes at the end of the crop due to increase in rate of evaporation. (Note. Another farmer elaborated on this subject. Apparently, there are hot, dry winds near the end of the wheat growing cycle. If a farmer can get his crops to mature before those winds begin, water usage will be reduced considerably.)

2) Land quality - some land requires more water especially for preparation prior to planting.

3) Pump efficiency - general condition of pump.

Although there were no pump repair costs this season, the pump quit working at the end of the season. The farmer has not had it repaired because he does not at present need the pump.

18. Abourérata Aboubacrine of Gabongo

He did not plant wheat this year. Last wheat season he received fuel from the Action late because he did not have empty barrels for transport. He

planted the crop anyway but the flood water receded before the crop was mature and the lost everything. He planted rice during the rainy season but had to be absent due to sickness in the family and lost the crop. He will try rice again this year. The pump works well.

19. Allassane Arafa of Gabongo

He has had the pump two years. The pump has a problem (possible manufacturers defect) and continually breaks a connector between pump and motor. The farmer has replaced this part nine times in two years. It is difficult to say how long the pump will last.

This year he spent 153,000 FM for fuel (200 l at 400 FM/l and 200 l at 365 FM/l). He had a successful crop on about 2.5 hectares; He spent 11,000 FM on lube oil (01). Labor cost were 30,000 FM at 500 FM/day. He spent 8,410 FM for repairs this season and 22,760 FM since owning the pump. (Almost all repairs were the connector.)

20. Hamadoune Cissé of Diré

He received the pump just before the last rice season began. He has not yet used the pump to grow anything because he doesn't have the resources. He was waiting on Action Blé to provide the resources on credit. He now intends to use the pump this rainy season to grow Kobé rice ogmsorghum or something.

21. Bokar Koïta

This was the most interesting person interviewed. He received the pump in 1980 and has just completed his second crop of wheat. He has a 12.6 hectare farm which is not completely in production yet. There is still some earth works to complete. He keeps detailed records on everything he does. He does not rely totally on farming as an income source; he is a painter of portraits and barber, among other things. However, his approach to farming is beyond the amateur.

He currently has two pumps on site and will eventually have a third one when the farm is fully in production. Last year he made four hectares of wheat. This season he made two of wheat and one of vegetables. He used 660 l of fuel during the season for which he paid 500 FM/l.

He only ran one pump during the wheat season. His vegetable crop included white potatoes, sweet potatoes, and onions. The pump cost him 42,800 FM in repairs.

Last rainy season he planted two types of rice -Kobé and one called Chinese rice. The Chinese rice was something of an experiment (much of his farm's experiments) because he heard that it required less water than Kobé. This he found to be true. Not only does it require less fuel, it would be more practical to farmers who risk crop failure due to pump down-time. He harvested 38 sacks of 80 kg each from 2.4 hectares of Chinese rice (about 3 tons). This rice can be without water for two weeks and not have reduced yields due to stress. The rice requires 75 days after transplanting. He produced this last year with three irrigations. (For rice irrigation supplements rainfall.)

Prices. The value of rice to farmers (paddy) has, over the past years varied from 100 FM per kg to 130 FM per kg. depending upon season (in Diré). Wheat was priced at 175 FM per kg before the recent harvest and now is about 150 FM per kilo.

Aththis point M. Koïta went into a lengthy discussion about pump profitability. He is convinced that farmers cannot pay for the pump growing cereals alone for several reasons. If the farmer is growing one crop (monoculture), he will find that near the end of the crop he will be pressed for cash -and will also need to act- thus he will be eager to sell immediately after harvest. When all farmers do this, the price drops. If the farmers had an alternate crop, they would have something to eat and could hold their wheat until the price becomes more attractive. He has been experimenting with many alternate crops that farmers could grow. He has found that sweet potatoes, onions and white potatoes do well and grew them commercially this year. He is also convincedrthat the average farmer cannot get over 1,500 kilograms per hectare yields.

(My comment. M. Koïta hires all of this farm labor which he can afford to do with non-farm income. There is a real question whether a farm family can handle 4 ha. of wheat. If labor is hired, most of the profits will go to paying for labor. M. Koïté currently pays 1,500 FM/day; but is quick to note

that they must also be fed and provided with tea. The project paper foreseens that farmers would share the pump -4 with one hectare each. This has not worked in practice. None of the farmers interviewed shared his pump with a non-owner nor admitted to renting the pump.)

He has experimented with the following crops and is ready to produce them commercially if he feels there is a sufficient market.

1. A short variety of corn -the tall varieties do not withstand the strong winds.
2. Cassava -180 days to maturity
3. Tobacco
4. Beets
5. Lettuce
6. Tomato -These are grown (and lettuce) on the sides of irrigation lands to maximize use of water.
7. Watermelon
8. A type of sugar pea grows in Southern Mali
9. Carrots, sweet pepper, cabbage
10. Several varieties of beans and peas.

He is also growing fruit trees. Grapefruit, orange, mandarin, dates, mango and two types of papaye that have already given fruit-maturity date of 17 months.

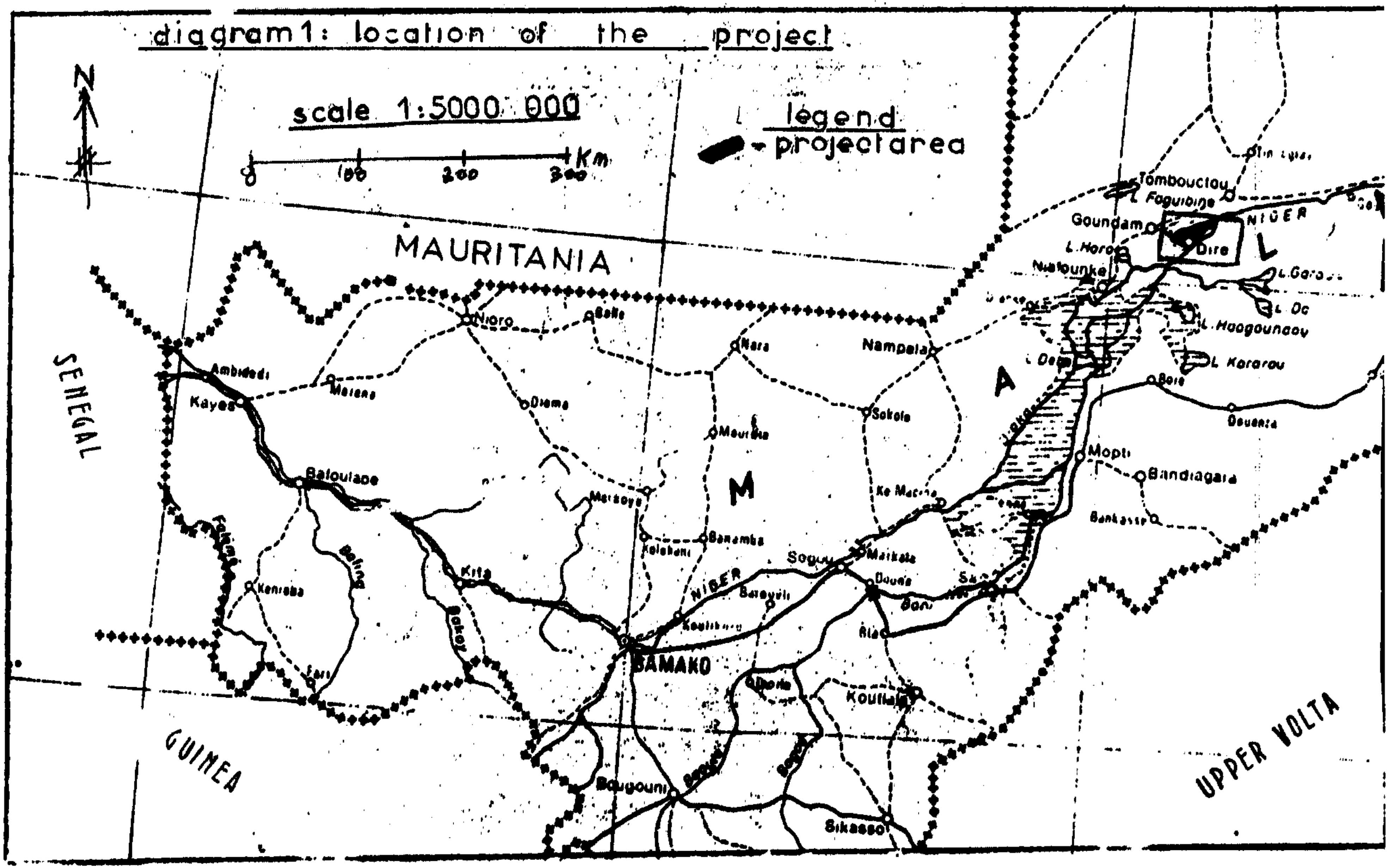
Next he began a long discussion of mechanical problem with the pump and how they can be avoided. The worst problem of proper pump function is educating the farmer in the use and maintenance of the pump. He feels that with proper care, the life of the pump will be well beyond five years.

His pump repair costs were 42,800 FM. His total costs were [illegible]537,925 for the past growing season, which includes 330,000 FM for fuel.

22. <u>Aliou Ibrahim of Diré</u>

He received the pump this year and did not plant wheat because he has not yet received the irrigation pipe (none left in ABD). He will try to plant Kobé rice this year.

Note. There were two other farmers to be interviewed in Diré but both were absent and no one seemed to know exactly whom the pumps were located, when the farmers would return and did not know if anyone el else could give any information on the pumps. These were deleted.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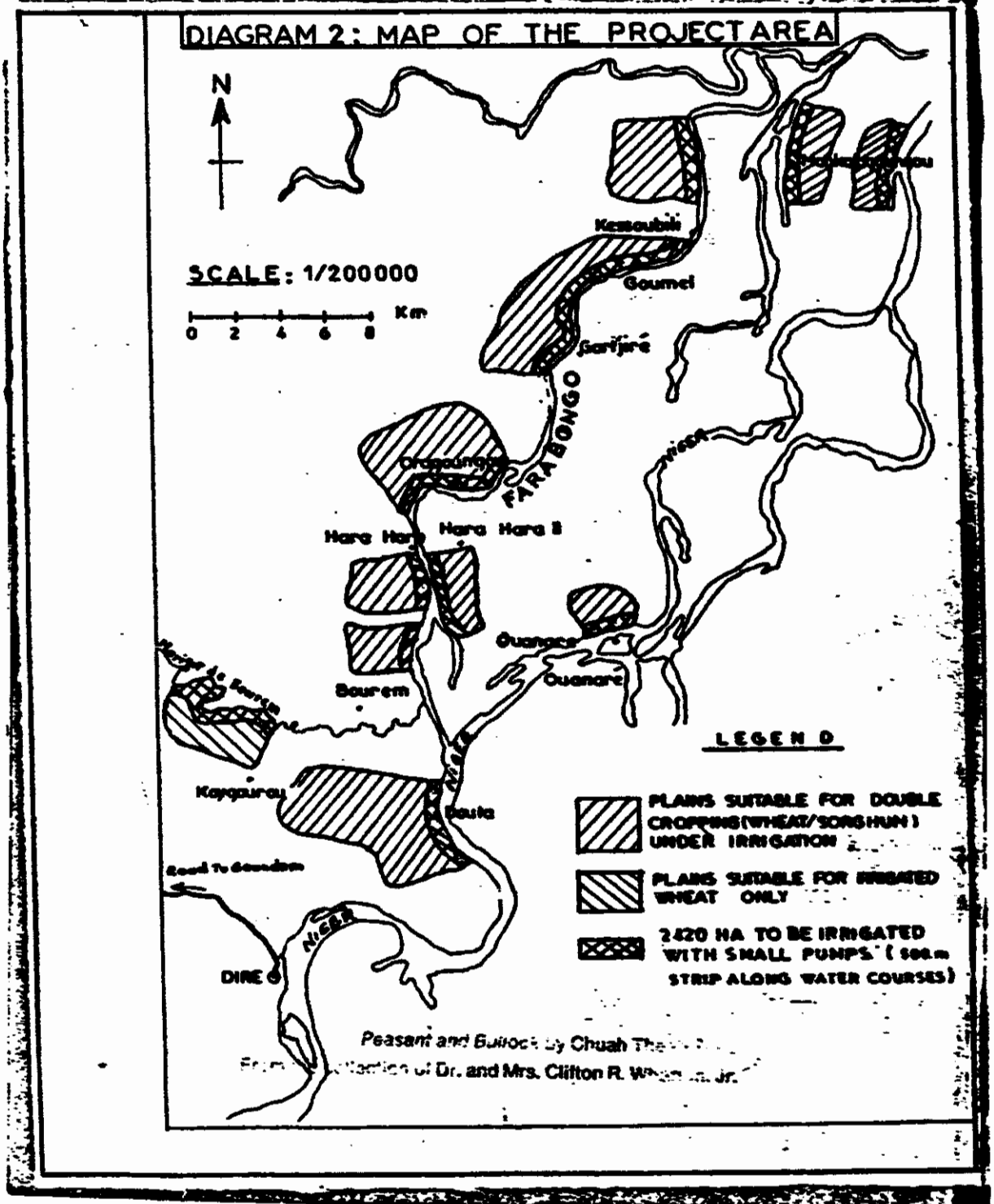
project area
MAURITANIA
SENEGAL
GUINEA
UPPER VOLTA
M
A
L
NIGER
Tombouctou
L. Faguibine
Goundam
Dire
L. Horo
Niafounke
Nioro
Nara
Nampala
Ambidedi
Kayes
Diema
Mourdiah
Sokolo
Mopti
Bandiagara
Bafoulabe
Kita
Kolokani
Banamba
Segou
Markala
Bamako
Koutiala
Bougouni
Sikasso
Kenieba
L. Korarou
Boré
Douentza
Bankass



Peasant and Bullock by Chuah The[illegible]
From the collection of Dr. and Mrs. Clifton R. [illegible] Jr.

DIAGRAM 3 : TYPICAL LAYOUT OF FARM UNITS

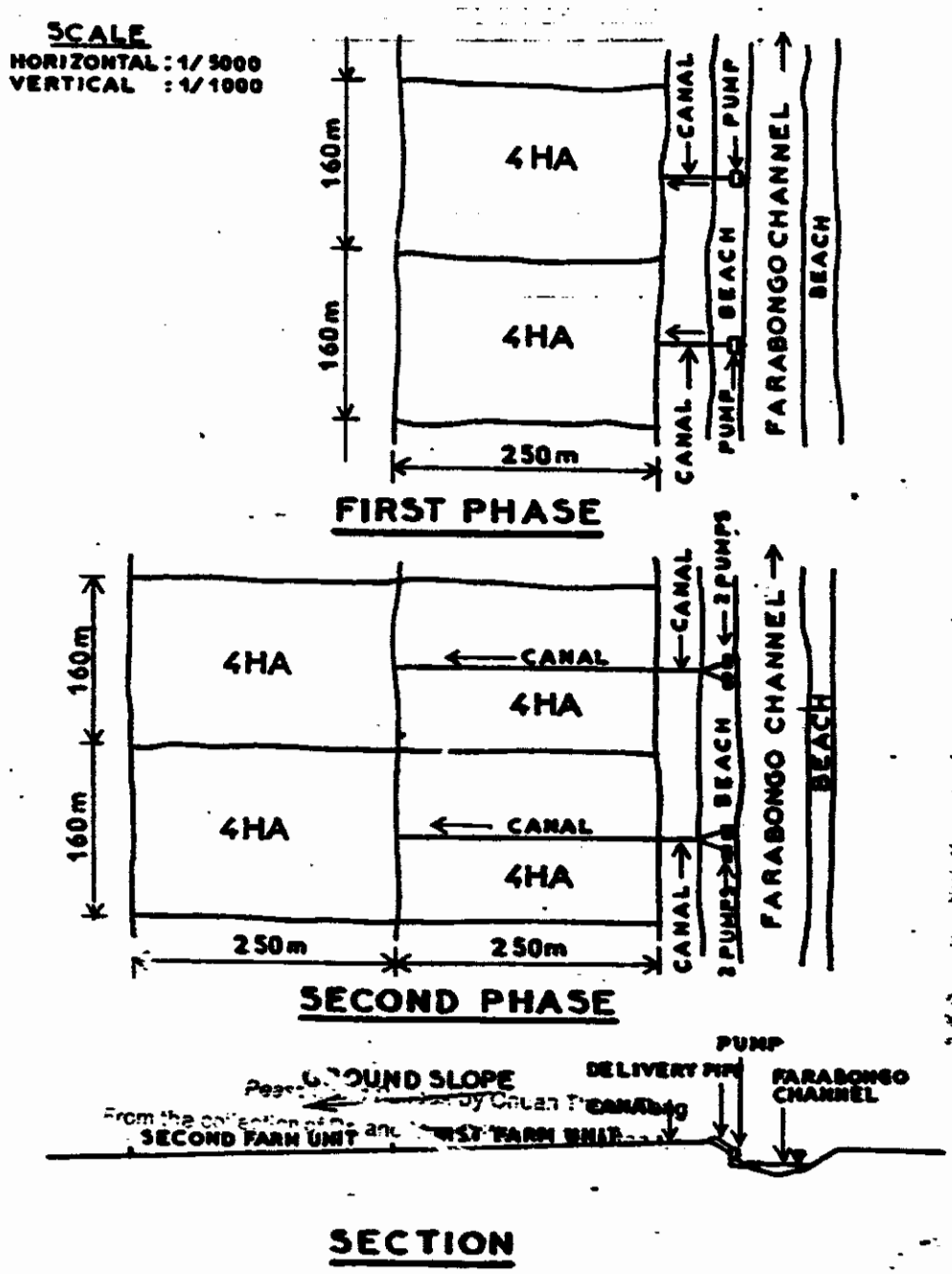
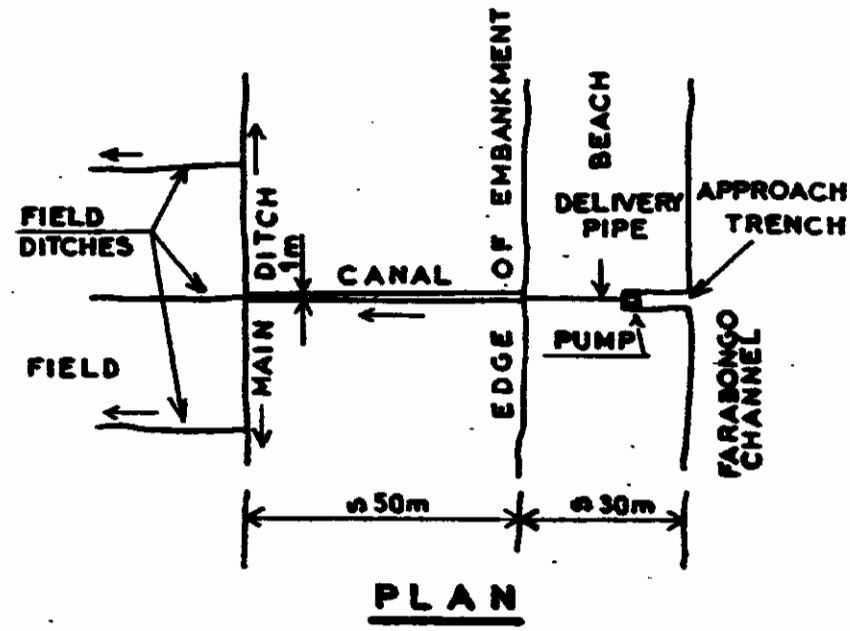
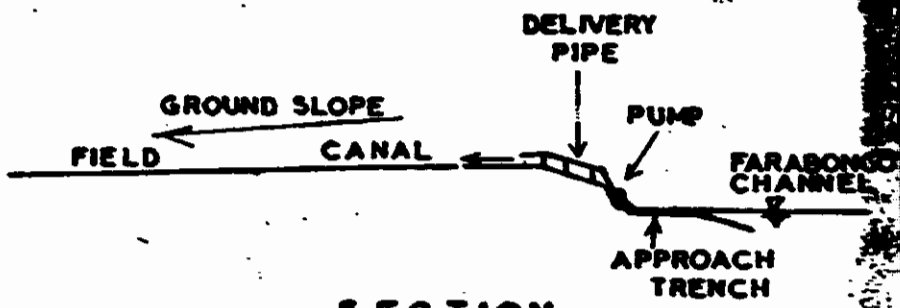


DIAGRAM 4: TYPICAL LAYOUT FOR DIESEL PUMP



PLAN



SECTION

Peasant and Bullock [illegible] Engraving

From the collection of Dr. and Mrs. Clifton R. Wharton, Jr.

DIAGRAM 5: FLOW PUMP