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# ACTION BLE-DIRE PROJECT
(688-0213)

## Economic Analysis Update

by: W. De Rafols, Consultant
Under IQC Contract No. OTR-1406-I-00-1131-00
with Tippets-Abbot-McCarthy & Stratton

Agency for International Development
May, 1982

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# PROJECT ACTION BLE - DIRE

## ECONOMIC ANALYSIS

April 1982

W. De Rafols
Consultant

ACKNOWLEDGEMENTS

The consultant would like to express his acknowledgement and gratitude for the information obtained in interviews with the following persons: Mr. Roger Simmons, USAID Washington D.C.; Mr. David Wilson, Director, USAID, Bamako; Ms. Diane McLean, Project Manager, USAID, Bamako; Mr. Robert Shomaker, USAID, Bamako; Mr. Ralph Connally, USAID, Bamako; Mr. Rollo Erig, USAID, Bamako; Mr. Lee Hall, USAID, Bamako; Mr. John Buursink, Project Manager, TAMS, Bamako; The Honorable Mr. Parker, U.S. Ambassador to Mali; Mr. Zoegger, Economist, FAC, French Embassy, Bamako; Mr. Phil Serafini, ICRISAT; Mr. Dagakoro Samake, Deputy Director, Genie Rural; Mr. François Gadelle, French Advisor, Genie Rural; Mr. Aliou Coulibaly; Mr. Gerard Achcar, Director, owner of Flour Mill; Mr. Omar Ba, Deputy Director, Action Ble, Dire; Mr. Mammadousy, Deputy Director for the Port (Diré?).

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 Bourem-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 |

(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 imputs) 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 approximate because 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 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) | 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 @ 400$m^3$=3600$m^3$ | 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 | | | | |
| 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 Blé - 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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