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Africare

L'Amélioration de la vie en afrique rurale en développant les ressources hydrauliques, la production agricole et les services de santé

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ACTIVITIES PAYSANNES
PHASE II

THIRD IN-HOUSE EVALUATION

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I. INTRODUCTION

Africare is succeeding in accomplishing an extremely difficult objective, i.e. increased food security through irrigated agriculture in Mali's drought prone Sixth Region. Having rescued a failing project in Phase I of Activities Paysannes, Phase II has built on these accomplishments by expanding the area under cultivation and establishing a reliable infrastructure to provide fuel, oil, credit, maintenance and other services to small scale farmers.

The five person Africare team based in Dire, and their two counterparts in the Bamako office, are to be commended for the professionalism, competence, and creativity they have demonstrated over the life of this project. Given the numerous physical, psychological, political and environmental difficulties that are unavoidable in Dire, the Africare team is indeed a rare example of excellence in the field of international development.

With these achievements as a backdrop, the team now faces another formidable challange, i.e. the transfer of project infrastructure to local institutions and, thereby, long-term sustainability. In itself, this is a long-term proposition which will require a period of time longer than the remaining 18 project months.

Within this context, Africare must begin to define the scope of work which will be required to complete the institutionalization after the close of Phase II. This is an extension which is entirely justifiable on the grounds of the overwhelming success to date, and the excellent

The evaluation report which follows considers both the accomplishments to date, and the specific factors which will invariably determine the Project's long-term sustainability. In can only be hoped that U.S.A.I.D. and the private donor community will acknowledge the significance of this effort by continuing their support.

The five person evaluation team consisted of John Berman, Associate Program Manager for West Africa (Africare/Washington); Jeff Gray, Africare/Mali Representative; Rabihah Mateen, Administrative Assistant for Africare/Mali; Professor Jean Due, Agricultural Economist (University of Illinois); and Kurt Lonsway, irrigation engineering consultant.

The evaluation team made site inspections, examined credit and other project records, held discussions with local officials, project staff, and reviewed all relevant project documents including the proposal, quarterly and consultancy reports, and project correspondence.

The focus of the evaluation -- sustainability -- was recommended by USAID/Bamako and Africare/Washington. Each team member was asked to prepare papers on various aspects of the sustainability issue based on their areas of expertise and interest.

The evaluation was conducted over a five-day period (March 22-27, 1987) with two days devoted to drafting the evaluation report and final recommendations. The remainder of the time was spent at the project site.

III. PROJECT DESCRIPTION

In an environment under stress from hunger and drought, Africare and USAID have demonstrated that farming families who have access to technical assistance and inputs are prepared to produce and consume the foods they grow. This is a project oriented towards increasing present food production levels by expanding the total number of hectares under cultivation in the region.

The project is designed to help wheat growing farmers efficiently utilize inputs on small irrigated plots. Increased utilization of water resources along with farm inputs are essential if food production is to be increased. Therefore, the project will teach farmers the importance of water management in addition to improved farming methods. The project will also analyze the present motor pump technology and explore possibilities of using alternative sources of energy.

An analysis of data from the most recent harvest revealed that farmers are obtaining yields of up to 3.2 tons per hectare. In the past, the average hectare yield has been only two metric tons. And though data sets on wheat yields are fairly extensive, knowledge of other crops (including vegetables, tobacco and spices) is limited. An important element of the extension, therefore, will be to expand the data base on crop yields.

In general, the project will improve the farmers' irrigations practices; increase the output of wheat, rice, and other crops; and most of importantly, train the farmers in the management practices they need to assume responsibility for all facets of project operations. When these ends are realized, the project will have helped Mali moved towards self-sufficiency in food production and, consequently reduced the need for an expensive, inefficient system of international food relief.

IV. External Factors

Elements outside the AP II project but having a direct impact on project implementation are numerous. Several of the major extraneous factors are considered below.

1. The most important external factor as been the influx of donor food aid in response to the 1984-85 drought. Much of this subsidized food, combined with an unusually good harvest, eventually came to rest in the marketplace, where it had the effect of dramatically depressing cereal prices. As a result, project grains recuperated in kind were extremely difficult to sell, as were the stocks that farmers did not return directly to the project.

2. Lack of agricultural credit and banking institutions in the project area has become extremely disadvantageous as the project strives to establish long-term sustainability. Should the Project assumption regarding farmers' cooperatives achieving the capacity to manage commercialization and credit infrastructures prove false, alternative courses of action should be identified immediately. One such option that the project is now exploring is the potential for commercial relationships between the BNDA and project farmers.

3. The project has had less than adequate support from the GOM's agricultural extension service (Action Ble), and the cooperative assistance center (CAC) based in Dire. The Activites Paysannes proposal assumed that these organizations would play significant roles in the support of farmer training and the introduction of improved

themselves have been plagued by internal difficulties which prevented them from offering significant assistance to the Project.

4. Investigation was made this year to determine the relationship between the Activites Paysannes project and the incidence of water-borne diseases in the Dire area. More specifically, the Italian medical team as well as the Malian state nurse were asked to summarize the prevalent water-borne diseases in the area and whether or not there has been an increase in reported cases which could directly be attributed to farmers' irrigation schemes supported by the Activites Paysannes project. Project management was informed that the Activites Paysannes farmers, although likely to drink the river water pumped onto their fields, more often will either carry a supply of water with them (in a small container) or go down to the river to satisfy their thirst (a habit resulting from years of traditional practice). The most prevelant water-borne diseases are diarrhea, amoebic dysentary, tuberculosis and cholera. Most of these diseases result from unsanitary facilities which is a function of their cultural practices and the lack of basic health sanitation education. Presently there are three health programs which can be cited in this area trying to bring about improvements in the health standards. UNICEF just recently completed a water resources developement program by providing drilled boreholes equipped with handpumps to every school and health facility in the Dire area. The Italian Cooperation organization has undertaken an immunization and health training program for many of the Malian health workers. The Malian Health Service has been

active with a latrine-building project in the area as well. To date they have built 1,247 latrines in ten villages. From these disussions Africare was provided helpful recommendations on how they might assist in the fight against increased incidence of water-borne diseases. It was proposed to incorporate health safety themes into the existing farmer adult literacy training program. Africare's technical assistants are studying if this idea can be made feasible.

V. PROJECT INPUTS

Personnel

- 7 expatriate technical assistant team 5 based in Dire and 2 in Bamako)
- 30 Malian support staff in place
- 2 project studies resulting from consultants' services: one preliminary economic analysis and another discussion on pumps in the Dire area

Travel & Allowances

- 5 houses under rental contracts completed furnished in Dire for technical staff and two in Bamako

Equipment & Supplies

- 11 new motorpumps purchased and delivered to project site
- workshop equipment: tools, speciality tools, battery recharger, welding tools, etc.
- 3 new four-wheel drive vehicles purchased and delivered to project site
- 2 large ten-ton trucks (one fuel tanker and one wagon) purchased and delivered to project site
- 1 medium-sized tractor purchased and delivered to project site
- 1 motorcycle and 4 mobylettes purchased and delivered to project
- 2 IBM typewriters purchased for the Bamako office
- office furniture purchased and delivered to project site in Dire
- 1 computer purchased and installed at the Africare office in Bamako

Construction

- installation of 2 tanks with 150,000 holding capacity in Dire
- completion of the new administration building at project site in Bourem Sidi Amar
- new grease pit built outside the project workshop

Training

- printing of several adult literacy publications in French and Sonrai
- photography and recording equipment purchased and delivered to project site

PLANNED OUPUTS	PLANNED INDICATORS	ACHIEVED INDICATORS
1. Increase food production	1a) Wheat production increased from 700 to 1800 tons/year	1a) 1300 tons produced '85-'86 campaign
	1b) Rice/millet production increased from 400 to 900 tons per year	1b) 350-400 tons millet produced '86 campaign; rice production figures unavailable due to lack of sufficient extension services
	1c) Spice production increased from 50 to 120 tons/year	1c) 24 known hectares of spices under cultivation during '87 campaign

Discussion: Approximately 5-10 additional 15 hp motorpumps are necessary in order to increase wheat production to 1800 tons. Due to current budgetary constraints, the objective of 1800 tons appears unrealistic if additional pumps cannot be secured. The original objective of 900 tons of millet/year does not appear realistic and will probably not be attained by the end of the project. The present production level of approximately 400 tons is considered satisfactory.
As mentioned above, rice production figures are unavailable at this time. Extension agents/monitors are needed to collect this information at harvest time, but there is not sufficient funding for this purpose. Emphasis was not placed on spices during the '87 wheat campaign, in part because cumin has been found to be risky and anise is not easily marketed (farmers have yet to sell anise from the previous campaign)

2. Organize farmer cooperatives	2a) 1 general co-op; 10 sub co-ops	2a) 2 sub co-ops have been formed; training for members of both are underway
	2b) Purchasing, recuperation, storage/marketing committees	2b) Purchasing and recuperation committees established for both sub co-ops

Discussion: The original project document intended to create a general cooperative that would assume management responsibilities for the overall project upon present project terminaton. To date, 2 subcoops have been established. One is primarily a localized production coop and other a purchasing coop. Neither is presently capable of assuming overall project management responsibilities.

3) Provide a service supply of fuel and oil	3a) Increased storage capacity to 200,000 liters of diesel fuel	3a) 50,000 l capacity at Bourem and 150,000 l capacity at Dire attained; this is more than sufficient for current production levels.
	3b) Establish reliable delivery system	3b)The Project stocks 200,000 l delivered by river annually (Aug-Nov) and is able to consistently meet the farmers' fuel needs
	3c) Procurement/ logistical support system established	3c) A reliable logistical system has been established by the Project with the addition of a 9,000 litre fuel tanker.
4) Provide a service supply of pumps and parts	4a) 300 pumps in operation	4a) 68 pumps presently being supported;8 project-owned pumps in operation through a rental program
	4b) Adequate supply of spare parts in stock room	4b) Adequate supply not presently in stock for overhauling Cooper motor and future procurement is not possible due to the supplier's insolvency. However, two new motorpumps models were introduced in the past year, for which there is an adequate supply of spare parts in Bamako

Discussion: Budgetary constraints have precluded additional purchases of a comparable replacement pump for the Cooper. The injection of 250 15 hp Deutz pumps in the Dire Circle diminished the utility and seriously questioned the necessity of purchasing additional pumps. In addition, there has been a shift away from numerous small pumps in favor of farmers grouping around larger output pumps. In this sense, the total number of pumps is perhaps less critical than overall pump output supported (i.e., total project beneficiaries).

It has been difficult to maintain adequate supplies of spare parts due to the credit fund's cash flow problem. Out of a total fund amount of 85.500.000 FCFA, roughly 75% is tied up in stocks(motorpumps, spare parts,and fuel). Until recently an additional 25% was tied up in wheat received in-kind from the previous campaign. Additional expenditures from the project credit fund were hence blocked by USAID until a satisfactory cash level could be attained.

5. Establish the management of a revolving credit fund	5a) Credit available to 800 farmers	5a) Approximately 400 farmers directly benefit from credit program
	5b) 90-100% recuperation	5b) Recuperation in-kind at 83%
	5c) Credit system managed by the cooperatives	5c) Both the sub co-ops manage their members credit.

Discussion: *After the sale of 102.777 tons of wheat (received in-kind) at a loss of 9.969.610 FCFA, overall recuperation for the last campaign was diminished to 49%

6. Establish a mechanic maintenance service for pumps	6. 30 trained mechanics serving farmers	6. 9 full-time mechanics;4 trained

Discussion: The Project decided it more beneficial to have an intensified training program for fewer mechanics rather than offer minimal training to many mechanics. The necessity of having many mechanics was also diminished due to 1) the Project's shift from numerous small output pumps to fewer higher output pumps and 2) the shift in the workshop's emphasis from repairs to preventive pump maintenance.

7.Strengthen the extension service to farmers	7a)10 agricultural extension agents	7a) 5 in-house, 5 IER ag extension agents
	7b) 2 cooperative agents supporting farmers	7b) Presently no GOM co-op agents support farmers
	7c) 10 demonstra-	7c) 6 demonstration

	tion plots within farmer community per year	plots in 6 villages are underway
8. Provide supply system for seed, fertilizer and other inputs	8a) 90 tons seed per year	8a) 90 tons seed were available from '85-'86 campaign
	8b) 90 tons urea/ 90 tons phosphate	8b) These quantities not attained; minimal quanitities provided by project for seed treatment at no cost to farmer

Discussion: Though over 90 tons of seed were available for the '86-'87 campaign, farmers bought only 8 tons as they had an ample stock from the previous campaign. The farmers are able to purchase highly subsidized fertilizer from Action Ble at a price lower than the Project could supply (50 FCFA/kg) - this eliminated the need for A.P. to purchase or stock fertilizer during the past year.

9. Establish a mechanics shop	9. Facility for repair and maintenance	9. Facility for repair and maintenance in place
10. Establish a cooperative training program	10a) 250 farmers literate	10a) 75 farmers have been trained in Songhay
	10b) Trained farmers management	10b) 8 farmers have received management training
	10c) 10 officers local coop groups trained	10c) 8 officers received training

Discussion: The project did not have a full-time trainer on staff until December '86. Most farmers are illiterate in Songhay, not to mention French. The lack of basic literacy skills in French is constraining at Ganganiberi; lack of literacy skills in Songhay is particularly constraining at Kessou Korey. Other constraints to achieving this component's objective are the farmers' reluctance to participate in literacy training courses unless remunerated (like other neighboring adult literacy programs do) and farmer preoccupation with agricultural activities. Given these constraints, it seems unlikely that more than 75 farmers will attain functional literacy (in Songhay) by the PACD date. It is questionable, however, that literacy in Songhay (as opposed to French) will prepare the farmers to assume overall management responsibilities for the project.

11. Establish	11a) 30 mechanics	11a) 2 mechanics

training progr retrained	b) 16 mechanic retrained	

Discussion: For present production levels, nine trained mechanics will suffice. Again, the workshop emphasizes maintenance, thus minimizing the number of mechanics necessary to do post-breakdown repairs.

12. Demonstrate alternative energy pumping programs	12. Solar energy, windmills, animal power	12. Solar energy system installed, windmill installation forthcoming, no animal power initiated
13. Gathering analyzing data	13. Ag production, economic data, water, energy	13. Data has been collected, though not yet analyzed

I. Introduction and Overview

The focal point of the AP II Mid-term evaluation has been the issue of sustainability. Within this context, the the evaluation team has attempted to identify and evaluate those factors which will determine whether or not, at the close of the remaining 18 project months, Africare's success in increasing irrigated agricultural production in Mali's Sixth Region can be sustained.

In summary, the concensus amoung the evaluation team, as well as the project staff, is that Africare has laid a solid foundation for a genuinely sustainable project. However, as solid as this foundation may be, the period remaining in the project is insufficient for the work which remains; the project needs a third phase to ensure that the progress which has been made can be institutionalized. It is the feeling of the evaluation team and project staff that such an extension is essential, justifiable, and entirely consistent with the nature of the work at hand.

The evaluation team arrived at this conclusion by considering the physical (pumping) infrastructure; economic viability; credit; marketing and storage; the infrastructure which supplies basic project inputs and services; and cooperative management systems & training. In almost each case, though remarkable progress has been made over a brief and difficult period, the 'institutionalization' of project infrastructure has yet to be achieved. With equal

II. Economic Viability of Small Scale Irrigated Agriculture

A number of questions have been raised as to whether o not small scale irrigated agriculture in the Dire Region is economically viable, and thus sustainable, because of 1) it remote location, 2) the level of farmer education, 3) the farmers experience with pumps and maintenance, 4) the difficulty of fuel and spare part procurement, 5) and the complicated process of effective water delivery and irrigation infrastructure maintenance. In spite of these difficulties, farmers have now had more time to learn how to care for their equipment, and have had good wheat yields. Furthermore, inputs are being delivered on time, and the issue of maintenance capability is being addressed. Some farmers are maintaining their own pumps, and others are receiving good servicing from AP staff and/or trainees.

As AP staff now have confidence in the technical data being collected, estimates of economic viability are generally more reliable. The most troublesome variable factor is the market price, especially in the case of wheat. For the purpose of this analysis, then, two prices are considered; a conservative 105 CFA/kg and a higher 160 CFA/kg which is closer to the prices received in 1984 and 1985 before large quantities of donor food aid were introduced.

Different estimates of economic viability are needed for the Ganganiberi cooperative where members are sharing

This assessment of the ecnoomic viability at Gangalberi includes the new 52 HP lombardini pump installed in 1986 for which 92.5 additional hectares of land were levelled and prepared, and for which an additional 185 new members were taken into the cooperative. This analysis employs average yields obtained in the 1985-86 (3.3 tons per hectare of wheat and 1.7 tons per hectare of millet)* and prices described above. It is also assumed that each family/household will be allocated one half hectare; that the average family size is 9, and that each family member will consume .5kg of grain per day (or approximately 184 kg per year). It is further assumed that families will first use millet for consumption needs and that remaining consumption needs will be met from wheat. Surpluses after consumption needs have been met are then assumed to be sold.

*/ In this campaign the method used for estimating yields was random sampling of farmers fields by taking small square samples and extrapolating. The numbers so obtained may be unrealistically high. The current wheat campaign (1985-86) at the time of this evaluation is almost finished and more sophisticated sampling techniques, using larger sampling

The average life of the Lombardini pumps is believed to be at least six years, and will increase as farmers gain experience with this equipment. However, a more conservative estimate of four years is utilized in this analysis.

Under the first price scenario of 105 CFA/kg in GAN1 (see Annex A) each farmer realizes average net return of $144 per year for the first four years, and a higher net return after pump repayment of the pump in year four. These net returns represent significant increases in income and food security to these farm families.

In addition to the second price scenario (GAN2) the average annual net returns increase to $279 per family for the first four years while loan repayments are being made.

b) Smaller Individual or Cooperative Groups

For the farmers at Kessou Korey, the estimate is based on the NIGER 200 pump as a replacement for the nearly defunct Cooper pumps. The Niger 200 pump has a discharge of 200 cubic meter of water per hour at 8 meters head (vertical distance), and is similar to the Deutz Guinard pumps which have recently entered the area. In estimating the economic viability of these pumps, the assumption is made first that 15 hectares of wheat and millet will be grown by four farmers with 3.75 hectares each. Assumptions regarding consumption remain the same as in the case above and the initial price is 105 CFA per kg for wheat and 100 CFA/kg for millet. Under these assumptions, the average benefit per hectare is 138,500 CFA or $462 (based on 300 CFA/$US) or $1,721 per farm family/household with 3.75 ha of land (Cas

When the same assumptions are used but the price of wheat increases to 160 CFA/kg (NIGER2) the price of millet remains the same as above, the net benefit increases to 229,250 CFA per ha ($764 or $2,866) per household for the first five years, and increases after capital repayment has been completed. Again, the importance of increased food security for these farm families and laborers cannot be overemphasized.

In NIGER3 and NIGER4 scenarios, the same prices are utilized, but the assumption is made that each farmer household receives only one hectare of irrigated land in addition to their rainfed holdings. In NIGER3, average net returns per hectare and per household fall to 2,210 CFA. With the higher wheat price of 160 CFA/kg in NIGER4 net returns per household increase to 26,410 per annum. Again, the importance of the food security for these families cannot be overemphasized.

In terms of economic viability, then, it appears reasonable to conclude that farmers will demonstrate net positive returns after all family consumption is considered, and operational costs have been subtracted from total output. It is worth nothing that this result is achieved even when the wheat price and average land holdings are reduced to 105 CFA/kg and 1 ha respectively.

iii. CREDIT

A solvent credit fund is critical to project sustainability, for it allows farmers to procure basic inputs and supplies needed each agricultural campaign. The AP credit fund is adequately fulfilling this role under project management; the issue now is to institutionalize this service to assure post-project sustainability.

The AP revolving credit fund consists of monies provided to the Project by the GOM in the form of PL 480 reflows, and monies provided by USAID under the original USAID Action Ble program. The objectives of the credit program have been 1) to provide farmers with the means to purchase diesel fuel, motor oil, spare parts, and other basic inputs. 2) train counterparts in credit management to sustain the project when Africare technical assistance terminates.

During AP II, credit contracts have been drafted for signature and signed by individual farmers; these contracts are written both in French and in the local language (Songhay). Credit needs are assessed for each farmer and limits established for each season. In the case of the cooperatives, only one contract is written irregardless of the number of cooperative members. It is the obligation of cooperative management to supervise allocation and collect repayment from its members. AP technical personnel have revised the list of farmers who could participate annually

so that farmers with poor repayment records are no longer receiving credit. Credit currently reaches over 400 farmers, and repayment has been principally in-kind (wheat). In 1987, Project mechanical services (excluding spare parts) will be paid on a cash basis only.

Repayment rates for 1985-6 were high in the context of credit programs across Africa -- e.g. 83%. However, the calculation of the repayment rate is conditional upon the market price of wheat at and after the harvest. This price has varied considerably from year to year, putting the credit recovery program in considerable jeopardy. Emergency donor food aid released on the Dire market caused prices to fall precipitiously. Thus by the time Africare could sell the wheat taken as repayment in kind, prices had fallen so that the real repayment rate for the year was approximately 34%. Repayment of old debts are not included in these estimates.

Repayment rates for earlier years were 48%and 52% respectively. Repayment rates for each of the major cooperatives, based on prices allocated at the time of delivery of wheat were 100% for Ganganiberi and 100% for Kessou Korey during 1986. At present, AP II technical assistance personnel collect wheat from the farmers and transport it to the Project's storage facilities.

Obviously the sustainability of the credit program is dependent upon market prices at harvest and, in the future,

the management program which will eventually be established. For the moment, the inputs are available and are being delivered on time -- a characteristic which is unique in most African credit programs. Credit procedures are in place, and record keeping is up to date. (Each farmer receives a card and each time credit or payment is received, an entry is made on the card. Thus each farmer knows his credit standing; duplicate records are kept at AP offices.) It is the volatile market price which is complicating matters. This will not change when AP withdraws from the program unless the GOM or some other agency provides a floor price which is guaranteed at harvest and known at planting times.

The sustainability of all aspects of the credit program depends upon its institutionalization before the Project's end. To date, there has not been adequate time to effect this institutionalization. The Local Centre d'Assistance des Cooperatives (CAC) in the Circle does not provide for such a service, as was anticipated during the project design. Training for the management committees of each cooperative (to enable them to supervise and allocate their own credit programs) is going forward but this does not address the problem of overall managerial and logistical infrastructures. The AP staff recommends a three year extension in order, among other things, to firmly establish these infrastructures.

Part VII A, IV Marketing

Successful marketing of the farmers final product is undoubtedly crucial for long-term sustainability. Without an effective marketing system, the farmers' incentives to produce will effectively be eliminated.

AP currently receives wheat in kind as payment for credit services rendered, and replenishes the credit fund by selling the wheat on the open market. OPAM is the GOM parastatal responsible for purchasing cereals at floor prices announced before planting. OPAM purchases millet and rice in Dire, but unfortunately not wheat. The Project's options for selling the wheat are therefore limited to the open market, or private grain dealers.

Wheat prices in Dire have fluctuated markedly over time due to severe shortages and, more recently, intensive inflows of donor grains. In 1985 wheat was in such short supply that local residents formed lines at the Project storage facility in Bourem in order to obtain a ration of cereal. Cereal prices are now so severely depressed that huge surpluses burden OPAM's storage facilities.
(It should be noted here that one food aid supplier has advanced the hypothesis that the imposition of large quantities of maize had little or no impact on the wheat prices in the dire region. The implication, therefore, is that the cross price elasticity of demand for Maize and

Wheat is Zero -- this is a postion that, given the nature of the goods and the consumption patterns in the region, appears extremely difficul to support.)

Prices in the Dire market

Wheat	CFA/kg
Dec 84	160
Jan 85	189
Feb 85	189
Mar 85	197
Apr 85	212
Aug 86	115
Sep 86	118
Oct 86	105
Nov 86	89
Dec 86	118

Rice	CFA/kg
Dec 84	200
Jan-Mar 85	190
April 85	225

Millet	CFA/kg
Nov 84-Jan 85	121
Jan 85-Mar 85	182
Apr 85	182
Aug 86	107
Sep 86	118
Oct 86	105
Nov 86	105
Dec 86	105
Mar 87 (Bamako)	65

Sources: 1) Activites Paysannes Phase II proposal, Dire Sixth Region, Mali, West Africa. pp. 38-40. 2) Activites Paysannes Phase II Fourths Quarterly Report, p. 64

Currently the market prices for rice and millet are below the official price, a condition that has not been

observed in the history of the OPAM. OPAM storage is overflowing with stocks, and they are now refusing to purchase additional cereals. Based on Project experience in 1985, Activities Paysannes staff stored wheat recuperated in-kind in anticipation of better market conditions. Unfortunately, prices continued to drop. In order to minimize further losses to the credit fund due to insect infestation and further deterioration of market prices, USAID recommended immediate liquidation of the wheat stocks irregardless of unfavorable market conditions. In-kind recuperation and final sale prices were 167 CFA/kg and 70 CFA/kg respectively -- a loss of roughly 60% the original value.

It is clear that the sustainability of the entire program is dependent on prices received for the major cereals produced. Farmers make planting decisions based upon prices expected at the time of harvest, other things being equal. If AP continues to subsidize wheat producers in this fashion, all credit funds will soon be exhausted. Project personnel have, however, a) modified the in-kind recuperation policy to reflect market conditions, and b) explored the possibility of securing commercialization loans from the BNDA for the major cooperatives. These loans would enable the cooperatives to hold their stocks until such a time when more favorable market conditions prevail.

In 1987, the BNDA agreed to provide the two cooperatives in the AP program loans at 66.22 CFA/KG to repay AP at harvest and sell the grain at a later time. The BNDA will not, however, guarantee a floor price to the cooperatives. This will transfer the risk from AP to the cooperative management and members. AP is assisting the cooperatives in the BNDA loan application procedure. It remains to be seen how viable these loans will become in 1987 and in the future.

In conclusion, the local markets for cereals were severly disrupted by exogeneous supply-side shocks and the consequent deterioration in crop prices. Stabilization of these prices, combined with commercialization loans to help local farmers market their crops, should reverse the current situation and achieve a marketing environment consistent with long-term sustainability.

The AP Project staff anticipate recuperation of between 400 and 500 tons of cereals during the 1987 wheat campaign. In light of this projection, the project's existing 120 ton storage facility appears inadequate both in terms of capacity and appropriateness. Without adequate storage facilities, the incentive for farmers to produce large cereal surpluses is dubious.

The grain storage issue is a complex problem that the AP personnel have been grappling with since the project's inception. Lack of facilities constrains both Project and farmer commercialization strategies, and thus threatens Project food production objectives. Given the volatile nature of the cereal market in the northern regions of Mali, storage is vital if farmers -- and the Project -- are to attempt to optimize grain sale revenues.

Selection of the most appropriate storage facilities and/or techniques has not been determined by the Project, and the course of action is seriously constrained given the inadequacy of funding available for storage. Another issue that has entered into the equation is the means by which 90 tons of urea and 90 tons of phosphate, specified in the Phase II proposal, are to be stocked. Project are convinced that fertilizer and chemical storage should be considered separately from cereal storage facilities.

The Ganganiberi and Kessou Korey cooperatives are also considering the storage issue. AP has recently initiated contact between the BNDA and cooperative groups interested in receiving commercialization loans (see Marketing section). The candidate's ability to store their grain, however, is a precondition to loan approval. Ganganiberi will require approximately 200 tons of storage capacity, and Kessou Korey 125 tons. The BNDA's definition of adequate storage includes the ability to closely monitor and maintain the quality of the stock which seems to preclude storage on an individual basis.

Construction alternatives of appropriate facilities --- both considering and not considering budgetary constraints --- are currently under investigation. The possibility of renting storage space in the immediate area has been approached, however, BNDA guidelines have again precluded certain options. Identification of purchasing agents or companies that could be contracted to reliably absorb surpluses would be an ideal solution. The responsibility for storage could then be shifted to the buyer. Improvement of farmers' traditional storage techniques has been suggested. Aside from problems with BNDA guidelines, the utility of improved storage facilities/techniques would be of great benefit to the farmers.

In conclusion, the cereal storage issue greatly affects

Irregardless of the alternative, the level of funding available to address this issue is seriously deficient. If the current budget cannot be adjusted to address this issue, Africare should seek assistance elsewhere.

V. Supply and Delivery systems

The timely supply of basic inputs is prerequisite to irrigated production and invariably long-term productive viability. While the current logistical infrastructure provided by the Activites Paysannes II project assures such timely input delivery with a minimum level of uncertainty, the post-project scenario will require rapid development of private sector and/or cooperative service institutions to achieve the same degree of efficiency. While this objective may prove difficult to resolve entirely in the remaining eighteen project months, it is clear that a prolonged period of institutional support, entirely consistent with the time-frame of the objective at hand, would be a logical alternative if self-reliance is in fact a donor objective.

Fuel and oil delivery under the API I project.

The project is currently meeting the fuel and oil demands of farmers participating in its program. Total fuel storage capacity has been increased to 200,000 liters of diesel fuel, and two to three thousand liters of motor oil. The delivery system is capable of providing 150,000 liters by river at a time three to four months of the year. A new company, Petrostock-Mali, began in 1986 to make successful overland fuel deliveries of up to 20,000 liters upon request. During the current peak demand (wheat season) total theoretical need is 80-90 thousand liters, while the demand at current production levels has reached only 120,000 liters

over similar periods. This implies potential for increased capacity of 40%.

Spare parts for pumps

As mechanical water delivery systems do not share the same generic qualities of fluid inputs, the infrastructure for suporting their delivery is decidedly more complex. The project is now stocking spare parts to support the maintenance of several varieties of equipment including the original Cooper motorpumps, two types of Lombardini motorpumps (Niger 200 and Niger 750), and 4 Hatz motorpumps (two 10.5 HP motorpump and two 9HP motorpumps) This is in addition to replacement parts for the project vehicles which enjoy a greater degree of standardization and off-shelf availability in Bamako.

Parts for the Cooper pumps are generally in short supply, and several important parts that would be required for the complete overhaul of marginally functional pump/motor sets are conspicuously absent; Cooper International's insolvency further complicates this situation by rendering future procurement entirely impossible. The fact that Cooper pumps have been in use for a period at least as great or greater than their effective operating lives, however, makes the issue of long-term serviceability essentially irrelevent; the Cooper motorpumps will most likely be retired by all but the most obstinate (or least solvent) farmers who will suffer the machine's

inefficiencies up to the time at which the pumps are entirely inoperable.

For newer equipment such as the Lombardini and Hatz motorpumps, some essential spare parts are available in Bamako and others stocked at the project site. The equipment is currently procured by the project and sold to the farmers for either cash or credit. The project also provides pump rental services (Hatz and Lombardini pumps) to the farmers.

The supply of seed and fertilizer is less problematic than either of the inputs described above due to their abundance locally. As for seed, the farmers generally use their own grain and are thus independent of external sources. Subsidized fertilizer has been available through Action Ble over the last two years and, as its use is limited, availability in the near or long-term scenarios does not appear to be an issue save for the case involving large irrigation schemes (where fixed pumping structures and large surface areas under cultivation require fertilizer over the years).

Conclusion

As the infrastructure for the supply and delivery of essential inputs now rests almost entirely within the expatriate project activity, the sustainability of the post-project delivery is contingent upon the transfer of

management capacity from project personnel to project beneficiaries, as was anticipated in the project document. While there is every indication that this transfer can be realized, its formula and timing are less certain. The question of management capacity is addressed later in the evaluation report. (See Cooperative Management)

VI. TRAINING

The Project's sustainability is contingent upon the transfer of management and service infrastructures from Project staff to local organizations. The vehicle by which this transfer is effected is, in short, the Project's training component. The following discussion will consider the constraints facing the Project's training component and hence the attainment of Project objectives: progress made to date; and prospects for future activities.

VI.1 Cooperative Management

The Project document envisioned the development of cooperative structures to the point where they would be autonomous management institutions capable of providing the goods and services requisite of sustainable irrigated production. The training that the cooperative members were to receive included, among others, adult literacy, farm management and cooperative administration. The sources anticipated for this training included the C.A.C., the Site Development Committee, and, of course, AP II Project staff. As stated in the Project's logical framework, the final organizational structure was to include one "general cooperative," which was presumably to assume responsibility for the overall coordination of logistical activity, and 10 "sub-cooperatives," which, in turn, were presumably to receive services from the "overall" cooperative while

assuming coordination among individual farmers at the village level.

Before considering the degree to which the Project has realized these objectives, it is important to acknowledge several unanticipated constraints: the CAC and the Dire Development Committee, which were expected to provide assistance in the cooperative development enterprise, have been only marginally cooperative in their provision of development assistance. This is further complicated by the problem of "double illiteracy," i.e; the need to first bring farmers to literacy in the local language before attempting literacy in French (which is required for nearly all logistical, procurement, management, and credit activites).

The constraints cited above have effectively prohibited the rapid development of the ZOP cooperative management structure described in the Project document; however, the Project staff has succeeded in materially advancing two cooperatives which may reasonably be considered "sub-cooperatives" capable of providing important services to their members. In the case of Ganganiberi --- a large cooperative of over 300 members cultivating approximately 170 hectares --- an administrative council oversees the procurement of fuel and supplies (on credit) from the Project as well as the design and construction of irrigation structures, and the provision of efficient water delivery services.

The Kessou Korey cooperative, with 18 members cultivating approximately 105 hectares, has achieved success only in its ability to provide procurement services. It is not, however, recognized by the CAC as a bonified cooperative. Nevertheless, the Kessou Korey members are now negotiating with Project personnel to procure new pumping equipment on credit in order to replace their existing equipment on the verge of collapse.

In both cases, as the Project's Fourth Quarterly Report notes, "the issue of rudimentary literacy skills for many of the Administrative Council members remains fundamental. This invariably poses an obstacle to the cooperatives' effective management, and, ultimately, to the viability of the entire project.

Project personnel are generally not optimistic that the literacy issue will be adequately resolved in the remaining 18 Project months. Given the rate of cooperative development during the first half of the Project, the logframe targets for this component may prove to be elusive if the Project's primary focus remains the expansion of total hectarage under cultivation. An intensification of the training effort, coupled with a Project extension of two or more years to complete and solidify the farmers literacy and management capabilities, could reasonably be expected to resolve this constraint.

vi.ii Mechanics Training

The objective of the mechanics training program is to produce mechanics competant in pump maintanence and repair. This program focuses on shop management, weekly planning, parts ordering, and long-term inventory needs. For the shop mechanics and trainees, the Project staff have placed emphasis on routine maintenance, proper use of tools, trouble-shooting, and distinguishing between various types of metals, etc. With this is mind, the Project's original goal of rapid training sessions to train 30 mechanics in pump repair has shifted to thorough, longer-term training. There are currently nine mechanic trainees involved in the program.

Though notable strides have been made in increasing the mechanics' level of proficiency, illiteracy is a serious handicap which retards the entire process. Functional literacy in French is necessary in order to read catalogs and repair manuals as well as to work with certain tools. The majority of mechanics, however, are illiterate not only in French, but in their native language, Songhay. Though a language trainer is presently engaged to deal with this problem, it is doubtful that the mechanics will achieve functional literacy in French by the EOP due to their "double illiteracy."

VI.ii. AP II Malian staff

Though not a formal Project objective, one cannot overlook the importance that the training of AP staff counterparts play in the long-range goal of sustainability. One option that has been advanced is that the Malian counterparts to the 5 Project Africare technicians assume management responsibility for all post-EOP activities. There are 6 qualified Malian counterparts who assist the AP expatriate staff. They are as follows:

o Hamuny Toure - Assistant Project Coordinator

Participated in the development of training programs for adult literacy and management for the cooperatives; conducts the above-cited programs; assists in the collection of information for the Agricultural Production Surveys

o Mohamed El Kassim - Assistant Shop Administrator

Assists in logistics,procurement, sale and distribution of Project and credit fuel, various administrative issues

o Mohammad Konare - Assistant Irrigation Specialist

An irrigation engineer, himself, he assists the Africare [illegible] to agricultural surveys, collecting and analyzing yield data, and installing improved irrigation systems

o Soumaila Maiga - Assistant Credit Manager

Maintains farmer credit records; conducts credit/management training for the cooperatives; participates in farmer credit recuperation

o Mamane Baba Soumare - Assistant Workshop Chief

Maintains records on pump maintenance and spare parts; assists in supervision of mechanics and trainees

o Kata Maiga - Trainer

A linguistics specialist, speaks English, French, and Songhay; assists in designing program materials for training; schedules and supervises overall training activities. He also translates most official Activites Paysannes documents and correspondence from English to French.

All of the above-mentioned Malian technical staff are capable of substituting, if need be, for their expatatriate counterparts.

B. Pumping Systems

Before launching into an intensive discussion on motorpump technology, there are several realities that need to be highlighted and reemphasized:

1. Activities Paysannes Personnel have estimated that there are possibly fewer than 100 Cooper motorpumps still operating in the region. There is also ample evidence that the pumps' operational viability is deteriorating so rapidly that their continued service during the next agricultural campaign can not readily be assumed.

2. Two hundred and fifty Deutz pumps have arrived in the Circle of Diré, although it now appears that a significant number of these have been taken outside the region for which they were intended. Present and future availability of spare parts for these pumps has yet to be determined. By the sheer force of their numbers, however, we may at least conclude their influx has, to a certain degree, accomplished standardization of pumping equipment in the region.

3. AP II has extremely limited funds to purchase additional motorpumps as replacements for the failing Cooper motorpumps. A certain amount of capital expenditure, either by the farmers themselves or through loans from the Project, the BNDA, or another outside funding source, will be required to sustain current levels of production.

4. The issue concerning the number of Deutz pumps which the project will support has not been resolved. This is a matter that must be resolved so that an appropriate level of spare parts/equipment can be procured.

The AP II Project fufills an important role in supporting much of the present motorpump technology in and around the Circle of Dire. And while the introduction of this technology may have radically increased the farmers' productive capacity over an extremely brief period of time with a relatively limited investment, the maintenance of the current level of output --- or indeed the technology itself --- requires a long term commitment on the part of the donor organizations to develop and institutionalize basic infrastructural support and management systems.

Past experience in Africa demonstrates the problems encountered when the production aspect of a project is emphasized over the sustainability of management infrastructures. Rapid development of physical infrastructure may be achieved, but followed by an equally rapid deterioration if little effort is made to develop the capability to effectively operate, manage, and maintain the physical infrastructure.

AP II is essentially still at the phase of solidifying such an infrastructure, and it appears unlikely that

adequate time remains before the EOP to institutionalize essential services now being provided by the Project.

The Cooper motorpump was a good selection in terms of pump requirements, and was an excellent choice for farmers making the quantam leap from calabash "technology." One of the few disadvantages of selecting Cooper over other models was that the pumps are no longer manufactured, and spare parts are essentially unavailable. Advantages of selecting Cooper motorpumps were many; the motorpumps are small enough to be amenable to individual farmer ownership cultivating between four to six hectares; they are relatively inexpensive, simple, durable, and rugged; they are easy to operate and maintain, watercooled, and portable. Unfortunately, there does not appear to be a similar motorpump within a reasonable price range that could be recommended as a candidate for replacing the Cooper. All recent motorpump arrivals in the region range anywhere from 3 to 4 times the capacity of the Cooper.

For the moment, the project suffers from having to support a wide variety of motorpumps, few of which have desired compatability when it comes to interchanging spare parts. Two benefits, though perhaps somewhat marginal, are 1) that AF mechanics will gain expertise through working on several different models and, 2) that motorpump performance can be evaluated for experimental and selection purposes. With the influx of 250 Deutz Guinard motorpumps, however,

every effort should be made to standardize any new project pumps with equipment currently in the Region.

Since farmers are moving into larger motorpumps, individual farmers are being encouraged to group around larger units in cooperative ventures. Because these units have a higher discharge, the irrigation infrastructure is naturally larger. It follows that mobility of the motorpump is also sacrificed to some degree. In the case of the larger cooperatives, where several large motorpumps are grouped, the irrigation infrastructure requires permanent structures at substantial investment costs. Other ramifications are that the soil fertility levels and infrastructural maintenance must be carefully monitored since farmers are no longer as mobile.

With regards to the Ganganiberi cooperative, the Agricultural component of AP II should investigate the construction of a suitable intake, and establish a stationary placement of the larger pumping units. This will also mean less head loss due to pipe friction and greater overall system efficiency since water will be channeled

C. Crop Diversification

What should be kept in mind before considering any crop diversification alternative is the location of Dire in relation to any potential market outlets. Assessment of local consumption habits and possible impact of integrating any new crop into the local economy is mandatory. Farmers cannot be expected to continue investing in irrigation and adopt different crop production strategies if markets cannot be developed for their crops. The AP Project is currently conducting improved seed variety and irrigation trials for wheat. The agricultural research station in Dire has conducted research on cowpeas, and the AP Project staff have expressed an interest in establishing demonstration plots both on individual and cooperative levels. The agricultural component is especially interested in pursuing forage crops such as alfalfa and cow pea production residuals, and assessing the animal traction potential in the area.

In addition to wheat, farmers also grow millet, onions, and rice (primarily floating), some spices, and small quantities of other crops. There does not appear to be any serious irrigation or agronomic constraints for crops presently under cultivation in the region. The important issue is whether farmers can market the crops they grow, and whether prices they receive will support sustained motorpump technology.

Lack of a developed transportation infrastructure greatly restricts diversification into vegetables (tomatoes for example) because transport costs are so great as to effectively prohibit competition in the more distant

markets. Diversification in vegetables must therefore be targeted to satisfy local and/or regional demands. In addition, before any crop diversification is encouraged, cultural and dietary factors must be assessed.

VIII. Recommendations

1. Shift the emphasis of the project during the remaining 18 months from increased production to intensified literacy and management training. In practice, this will amount to holding the number of hectares and/or farmers participating in the project constant while redirecting energies to the training aspect of the project.

2. Contract a consultant experienced in West African Marketing problems to study the marketing options in the Dire Region.

3. Based on (2) above, contract a storage/processing expert to examine a) the prospects for the promotion of village level storage facilities and, b) the cost, feasability, need, and appropriateness of large scale storage structures.

4. Begin preparation of a Phase III Project Paper which will have the objective of institutionalizing management service infrastructures.

5. Pursue standardization in pump procurement with respect to other equipment now entering the region [illegible] the issue of adequate spare part supply is resolved. Otherwise, encourage procurement of equipment for which there is a readily available supply in Bamako.

6. Regarding fuel storage:

a. procure a fuel pump and counter;

b. ground the fuel tanks;

c. secure liability insurance for the tanks.

7. Develop a means of releasing trained mechanics into the private sector after they have achieved an appropriate level of competence. There may be a need to increase the total number currently working with the project (9) --- this need should be evaluated.

8. Agressively pursue negotiations with the BNDA to provide an institutional framework for the provision of credit. One EOP scenario would be to have the BNDA assume responsibility for administering credit monies.

ANNEX A

III. Economic Feasibility New Pumping Systems

Introduction:

The Islamic Development Bank's gift of 250 irrigation pumps to the Dire Region will have a profound effect on the farmers' incentives for taking on long-term credit. The promise of these pumps reduces the expected value (or cost) of such equipment; it is rational for the farmers to refuse to purchase similar equipment at higher (non zero) prices. Purchasing pumps from the project, in fact, would be an unlikely, and illogical decision for utility maximizing consumers.

At this time, however, there are still a number of uncertainties regarding the new 'gift' pumps. For one, there is some debate about the actual number to be distributed -- while most parties generally speak of 250, there has been mention of this figure being reduced to 125. Furthermore, agreements as to the number of pumps the project will receive are still preliminary. And finally, the terms or conditions (if any) on which these pumps will be given to the farmers have not been specified.

In short, there is a good deal of ambiguity regarding the economic environment in which farmers may or may not be taking on credit to purchase new equipment. As such, it appears particulary important to pay close attention to the financial ramifications of long term credit for pumping equipment. This analysis, therefore, does not attempt to assess the probability that farmers in any given area will or will not

decide to purchase pumps from the project -- it is already clear that there are powerful disincentives for doing so -- rather, the discussion here focuses on farmers who actually d purchase pumps.

a) Ganganiberi Site

The Ganganiberi Cooperative cultivated 92.5 hectares during the last wheat season, and proposed to expand production to 200 hectares during the next season. Technical recommendations from Dire Ag. Engineer Gary Freeman and Consultant Kurt Lonsaway (irrigation engineer) include limiting expansion to 185 hectares, the procurement of a new 52 HP Lombardini pump, an upgrade of the Cooperative's Hatz pump, and the provision of hosing for the pump upgrade. The total cost of this capital investment, including spare parts for the new Lombardini pump, is $34,100 at current exchange rates. In addition to these expenses, Freeman and Lonsway projected that fuel consumption during the wheat season to service the expanded hectarage (92.5 additional hectares for a total of 185 ha) would come to $17,680, approximately $11,871 more than the Cooperative spent during the most recent wheat campaign.

The feasibility study presented here is a Marginal Budget Analysis that considers sensitivity to prices and yield. The model assumes that the additional 92.5 hectares will be farmed by 185 new cooperative members each with a family size of 9. The number of new members used here was based on the current average of one half hectare per farmer, while the family size is based estimates of regional averages. Furthermore, the model assumes that the farmers and their families will consume .5 kg

of grain per day (or approximately 184 kgs of grain per year),[1] and that the farmers will first use millet for consumption needs. Remaining consumption needs will be met from wheat crop production. Unconsumed wheat is assumed to be sold in one of the local markets - either Dire or Tombouctou.

The "Capital Replacement Fund" used in these calculations represents the amount that needs to be set aside each year in order to purchase a new 52 hp motor and spare parts (25% of purchase price) at the end of four years. It is also assumed that the annual payments are made to an account bearing 9 percent annual interest. The cost of the pump upgrade is not included in the capital replacement fund principally because we may assume that the replacement fund that was (or should have been) established to replace the Hatz pumping set will cover this expense.

According to the model, then, the farmers of Ganganiberi will, as a result of the anticipated expansion, realize a net loss of $15,331 during the first year and $11,284 in years 2 through 4 if:

* they do not improve their current average yields of 2.25 tons per hectare

* the price of wheat stabilizes at 105 CFA per KG.

Per farmer losses come to $83 in the first year and $64 in years 2 through 4. It is important to remember that this is a

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1, In fact, .5 kg per day is on the high side -- estimates now used by food relief agencies range from 119 to 184 kgs per year, or .32 to .5 kg per day.

marginal loss, and does not reflect the farmers' cash position. For example, if some given farmer's income was $200 before the expansion, his income will be reduced by $83 to $117 as a result of this expansion. (Returns to his labor will obviously fall more sharply given that these reduced profits are applied to an expanded labor input.)

The situation improves, however, if the farmers manage to sustain yields of 3 tons per hectare - at which point they would have collective profits of 5,482 in year one and $8,892 in years 2 through 4. The corresponding per farmer profits are $30 and $48.

Holding yields constant and moving the price to 125 CFA per kg results in per farmer profits of $64 in year one and 83 in years 2 through 4. Finally, in the best case scenario where yields reach the project average of 3.5 tons per hectare and wheat prices stabilize at 185 CFA kg, profits for the Cooperative will come to $55,617 in year one, and $59,027 in years 2 through 4. Corresponding per farmer profits in this case are $301 in year 1, and 319 in years 2 through 4.

In Summary, the farmers of the Ganganiberi Cooperative will probably lose money (or fail to make payment on their loans or to a capital replacement fund) if they do not improve their yields and, at the same time, wheat prices remain depressed. Improvements in yields and wheat prices, however, will result in a positive net marginal benefit. These scenarios are presented in detail in the following tables.

File: GANGANIBERI

MARGINAL BUDGET ANALYSIS FOR GANGANIBERI COOPERATIVE EXPANSIO
(I.E. FINANCIAL IMPLICATIONS OF PROPOSED EXPANSION)

CASE 1. ANNUAL INPUT EXPENSES ASSUME 10% DOWNPAYMENT, 4YR WUP AT 12 % INT

E. RATE = 1350

DESCRIPTION	COST	YEAR ONE EXP	YEARS 2-4 EXP
I. FIXED (CAPITAL) COSTS			
NEW LONEARDINI 52 HP IN GRAPES	121,250		
PUMP UPGRADE	110,000		
ADDITIONAL HOSE FOR UPGRADE PUMP	12,857		
Total Loan	134,107		
Annual Repayments		13296	9869
Capital Replacement Fund(@ 5% int)		4647	4647
Total Annual Payments		17943	14533
II. VARIABLE COSTS/SAVINGS			
WHEAT CAMPAIGN			
CURRENT FUEL CONSUMPTION (ACTUAL)	16,916	210	
~~Litres~~ Projected Fuel Consumption	17,680		
Cost Per Litre (CFA)	235		
~~Marginal~~ Total Fuel in U.S. $	111,671		
Litres Oil Consumption	95		
Price Per Litre	280		
~~Marginal~~ Total Oil in U.S. $	212		
~~Marginal~~ Total Fuel & Oil Consumption $	112,083		
NET FUEL COST INCREASES (Unsigned)	15,167	15,167	15,167
TOTAL COST INCREASES (EXCLUDING LABOR)	139,274	123,110	119,700

III. Increased Production

a) Wheat Season

Hectares =	92.5
Tons/Hectare	2.25
Total Tons Production	208.125

Quantity Saved for Consumption Assuming:

a) # additional farmers =	185		
b) Av family size =	9		
c) kgs./person/day =	.2716895		
Total Tons Consumed =	165		
Tons Wheat Remaining (yrs 1-4)	43		
CFA Per KG Wheat	105	Year 1	Years 2 - 4
$per ton at 350 CFA/U.S.$	$300		
Value of Remaining Wheat	$12,904	$12,904	$12,904
Profits		($10,206)	($6,796)
Profits Per Farmer		($55)	($37)

b) Expanded Millet Production (AP Projection)

1. Marginal Variable Costs		Year 1	Years 2 - 4
Litres additional fuel consumption	7,500		
Price Per Litre (CFA)	235		
Additional Fuel Consumption ($$)	$5,036		
Litres additional oil consumption	40.0		
Cost per litre (CFA)	780.0		
Additional oil consumption ($$)	$87.1		
Total Margin Millet Campaign Costs	$5,124.9	$5,124.9	$5,124.9

Hectares	92.5
Tons per Hectare	1.5
Total Tons per Season	138.8

Tons Saved for Consumption

Number of new Farmers	185.0
average family size	9.0
av kg consumption per day	.5
Tons Needed for Consumption	303.7

File: G:\MORNIBERI

SUMMARY ----------

	Year 1	Years 2 - 4
Total Marginal Costs	$28,234	$24,624
Total Marginal Benefits	$12,904	$12,704
Total Profits/Losses	($15,331)	($11,921)
Profits/losses per farmer/year	($82)	($64)

File: GANGANIEERI

MARGINAL BUDGET ANALYSIS FOR GANGANIEERI COOPERATIVE EXPANSIO
(I.E. FINANCIAL IMPLICATIONS OF PROPOSED E PANSION)

CASE 1: ANNUAL INPUT EXPENSES ASSUME 10% DOWNPAYMENT, 4YR AMR AT 12 % INT

Ex RATE = 1250

DESCRIPTION	COST	YEAR ONE EXP	YEARS 2-4 EXP
I. FIXED (CAPITAL) COSTS			
NEW LOMBARDINI 52 HP W/SPARES	$21,250		
PUMP UPGRADE	$10,000		
ADDITIONAL HOSE FOR UPGRADE PUMP	$2,857		
Total Loan			
Annual Repayments	$34,107		
Capital Replacement Fund(3 % int)		13296	9886
		4647	4647
Total Annual Payments		17943	14533
II. VARIABLE COSTS/SAVINGS			
WHEAT CAMPAIGN			
CURRENT FUEL CONSUMPTION (ACTUAL)	$5,516		
Litres Projected Fuel Consumption	$17,550		
Cost Per Litre (CFA)	235		
Marginal Fuel in U.S. $$	$11,371		
Litres Oil Consumption	55		
Price Per Litre	760		
Marginal Oil in U.S. $$	212		
Marginal Fuel & Oil Consumption $_	$12,023		
NET FUEL COST INCREASES	$5,167	$5,167	$5,167
TOTAL COST INCREASES (EXCLUDING LABOR)	$39,274	$23,110	$19,700

III. Increased Production

a) Wheat Season

Hectares =	92.5
Tons/Hectare	3.00
Total Tons Production	277.5

Quantity Saved for Consumption Assuming:

a) # additional farmers =	185
b) Av family size =	9
c) kgs/person/day =	.271595
Total Tons Consumed =	185
Tons Wheat Remaining (yrs 1-4)	112
CFA Per KG Wheat	105
1per ton at 350 CFA/U.S.$	1300
Value of Remaining Wheat	133,716

		Year 1	Years 2 - 4
		133,716	133,716
Profits		110,607	114,017
Profits Per Farmer		157	176

b) Expanded Millet Production (HP Projection)

1. Marginal Variable Costs		Year 1	Years 2 - 4
Litres additional fuel consumption	7,500		
Price Per Litre (CFA)	235		
Additional Fuel Consumption (11)	15,036		
Litres additional oil consumption	40.0		
Cost per litre (CFA)	760.0		
Additional oil consumption (11)	137.1		
Total Margin Millet Campaign Costs	15,124.9	15,124.9	15,124.9

Hectares	92.5
Tons per Hectare	1.5
Total Tons per Season	138.8

Tons Saved for Consumption

Number of new Farmers	185.0
average family size	9.0
av kg consumption per day	.5
Tons Needed for Consumption	303.9

File: GRIGRNTBERI

Remaining tonnage or need (yr 1)

SUMMARY ----------

	Year 1	Years 2 - 4
Total Marginal Costs	$28,234	$24,824
Total Marginal Benefits	$33,716	$33,716
Total Profits/Losses	$5,482	$8,892
Profits/losses per farmer/year	$30	$48

File: GANGWIEERI

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MARGINAL BUDGET ANALYSIS FOR GANGWIEERI COOPERATIVE EXPANSION
(I.E. FINANCIAL IMPLICATIONS OF PROPOSED EXPANSION)

CASE I: ANNUAL INPUT EXPENSES ASSUME 10% DOWNPAYMENT, 4YR PAYS AT 12 % INT

EX RATE = 1350

DESCRIPTION	COST	YEAR ONE EXP	YEARS 2-4 E P
I. FIXED (CAPITAL) COSTS			
NEW LONGARDINI 52 HP W/SPARES			
FUNF UPGRADE	121,250		
ADDITIONAL HOSE FOR UPGRADE FUNF	110,000		
	12,557		
Total Loan			
Annual Repayments	134,107		
Capital Replacement Fund(@ 8% int)		13296	9883
		4647	4647
Total Annual Payments		17943	14533
II. VARIABLE COSTS/SAVINGS			
WHEAT CAMPAIGN			
CURRENT FUEL CONSUMPTION (ACTUAL)	36,916		
Litres Projected Fuel Consumption	117,160		
Cost Per Litre (CFA)	225		
Marginal Fuel in U.S. $	111,871		
Litres Oil Consumption			
Price Per Litre	95		
Marginal Oil in U.S. $	780		
	212		
Marginal Fuel & Oil Consumption $	112,083		
NET FUEL COST INCREASES	15,167	15,167	15,167
TOTAL COST INCREASES (EXCLUDING LABOR)	139,274	123,110	119,700

III. Increased Production

a) Wheat Season

Hectares =	92.5
Tons/Hectare	3.00
Total Tons Production	277.5

Quantity Saved for Consumption Assuming:

a) # additional farmers =	185
b) Av family size =	9
c) Kgs/person/day =	.2716695
Total Tons Consumed =	135
Tons Wheat Remaining (yrs 1-4)	112
CFA Per kg Wheat	125
$per ton at 350 CFA/U.S.$	1357
Value of Remaining Wheat	$40,136

	Year 1	Years 2 - 4
	$40,136	$40,136
Profits	$17,029	$20,439
Profits Per Farmer	$92	$110

b) Expanded Millet Production (AP Projection)

1. Marginal Variable Costs		Year 1	Years 2 - 4
Litres additional fuel consumption	7,500		
Price Per Litre (CFA)	235		
Additional Fuel Consumption ($$)	$5,036		
Litres additional oil consumption	40.0		
Cost per litre (CFA)	750.0		
Additional oil consumption ($$)	$87.1		
Total Margin Millet Campaign Costs	$5,124.9	$5,124.9	$5,124.9

Hectares	92.5
Tons per Hectare	1.5
Total Tons per Season	138.8

Tons Saved for Consumption

Number of new Farmers	185.0
average family size	9.0
av kg consumption per day	.5
Tons Needed for Consumption	303.9

SUMMARY ----------

	Year 1	Years 2 - 4
Total Marginal Costs	$28,234	$24,824
Total Marginal Benefits	$40,138	$40,138
Total Profits/Losses	$11,904	$15,314
Profits/losses per farmer/year	$54	$83

File: GANGANIBERI

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MARGINAL BUDGET ANALYSIS FOR GANGANIBERI COOPERATIVE EXPANSION
(I.E. FINANCIAL IMPLICATIONS OF PROPOSED EXPANSION)

CASE I: ANNUAL INPUT EXPENSES ASSUME 10% DOWNPAYMENT, 4YR AMP AT 12 % INT

EX RATE = $350

DESCRIPTION	COST	YEAR ONE EXP	YEARS 2-4 EXP
I. FIXED (CAPITAL) COSTS			
NEW LOMBARDINI 52 HP W/SPARES	$21,250		
PUMP UPGRADE	$10,000		
ADDITIONAL HOSE FOR UPGRADE PUMP	$2,857		
Total Loan	$34,107		
Annual Repayments		13396	9886
Capital Replacement Fund(2 9% int)		4347	4347
Total Annual Payments		17743	14233
II. VARIABLE COSTS/SAVINGS			
WHEAT CAMPAIGN			
CURRENT FUEL CONSUMPTION (ACTUAL)	56,916		
Litres Projected Fuel Consumption	47,680		
Cost Per litre (CFA)	235		
Marginal Fuel in U.S. $$	$11,871		
Litres Oil Consumption	95		
Price Per litre	760		
Marginal Oil in U.S. $$	212		
Marginal Fuel & Oil Consumption $	$12,083		
NET FUEL COST INCREASES	$5,167	$5,167	$5,167
TOTAL COST INCREASES (EXCLUDING LABOR)	$39,274	$23,110	$19,700

III. Increased Production

a) Wheat Season

Hectares =	92.5
Tons/Hectare	3.50
Total Tons Production	323.75

Quantity Saved for Consumption Assuming:

a) # additional farmers =	185		
b) Av family size =	9		
c) kgs/person/day =	.2716895		
Total Tons Consumed =	165		
Tons Wheat Remaining (yrs 1-4)	154		
CFA Per KG Wheat	185	Year 1	Years 2 - 4
(per ton at 350 CFA/U.S.$	1529		
Value of Remaining Wheat	183,851	183,851	183,851
Profits		160,742	164,152
Profits Per Farmer		1328	1347

b) Expanded Millet Production (GP Projection)

		Year 1	Years 2 - 4
i. Marginal Variable Costs			
Litres additional fuel consumption	7,500		
Price Per Litre (CFA)	205		
Additional fuel Consumption (3$)	15,036		
Litres additional oil consumption	40.0		
Cost per litre (CFA)	760.0		
Additional oil consumption (1$)	189.1		
Total Margin Millet Campaign Costs	15,124.9	15,124.9	15,124.9

Hectares	92.5
Tons per Hectare	1.5
Total Tons per Season	138.8

Tons Saved for Consumption

Number of new Farmers	185.0
average family size	9.0
av KG consumption per day	.5
Tons Needed for Consumption	303.7

File: GAYCANIDERI

Remaining tonnage or need	(165.11)
price per kg	[illegible]

SUMMARY ----------

	Year 1	Years 2 - 4
Total Marginal Costs	$23,234	$24,824
Total Marginal Benefits	$83,851	$83,851
Total Profits/Losses	$55,617	$59,027
Profits/losses per farmer/year	$301	$319

ANNEX B

B) Niger 200 pumps as replacement for Cooper pumps.

As with the Ganganiberi project, changes in the price of wheat over the next season will have a significant effect on the farmers' ability to support the costs of new pumps. Furthermore, the credit terms which the project offers must be taylored so as to maximize the farmers' chances of making payment on their loans while simultaneously paying into a capital replacement fund for the purchase of new pumps at the close of five years.

As with Ganganiberi, we are interested in determining the marginal effect of the new pumps - i.e. the difference between the savings and additional expenses that are realized as a result of the new pumping systems. Unlike Ganganiberi, however, these marginal changes are more likely to have a significant influence on the farmers' cash position; production around the new Lombardini pumps is more likely to be a principal rather than secondary activity (at Ganganiberi many farmers are engaged in other activities). It is therefore important to attempt to consider the importance of these marginal activities with respect to their total cash position.

i. Marginal Savings/Expenses.

Savings: The Niger 200 pump has an estimated discharge of 200 cubic meters of water per hour at 8 meters head (vertical distance). Given a water requirement of 8,000 cubic meters per season, per hectare for wheat, and a fuel consumption rate

of 3.5 litres per hour, the pump would be expected to consume 2,100 litres of diesel fuel per season to irrigate 15 hectares of wheat. At a cost of 235 CFA per litre, this comes to 32,900 CFA per hectare of wheat for fuel. Oil Consumption over the same period is estimated at approximately 30 litres for a total cost of 1,560 per season, per hectare at 780 CFA per litre. The cost of spare parts, which is included in the loan, will average 4,400 per season, per hectare over a five year pump life. Average per hectare operating costs, therefore, come to 38,860 CFA during the wheat season.

Average operating expenses for Cooper pumps during the 1984-5 Wheat Season came to 60,133 CFA for fuel, oil, and repairs.2 For the (five) farmers considered in the 1985-6 season, average per hectare operating costs were on the order of 67,362 CFA (which is consistent with the 1984-5 findings given that the pumps are older, and thus could be expected to consume more fuel and oil per operating hour.) A comparison of these figures, then, implies a 42% savings on operational costs per hectare attributable to the introduction of the Lombardini pumps. Given current operating expenses, this would result in 28,502 CFA savings per hectare of wheat and 12,737 CFA per hectare of millet.3 Furthermore, if a farmer cultivates

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2, Acticities Paysannes Proposal, p. 34.

3, While the calculation of per hectare wheat pumping costs may be estimated fairly easily, the rainy reason crops are not so, and hence are not as reliable. The principal complication in these calculations is that the farmers'relative water applications per crop have not been well documented. As a

an average of 3.75 hectare of wheat and millet per year (based on assumption of 4 owners per pump and a potential of 15 hectares of wheat per season), total savings per farmer, per year would come to 154,646 CFA.

Marginal Costs:

The magnitude of additional costs is largely dependent on the credit terms that the project offers. Two cases are considered here 1) the terms that project staff are now negotiating for, i.e. 10 (to 20) % down-payment, and 15% interest over a three year repayment period; 2) recommended terms of 10 % down-payment (where possible), and 10 percent interest over a five year repayment period.

Under the first plan, a group of farmers purchasing a Lombardini pump would be expected to make an annual loan payment of 1,300,717 CFA in addition to a 441,100 payment to a capital replacement fund. Under the more liberal credit terms, the annual loan repayment would come to 763,521 CFA per year.

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result, estimates of actual operating costs per hectare of a given rainy season crop tend to be more on the theoretical side as they are based on estimates of actual water requirements. The estimates for millet used here were derived with engineers Freeman and Lonsway's rule of thumb that (irrigated) rice crops will generally take four times the amount of water as millet.

Net Additional Costs Per Farmer.

Plan one: 280,208 CFA per year.

Plan two: 146,509 CFA per year.

Furthermore, if one were to assume only a loan repayment (i.e. that the farmers would seek credit when they needed to replace their pumps) annual cost increases come to 170,533 CFA and 36,234 CFA under plans one and two respectively.

Hypothetical Cash Positions

By introducing labor costs and family consumption rates, it is possible to make rough approximations of the farmers' cash positions under various combinations of yields and prices. The scenarios which follow consider a) farmers which grow only wheat (and the change in net benefit per hectare in the with and without Lombardini case) and b) farmers who grow wheat during the dry season and millet during the 'rainy' season. In each case, millet yields and prices are held constant at 1.5 tons/ha and 100 cfa/kg respectively while wheat yields and prices are allowed to vary between 2.5-3.5 tons/ha and 105-185 CFA/kg.

The cost of labor inputs used here were based on information collected during interviews with the farmers (of the Kessou Kourey Cooperative), and are consistent with other such labor budgets that have been prepared previously.

Summary of Results

1) For Farmers Growing Only Wheat:

yrs loan	int	Cfa/kg	tons/ha	% Change Benefit per Hectare
5	10%	185	3.5	- 8.17
5	10%	125	3.0	- 15.40
5	10%	105	3.0	- 19.40
5	10%	105	2.5	- 24.29
3	15%	185	3.0	- 17.07
3	15%	150	3.0	- 21.75
3	15%	105	3.0	- 33.60
3	15%	105	2.5	- 42.65

2) Wheat & Millet Crops: average benefit per hectare after family consumption with Lombardini pumps. (All benefits are in CFA.)

yrs loan	int	cfa/kg	tons/ha	benefit/ha	total benefit
5	10%	185	3.5	264,297	1,982,227
5	10%	150	3.0	165,574	1,241,602
5	10%	125	3.0	128,047	960,352
5	10%	105	3.0	98,047	735,352
5	10%	105	2.5	71,797	538,477
3	15%	185	3.5	246,390	1,847,928
3	15%	185	3.0	200,140	1,501,053
3	15%	150	3.0	147,640	1,107,303
3	15%	105	3.0	80,140	601,053
3	15%	105	2.5	53,840	404,178

(Note: Cost increases per hectare due to charge in credit terms is 17,907 CFA per hectare per season.)

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Par
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	120,00
Farmer2	1	4	900	235	211,500	32	780	24,960	48,00
Farmer3	2	6	1,350	235	317,250	32	780	24,960	120,00
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75,00
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25,00
Totals	8	26.25			1,258,425			131,820	378,00

Cost Diesel per Hectare	47,940	Tons/ha	3.00
Total Oil Per Hectare	5,022	price/kg	105
Spare Parts per hectare	14,400	Benefit	315,000
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	247,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 5 year loan at 10% interest, 10% payment in advance.
Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Costs	516,900
Variable Costs Per hectare	34,460
Capital Servicing:	
Annual Loan Repayment	763,521
Capital Replacement Fund	441,100
Total	1,204,621
Capital Servicing Per Hectare	80,308
Total Costs	1,721,521
Total Costs per hectare	114,768
Net Benefit Per Hectare	200,232
% increase net benefit/ha if farmer produces only wheat	-19.14

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.) .

Family size	9
Hectares wheat	3.75
yield per hectare	3.00
total tons wheat	11.25
kg/person/year	0.00
[illegible]	0.00
Wheat [illegible]	11.25
Price per kg wheat	105.00
Value of crop	1,181,250
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	1,579,500
Total Surplus Production (U.S.$)	$4,513
Total Variable Pumping Costs	157,573
Total Fixed Pumping Costs	301,155
All Pumping Costs	457,148
Wheat: Wage bill/ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	844,148
Total Income	1,579,500
Net Profit/year	735,352
Profit in U.S.	2,101
Average Benefit Per Hectare	96,047

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Far
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100,00
Farmer2	1	4	900	235	211,500	32	780	24,960	68,00
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,00
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75,00
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25,00
Totals	8	26.25			1,258,425			131,820	378,00

Cost Diesel per Hectare	47,940	Tons/ha	3.50
Total Oil Per Hectare	5,022	price/kg	165
Spare Parts per hectare	14,400	Benefit	847,500
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	580,138		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 5 year loan at 10% interest, 10% payment in advance.
Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Costs	516,900
Variable Costs Per hectare	34,460
Capital Servicing	
Annual Loan Repayment	763,521
Capital Replacement Fund	441,100
Total	1,204,621
Capital Servicing Per Hecatre	80,308
Total Costs	1,721,521
Total Costs per hectare	114,768
Net Benefit Per Hectare	532,732
% [illegible]	-0.17
If [illegible] produces only wheat	

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
yield per hectare	3.50
total tons wheat	13.12
kg/person/year	0.00
Wheat Consumed	0.00
wheat remaining	13.12
Price per kg wheat	185.00
Value of crop	2,428,125
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	2,826,375
Total Surplus Production (U.S.$)	$8,075
Total Variable Pumping Costs	167,993
Total Fixed Pumping Costs	301,155
All Pumping Costs	469,148
Wheat: Wage bill/.ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	844,148
Total Income	2,826,375
Net Profit/year	1,982,227
Profit in U.S.	5,664
Average Benefit Per Hectare	264,297

I. Observed Expenses for Cooper Pumps: Nesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Par
Farmer1	2	0.75	1,350	235	317,250	57	760	44,460	100.00
Farmer2	1	4	900	235	211,500	32	760	24,960	65,00
Farmer3	2	6	1,350	235	317,250	32	760	24,960	110,00
Farmer4	2	6	1,200	235	282,000	32	760	24,960	75.00
Farmer5	1	3.5	555	235	130,425	16	760	12,480	25.00
Totals	8	20.25			1,258,425			121,820	375,00

Cost Diesel per Hectare	47,240	Tonsina	3.00
Total Oil Expenses	5,122	Price/kg	125
Spare Parts per Hectare	15,000	Benefit	375,000
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	307,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 5 year loan at 10% interest, 10% of debt in subsidy.
Capital Replacement fund assumes five annual installments
to account bearing zero interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	760	23,400
Total Variable Costs			516,900					
Variable Costs Per hectare			34,460					
Capital Servicing								
Annual Loan Repayment			763,521					
Capital Replacement Fund			441,100					
Total Capital Servicing Per Hecatre			1,204,521					
			80,308					
Total Costs			1,721,521					
Total Costs per hectare			114,768					
Net Benefit Per Hectare			260,232					
% increase net benefit/ha if farmer produces only wheat			-15.41					

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
yield per hectare	3.00
total tons wheat	11.25
kg/person/year	0.00
Wheat Consumed	0.00
wheat remaining	11.25
Price per kg wheat	125.00
Value of crop	1,406,250
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	1,804,500
Total Surplus Production (U.S.$)	85,155
Total Variable Pumping Costs	167,972
Total Fixed Pumping Costs	301,155
All Pumping Costs	469,146
Wheat: Wage bill/ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	844,146
Total Income	1,804,500
Net Profit/year	960,352
Profit in $U.S.	2,744
Average Benefit Per Hectare	128,047

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Par
Farmer1	2	6.75	1,350	235	317,250	57	760	44,460	100,00
Farmer2	1	4	900	235	211,500	32	780	24,960	69.00
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,00
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75.00
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25.00
Totals	8	26.25			1,258,425			121,820	378.00

Cost Diesel per Hectare	47,940	Tons/ha	3.00
Total Oil Per Hectare	5,022	price/kg	105
Spare Parts per hectare	14,400	Benefit	315,000
Total Pumping Cost/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	247,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 5 year loan at 10% ineterest, 10% payment in advance.
Capital Replacement fund assumes five annual installments
to account bearing 7% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Costs	516,900
Variable Costs Per hectare	34,460
Capital Servicing	
Annual Loan Repayment	763,521
Capital Replacement Fund	441,100
Total	1,204,621
Capital Servicing Per Hectare	80,308
Total Costs	1,721,521
Total Costs per hectare	114,768
Net Benefit Per Hectare	200,232
% increase net benefit/ha if farmer produces only wheat	-19.14

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
yield per hectare	3.00
total tons wheat	11.25
kg/person/year	0.00
Wheat Consumed	0.00
wheat remaining	11.25
Price per kg wheat	105.00
Value of crop	1,181,250
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	1,579,500
Total Surplus Production (U.S.$)	$4,513
Total Variable Pumping Costs	167,992
Total Fixed Pumping Costs	301,155
All Pumping Costs	469,148
Wheat: Wage bill/.ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage Bill	56,250
Total Wage Bill	375,000
Total Production Costs	1,844,148
Total Income	1,577,500
Net Profit/year	735,352
Profit in U.S.	2,101
Average Benefit Per Hectare	98,047

I. Observed Expenses for Cooper Pumps: Keiou Kouney
Wheat Season Calculations

Observation	# pumps	Hs wheat	diesel price		Cost	Lt oil	Price	Cost oil	Par
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100.00
Farmer2	1	4	900	235	211,500	32	780	24,960	66.00
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110.00
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75.00
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25.00
Totals	8	26.25			1,258,425			131,820	378.00

Cost Diesel per Hectare	47,940	Tons/ha	2.50
Total Oil Per Hectare	5,022	price/kg	105
Spare Parts per hectare	14,400	Benefit	262,500
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	195,138		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 5 year loan at 10% interest, 10% payment in advance. Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel price		Cost	Lt oil	Price	Cost oil
	1	15	[illegible]	235	[illegible]	30	[illegible]	[illegible]
Variable Costs per Hectare			34,410					
Capital Servicing								
Annual Loan Repayment			743,521					
Capital Replacement Fund			411,100					
Total			1,154,621					
Capital Servicing Per Hectare			60,200					
Total Costs			1,721,521					
Total Costs per hectare			114,768					
Net Benefit Per Hectare			147,732					
% increase net benefit/ha if farmer produces only wheat			-24.29					

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	7
Hectares wheat	3.75
Yield per hectare	2.50
total tons wheat	9.38
Kg/person/year	0.00
Wheat Consumed	0.00
Wheat remaining	9.38
Price per kg wheat	105.00
Value of crop	984,375
Hectares millet	3.75
Yield per hectare	1.50
total tons millet	5.62
Kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	1,382,625
Total Surplus Production (U.S.$)	13,950
Variable Pumping Costs	[illegible]
Total Fixed Pumping Costs	301,155
All Pumping Costs	469,148
Wheat: Wage bill/ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	844,148
Total Income	1,382,625
Net Profit/year	538,477
Profit in U.S.	1,539
Average Benefit Per Hectare	71,797

1. Observed Expenses for Copper Pumps: Nesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel price		Cost	Lt oil	Price	Cost oil	Far
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	102,00
Farmer2	1	4	900	235	211,500	32	780	24,960	68,00
Farmer3	2	6	1,150	235	317,250	32	780	24,960	118,00
Farmer4	2	9	1,200	235	282,000	32	780	24,960	75,00
Farmer5	1	2.5	555	235	130,425	16	780	12,480	32,00
Totals	8	26.25			1,259,425			131,220	375,00

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

Observation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Par
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100,00
Farmer2	1	4	900	235	211,500	32	780	24,960	60,00
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,00
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75,00
Farmer5	1	3.5	555	235	130,425	16	780	12,480	35,00
Totals	8	26.25			1,256,425			131,820	378,00

Cost Diesel per Hectare	47,940	Tons/ha	3.00
Total Oil Per Hectare	5,022	price/kg	185
Spare Parts per hectare	14,400	Benefit	555,000
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	487,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 2 year loan at 15% interest, 10% payment in advance.
Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimates)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Cost.	516,900
Variable Costs Per hectare	34,460
Capital Servicing	
Annual Loan Repayment	1,300,717
Capital Replacement Fund	441,100
Total	1,741,817
Capital Servicing Per Hectare	116,121
Total Costs	2,258,717
Total Costs per hectare	150,581
Net Benefit Per Hectare	404,419
% increase in Benefit/ha if farmer produces only wheat	-17.[illegible]

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lomar [illegible] larger 200 ha.

Family size

Hectares wheat	3.75
Yield per hectare	3.00
total tons wheat	11.25
kg/person/year	0.00
Wheat Consumed	0.00
Wheat remaining	11.25
Price per kg wheat	185.00
Value of crop	2,081,250

Hectares millet	3.75
Yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250

Total Surplus Production (CFA)	2,479,500
Total Surplus Production (U.S.$)	17,034

Total Variable Pumping Costs	167,992
Total Fixed Pumping Costs	435,454

I. Observed Expenses for Cooper Pumps: Kesou Kouey
Wheat Season Calculations

sObservation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Part
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100,000
Farmer2	1	4	900	235	211,500	32	780	24,960	63,000
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,000
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75,000
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25,000
Totals	8	26.25			1,258,425			131,820	378,000

Cost Diesel per Hectare	47,940	Tons/ha	3.00
Total Oil Per Hectare	5,022	price/kg	150
Spare Parts per hectare	14,400	Benefit	450,000
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	382,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 3 year loan at 15% interest, 10% payment in advance. Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Costs	516,900
Variable Costs Per hectare	34,460
Capital Servicing	
Annual Loan Repayment	1,300,717
Capital Replacement Fund	441,100
Total	1,741,817
Capital Servicing Per Hecatre	116,121
Total Costs	2,258,717
Total Costs per hectare	150,581
Net Benefit Per Hectare	299,419
% increase net benefit/ha if farmer produces only wheat	-21.75

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
Yield per hectare	3.00
total tons wheat	11.25
Kg/person/year	0.00
Wheat Consumed	0.00
wheat remaining	11.25
Price per kg wheat	150.00
Value of crop	1,687,500
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
[illegible]	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	2,085,750
Total Surplus Production (U.S.$)	15,959
Total Variable Pumping Costs	167,993
Total Fixed Pumping Costs	435,454
All Pumping Costs	603,447
Wheat: Wage bill/ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	978,447
Total Income	2,085,750
Net Profit/year	1,107,303
Profit in U.S.	8,164
Average Benefit Per Hectare	147,640

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

sObservation	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil	Part
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100,000
Farmer2	1	4	900	235	211,500	32	780	24,960	68,000
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,000
Farmer4	2	6	1,200	235	282,000	32	780	24,960	75,000
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25,000
Totals	8	26.25			1,258,425			131,820	378,000

Cost Diesel per Hectare	47,940	Tons/ha	3.00
Total Oil Per Hectare	5,022	price/kg	105
Spare Parts per hectare	14,400	Benefit	315,000
Total Running Cost/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	247,638		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 3 year loan at 15% ineterest, 10% payment in advance.
Capital Replacement fund assumes five annual installments to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel	price	Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400

Total Variable Costs	516,900
[illegible] per hectare	34,460
Capital Servicing	
Annual Loan Repayment	1,300,717
Capital Replacement Fund	441,100
Total	1,741,817
Capital Servicing per Hectare	116,121
Total Costs	2,258,717
Total Costs per hectare	150,581
Net Benefit Per Hectare	164,419
% increase net benefit/ha if farmer produces only wheat	-33.61

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
yield per hectare	3.00
total tons wheat	11.25
kg/person/year	0.00
wheat Consumed	0.00
wheat remaining	11.25
Price per kg wheat	105.00
Value of crop	1,181,250

Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.04
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250

Total Surplus Production (CFA)	1,579,500
Total Surplus Production (U.S.$)	$4,513

Total Variable Pumping Costs	167,992
Total Fixed Pumping Costs	435,454
All Pumping Costs	603,447
Wheat: Wage bill/ha	85,000
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	978,447
Total Income	1,579,500
Net Profit/year	601,053
Profit in U.S.	1,717
Average Benefit Per Hectare	60,140

I. Observed Expenses for Cooper Pumps: Kesou Kourey
Wheat Season Calculations

sObservation	# pumps	Ha wheat	diesel price		Cost	Lt oil	Price	Cost oil	Part
Farmer1	2	6.75	1,350	235	317,250	57	780	44,460	100,000
Farmer2	1	4	900	235	211,500	32	780	24,960	68,000
Farmer3	2	6	1,350	235	317,250	32	780	24,960	110,000
Farmer4	2	6	1,300	235	282,000	32	780	24,960	75,000
Farmer5	1	3.5	555	235	130,425	16	780	12,480	25,000
Totals	8	26.25			1,258,425			131,820	378,000

Cost Diesel per Hectare	47,940		
Total Oil Per Hectare	5,022	Tons/ha	2.50
Spare Parts per hectare	14,400	price/kg	105
		Benefit	262,500
Total Pumping Costs/hectare	67,362		
Net Benefit Per Hectare (excluding labor)	195,138		

II. Projected Lombardini Operating Expenses (Wheat Season Only)

Assumes 3 year loan at 15% ineterest. 10% payment in advance.
Capital Replacement fund assumes five annual installments
to account bearing 9% interest.

Observation (Estimate)	# pumps	Ha wheat	diesel price		Cost	Lt oil	Price	Cost oil
	1	15	2100	235	493500	30	780	23,400
Total Variable Costs			516,900					
Variable Costs Per hectare			34,460					
Capital Servicing								
Annual Loan Repayment			1,300,717					
Capital Replacement Fund			441,100					
Total			1,741,817					
Capital Servicing Per Hectare			116,121					
Total Costs			2,258,717					
Total Costs per Hectare			150,581					
Net Benefit Per Hectare			111,919					
% increase net benefit/ha if farmer produces only wheat			-42.65					

III. Projection of Individual Farmers' Cash Position for wheat and millet production . (Farmer is one of four working with Lombardini Niger 200 pump.)

Family size	9
Hectares wheat	3.75
yield per hectare	2.50
total tons wheat	9.38
kg/person/year	0.00
Wheat Consumed	0.00
wheat remaining	9.38
Price per kg wheat	105.00
Value of crop	984,375
Hectares millet	3.75
yield per hectare	1.50
total tons millet	5.62
kg/person/day	.50
Tons Millet Consumed	1.64
Tons Millet Remaining	3.98
CFA per kg millet	100.00
Value of production (CFA)	398,250
Total Surplus Production (CFA)	1,382,625
Total Surplus Production (U.S.$)	13,750
Total Variable Pumping Costs	167,993
Total Fixed Pumping Costs	435,454
All Pumping Costs	603,447
Wheat: Wage bill/ha	85,750
Wheat Wage Bill	318,750
Millet: Wage bill/ha	15,000
Millet Wage bill	56,250
Total Wage Bill	375,000
Total Production Costs	978,447
Total Income	1,382,625
Net Profit/year	404,178
Profit in U.S.	1,155
Average Benefit Per Hectare	53,890