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EXPERT CONSULTATION ON SMALL RURAL ENTERPRISES IN AFRICA

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PLANNING AND EVALUATING TECHNOLOGY-BASED SMALL ENTERPRISE PROJECTS IN AFRICA

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INTRODUCTION

This paper discusses the importance of small- and micro-enterprises in rural areas of Africa and also the programme approach of Appropriate Technology International (ATI) in planning and evaluating projects for commercialization of innovative technologies and upgraded traditional technologies. Examples from food processing projects in Africa covering the areas of grain milling, palm oil extraction, shea butter production and sunflower seed oil extraction are discussed.

In addition to the development, identification, transfer and adaptation of technologies, the successful development of small- and micro-enterprises often requires financing and good business planning. Techniques that deserve special attention include:

1. Market assessment
2. Commercial analysis
3. Financial controls
4. Technical support (engineering, training, extension, management and legal), and
5. Business evaluation.

The Importance of Small Enterprise Development

Small- and micro-enterprises are important for efficient and equitable economic growth and for generation of new employment. Many large-scale, industrial projects have not been too successful in achieving these goals because they did not meet the economic needs of the population, clashed with local social structures and cultures, provided greater benefits to international companies rather than the local economy, and displaced other economic activities. To determine their appropriateness, technologies should also be assessed for their unintended social and environmental impacts (Hyman, Stiftel, Moreau and Nichols, 1988).

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Appropriate technologies for small enterprises can utilize local labour, inputs, and energy. Small-scale industries can generate broader-based gains in employment and income because they are usually labour intensive. Due to rapid population growth and the age structure of the population the labour force in Africa is expected to grow at an average annual rate of 2.52% between 1985 and the year 2000. Just to maintain the current high rates of unemployment, 105 million new jobs will have to be created on that continent over the next 12 years (ILO, 1986). Also, small-scale rural industries often produce more appropriate products to meet the basic needs of the poor majority of consumers (Hyman, 1987b).

There is no standard typology of firm sizes, but micro-enterprises are usually defined as firms with ten or fewer employees, while small enterprises may employ as many as 25-50 workers. A survey of small manufacturing enterprises in twelve countries found that the average number of employees per firm ranged from 1.6 to 5.5. In five of these countries, over half of the enterprises consisted of one-person firms. using the U.N. definition of "rural" as places with a population of less than 20 000, 63% of the number of jobs in small-scale manufacturing were found to be in rural areas (Liedholm and Mead, 1987). In most African countries, 70-80% of the total population live in rural areas. Non-agricultural enterprises in these rural areas, market towns and small towns, comprise a large share of the rural labour force (Bagachwa, 1988).

Often, but not always, small- and micro-enterprises are in the informal sector of the economy. The informal sector refers to businesses that do not have a business license or a recognized legal identity. Some informal sector artisans lack a fixed physical location for their business. Usually, the informal sector is not affected by government regulations on minimum wages and business taxes. As a result of the changing world and the economic environment, the informal sector has grown in importance in many LDCs.

The food processing and forest product industries are particularly important in rural and peri-urban areas for local retention of a greater share of the value added to agricultural and silvicultural commodities (Arnold, Chipeta and Fisseha, 1987: Liedholm and Parker, 1989). Micro-enterprises are also heavily involved in the food distribution system in rural and urban areas of Africa.

With technical and financial assistance, significant improvements in the productivity of small-scale processing enterprises could be achieved. Entrepreneurs may not be aware of the range of choice in production technologies or ways of obtaining access to better equipment, machinery and processes. Similarly, the productivity of small farms could be increased through development and use of simple, low-cost technologies. Profits from rural industries can stimulate growth in other rural industries and reinvestment in agriculture. Higher farm productivity, in turn, can stimulate industries that process agricultural products. Also needed are technologies to reduce the burden of time-consuming and arduous manual labour on women in the

household. In Africa, the time saved from household labour is usually devoted to more agricultural activities or other productive uses (Carr and Sandhu, 1987).

The entrepreneurial aspirations of the rural poor in developing countries often go unrealized for the lack of access to financing, management skills, knowledge of appropriate technologies suitable for commercialization, and an understanding of the potential market for the product. Commercial banks and government development banks often shy away from investing in small-scale rural enterprises because they perceive the risks to be high. Also, it is expensive to evaluate and administer a large number of small loans. Even when conventional financing is available, new entrepreneurs may not be able to meet collateral and equity requirements and often find it difficult to surmount bureaucratic hurdles. Consequently, special credit programmes or other alternative financing arrangements are often needed to allow these entrepreneurs to upgrade production technologies or expand.

Financing is not the only problem rural entrepreneurs face. They often lack information about appropriate technologies that are more productive than the traditional alternatives. Furthermore, because these technologies might not yet have been commercialized in a particular area, little information may be available on the costs and benefits of adopting them. The demand for a new product is unproven and entrepreneurs might not know the best way to reach potential markets. It can be difficult to convince the rural poor to buy a new product because they cannot afford to take risks and have limited information about the choices in products. Thus, assistance in technical choice and transfer as well as market assessment and market strategy preparation are also important. Venture capital mechanisms that combine financing and technical and managerial assistance deserve further attention.

Business Planning for Small Enterprise Development

At the small- and micro-enterprise scale of operation, business planning is often neglected, yet it is important to reduce the risks associated with establishing a new venture or revamping operations. small businesses cannot afford not to plan because they are even more vulnerable to changes affecting supply or demand than large businesses. Most successful small entrepreneurs have at least an intuitive sense of business planning. However, many other people do not even attempt to start a small business or fail because they do not know how to go about it. This is particularly true when innovative technologies, products, or processes are involved. With the necessary support, NGOs can play a useful role in assisting small- and micro-enterprises at the grassroots level.

Market Assessment and Strategy

Before creating or expanding an enterprise, it is important to have a thorough understanding of the competition, demand, availability and price of inputs and prices for the product. Other important questions include:

1. Who else is producing the goods and at what cost and quality?
2. What are the trends in production and consumption and why?
3. Do a few firms control the market or vital inputs to the manufacturing process?
4. How do government policies affect the market?
5. Who are the targeted consumers?
6. How much can people afford to pay for the product?
7. How will people get information about the product and at what cost?
8. Does the market vary seasonally?
9. Is there a new market opportunity and why has no one else acted upon it?
10. Is there an adequate transportation and distribution system for the products?
11. What is the level of skills needed to produce, process and market the product?
12. What are the social constraints and advantages for the new product or process?
13. Who will gain and lose by introduction of the new technology?

Within every major market, there are usually many segments for different uses or product specifications. The targeted segments can have a major influence on the choice of technology. Market research and marketing techniques must be matched to the realities of rural areas in developing countries. Although taste tests, surveys, focus groups, direct mailings and media campaigns may be effective in developed countries, they have to be adapted for consumers who may be illiterate or less willing to accept new products and ideas. The degree of sophistication necessary for market tests depends on the level of risks and the costs.

Commercial Analysis

Standard business techniques must be adapted to the resources and needs of small- and micro-enterprises in LDCs, for example, break-even analysis can estimate when the expected revenues of a business will cover its costs. There are two concepts of break-even: (1) the level of production (or capacity use rate) at which the firm would cover all of its costs given a particular product price, and (2) the break-even price for the product at an assumed level of production.

However, sometimes a business can be generally profitable over a long period of time, even though it could face a severe cash shortage in the short run. Since this situation can put a firm out of

business before it can generate the long-term profits, it is important to know whether the firm is likely to have enough cash to meet its obligations at each point in time. It may be important to base an analysis on monthly figures because of the large seasonal variations that a business can experience, and their implications for working capital requirements.

Consequently, since 1986, cash-flow analysis has been adopted as a basic tool of commercial analysis for small- and micro-enterprises. Each of the proposed enterprises supported by a project must have a commercial analysis consisting of a month-by-month cash-flow analysis, a projected income and expense statement, a projected balance sheet, and a sensitivity analysis. A financial analysis focuses on the actual flow of funds to and from the enterprise. By contrast, an economic analysis shows the cash and non-cash benefits and costs to the larger society (usually the national economy), which may differ from those at the perspective of the firm.

All assumptions for the cash-flow analysis are documented and a sensitivity analysis included to examine the effects of possible changes in key variables such as the scale of production, capacity use rate, raw material types and costs, and sales prices. Often a break-even analysis is also carried out as a supplement to the cash-flow analysis.

Example of a Financial and Economic Analysis

A recent example from Senegal is about a project which would disseminate an animal traction mill for service enterprises owned and operated by groups of village women. This commercial analysis compares use of the animal traction mill with a locally produced diesel hammermill. An animal traction mill can be operated by a pair of donkeys or a single horse. Most women in the project area already have access to donkeys. Users would be expected to bring their own animals; this would avoid the problems of the care and feeding or overworking of collectively owned draft animals.

The animal traction mill could be used at any time during the day since a special operator is not needed. The cost could be recouped in one or two ways. First, there could be a flat monthly fee for each household allowed to use the mill. A monthly fee of at least CFAF 450 would be necessary for unsubsidized financial viability (in mid-1989, US$ 1.00 was work CFAF 295). The second alternative would be to have a paid cashier collect a service fee based on the amount milled. Interviews indicated that a fee of CFAF 10/kg would be acceptable to users who bring their own animals; this compares favourably to the CFAF 15-20/kg charged by diesel mills in rural areas. Three levels of production were compared in the analysis.

In the economic analysis, but not the financial analysis, a value was imputed to a non-cash benefit -- the time savings associated with use of mechanized mills instead of the traditional process of pounding grain in a mortar with a pestle. For a household that

consumes 3 kg of grain a day and does milling on alternate days, the animal traction mill can save over 50 minutes of time every other day. The time savings was valued at half the casual agricultural wage rate of CFAF 30-50 per hour.

Domestic production of diesel-powered hammermills is relatively well established in Senegal, although the motors are imported. The capital costs shown for the motorized mills exclude import duty and value added tax on the motor since most of these mills have been distributed by donors or tax-exempt NGOs. Major constraints on the continued operation of diesel mills over time include the availability and cost of diesel fuel and spare parts. Conservative estimates of the capacity use rate and operating time were adopted. Although costs would be greater with a motorized mill, so would the time savings.

Six scenarios (A to F) were analyzed for each of the two technologies, based on two levels of user fees and three levels of production. Net present values were calculated at three discount rates: 10%, 15% and 20%. Appendix A contains the list of scenarios, examples of cash-flow charts for two of the scenarios, and the results for all the scenarios.

The animal traction mill was both financially and economically viable in all of the scenarios considered. However, at the low production rate, the animal traction mill could only generate small profits. In most cases, the CFAF 10/kg user fee would generate greater revenues than the flat monthly fee of CFAF 450 per household. Inclusion of the value of the time saved in the economic analysis substantially increases the net present value of the animal traction mill.

A diesel mill is only financially viable under more restricted conditions. With external financing, it would only be profitable when a user fee of CFAF 20/kg is charged. Without financing, it would also be profitable at a user fee of CFAF 15/kg.

Since a diesel mill saves more time than an animal traction mill, inclusion of the value of this time makes a large difference in the net present value. Even when a low value is placed on the time savings, the economic viability of a diesel mill is substantial at the high production rate at both levels of user fees. At the CFAF 20/kg user fee, a diesel mill is also economically viable at the medium production rate.

For the most part, the larger or more prosperous villages in Senegal with the best prospects for effective use of a diesel mill have already received motorized mills from donors on highly subsidized terms. The remaining smaller or poorer villages are less likely to have as large a demand for the relatively expensive services of a diesel mill. Some of these villages may be good candidates for an animal traction mill because of its smaller scale and lower capital operating costs.

Lessons Learned from a Processing Project

The remainder of this paper discusses some of the lessons learned from a food processing project in Africa.

A Demonstration Project for Commercialization of a Technology

In West Africa, the traditional process of palm oil extraction by food stomping is labourious and yields a low percentage of the oil contained in the fruit. By upgrading the traditional technology through simple pressing equipment, rural incomes can be increased, labour drudgery reduced, and consumer benefits boosted from an increased supply of palm oil. The traditional process is still used in less prosperous parts of Cameroon and in much of West and Central Africa. However, most artisanal-scale commercial producers of palm oil in Cameroon have access to an old Colin press, a horizontal expeller. Small farmers who do not have their own presses can purchase pressing services from others in exchange for an in-kind payment, usually of one-fifth of the oil extracted. In addition, the client provides the labour for a manual press or the fuel cost for a motorized press.

The Colin expeller was imported to Cameroon between the 1930s and 1973. Most are now over 30 years old and many were in disrepair, leading to poor productivity and frequent downtime. The French company stopped routine manufacturing of artisanal-scale presses and replacement parts are no longer available. Due to the lack of affordable new equipment for replacement and expansion, increases in artisanal palm oil production have been limited, therefore a project to recondition 75 existing Colin expellers and produce auxiliary equipment such as cooking drums, bunch strippers and clarifiers, was begun. A lease-purchase arrangement was established to finance the purchase of reconditioned presses by groups or individuals. The original design of the project had to be modified in implementation. First, only 12 used Colin expellers were available for purchase at a reasonable price. Since many expellers had the wrong parts and maintenance difficulties resulted in downtime, they were still unusable most of the time. Second, it took up to 10 months to obtain imported replacement parts to recondition. Third, because of the high cost of repairs in small batches, the price of a reconditioned unit was too expensive for potential buyers. At the same time, world market prices for palm oil declined, causing the large-scale firms to shift more production from exports to the domestic market where prices were higher. This competition adversely affected the prices received by artisanal producers. As a result, a decision was made that it would be cheaper and faster to manufacture a new press. A simpler, less expensive version with fewer imported components was designed, the horizontal Caltech. The manual horizontal Caltech cost US$ 3 350 and the gasoline-powered version cost US$ 5 950. Later, a much cheaper(US$ 1 300) manually operated vertical axis Caltech was developed.

After the reorientation, the project exceeded its targets for production and sales. Financing played an important role in encouraging sales. By mid-1988, the workshop had sold 76 Caltech expellers. However, the idea of purchaser groups proved unpopular because the area is dominated by the individualistic Bassa tribe. Considerable interest in artisanal-scale presses exists there because farmers are too far from the parastatal oil mills to market their palm fruits. In addition, a programme of the Catholic mission has made progress in establishing smallholder plantations of improved palm varieties in this area.

The horizontal Caltech is a modification of an accepted technology that is well-proven in Cameroon. The modifications make it more appropriate for a smaller scale of palm oil production and allow local manufacture. The manual and motorized versions of the horizontal Caltech have been working well and the estimated demand for these expellers in Cameroon is 24 per year. The vertical Caltech has a much larger potential market since its cost is only 39% of that of the manual, horizontal Caltech. The marketability of the vertical Caltech depends on whether workers will accept the form of labour -- turning a pole while walking in a circle -- or alternatively, the feasibility of using animal power?

Conclusions

In the early years of the appropriate technology movement, emphasis was on the hardware or equipment and it was assumed that a latent demand existed for this equipment. This "technology push" approach by inventors and tinkerers proved unsuccessful by itself and often led to museum-like installations that were not adopted by small- and micro-enterprises. At present, a more sophisticated "needs-based" approach is being implemented, which begins with an assessment of the needs, resources and constraints of producers and consumers.

Experience has demonstrated that to carry out technology-based small enterprise development one must:

- Test cost-effective, innovative, development strategies which are based on applied science and technology;

- Transfer successful innovations tested in commercially viable small-scale enterprises from original site to other countries;

- Provide technical, financial and managerial services to help local enterprises become established and grow;

- Analyze policies of government, banks and local institutions that affect commercially viable, small-scale enterprises;

- Document the experiences gained in projects and the results of policy analyses and disseminate this information to

development organizations, governments and other institutions; and

- Promote replication of successful technologies in other locations.

Some important lessons on how to commercialize appropriate technologies for small- and micro-enterprises are set out below:

A niche frequently exists for businesses of various scales using different technologies. The appropriateness of a technology may vary in different parts of a country and across LDCs due to variations in social, economic and environmental conditions. The context for a technology should be carefully assessed in advance of planning a dissemination strategy.

Assessments of the appropriateness of a technology should examine (1) the scale of equipment or processes; (2) cost savings in capital, maintenance, and replacement, and foreign exchange; (3) the generation of profits through increased production, higher product prices and local retention of value added in processing; (4) extent of the socio-economic impacts and the distribution of benefits via [a] job creation, higher wages, reduced labour displacement; [b] increases in net incomes of other enterprises from a greater demand for locally produced raw materials, and higher profits in use or processing; and [c] benefits to rural or low-income consumers through lower prices, improved quality of products, and greater availability of products; and (5) environmental impacts including natural resources consumption, amenities, and health and safety for workers and the public.

A needs-oriented approach emphasizes working directly with the poor, building on their own skills and locally available resources. The key constraints facing entrepreneurs may be limited access to physical capital or working capital, too few clients or an irregular sales pattern, unequal market power, unfair competition, and absence of legal status. Organized assistance may be needed to remove key constraints. Field testing followed by further modifications where needed is one way of helping to ensure that the technology meets the needs of small businesses and consumers.

Small- and micro-entrepreneurs often lack information on the range of choice in technologies or how to obtain improved equipment that they might have heard of. Greater exchange of information within and between developing countries can help in this regard.

Rural and urban industries do not have access to technology extension services like those available to farmers.

Although the informal sector does not have the ability to conduct R and D or testing of a new technology, it can adapt rapidly to introduced designs by making and marketing simple producer and consumer goods at a relatively low cost. External assistance from developed countries can play a catalytic role in upgrading traditional rural technologies as the relatively small investments needed for this purpose are not likely to be made by the private sector.

Reliance on existing enterprises is usually more successful than starting new ones because it avoids the need to establish a whole new infrastructure and completely train inexperienced workers.

In many countries, small- and micro-enterprises in rural areas have little access to credit due to collateral requirements, registration requirements, high transaction costs for both the firms and banks, and a bias toward larger and urban enterprises in rationing limited funds. Subsidized interest rate policies may exacerbate the problem of credit availability, which is usually more of a concern to small firms than its cost. Lending criteria may also need to be revised to favour cash-flow considerations, character, and group guarantees instead of collateral and land titles.

Alternative financing mechanisms to credit that share the risks and benefits may be important in allowing small- and micro-enterprises to adopt innovations. These may include equity financing mechanisms such as venture capital, lease-purchase arrangements and franchises.

Access to appropriate equipment and financing are necessary, but not always sufficient for wide-scale technology transfer. Small firms may need technical assistance and training as well as managerial assistance. NGOs and producer associations can have an important role in providing this assistance at the grassroots level. Better approaches and materials may be needed to ensure that the assistance meets the needs of the enterprises.

Market assessments and market strategy planning have been neglected in many small- and micro-enterprise assistance programmes as well as private sector attempts at business creation and expansion. Deficiencies in the area of marketing are common causes of business failure.

Although one-person cottage industries may be of marginal macro-economic importance, they are critical sources of income and employment for the rural poor, especially women. Rural women in many LDCs are burdened by a heavy load of time-consuming and arduous work. Thus, particular attention needs to be devoted to technologies and methods of assistance for one-person firms, which are often operated by women seasonally or part-time. There is still debate as to whether this is best accomplished through targeted programmes or mainstreaming.

The design of many donor-funded small enterprise programmes has been paternalistic or biased against individual economic activities in favour of collective ownership and control. This orientation may reduce the rate of spontaneous replication of a technology and the maturation of social and individual attitudes that promote economic development. Programmes should address the identification of ownership and management patterns that facilitate profitable use of specific technologies by small firms.

The sustainability of donor and government enterprise development programmes and the firms they assist once the tap of external assistance is turned off deserves greater attention in programme design and implementation. The availability of equipment and spare parts, skilled labour for repairs, and continued financing and "graduation" from special programmes is especially important in sustainability.

The environment in which businesses operate is heavily influenced by government macro-economic and sectorial policies. In most countries, policies generally place small and rural enterprises at a disadvantage compared to larger and urban firms after accounting for differential subsidization and taxes, trade restrictions, labour costs, costs and availability of capital and foreign exchange, price controls, infrastructure establishment, and research expenditures. Export industries often receive preferential treatment over firms producing for the domestic market. Public investments in large and often inefficient parastatals are frequently sheltered from competition through marketing board monopolies and processing restrictions, to the detriment of artisanal-scale production.

A commodity/sector approach can facilitate dissemination of a technology through development of a package of technical and other types of assistance for replication. These packages may be promoted through regional (inter-country) networks for information exchange and interchange of experts.

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SCENARIOS FOR THE ANALYSIS

Animal Traction Mill

	Flat Fee (CFAF 450/mo)	User Fee (CFAF 10/kg)	Production/Year 33,600 kg	25,200 kg	18,060 kg
A	X		X		
B	X			X	
C	X				X
D		X	X		
E		X		X	
F		X			X

Local Diesel Mill

	Typical Fee (CFAF 15/kg)	High Fee (CFAF 20/kg)	Production/Year 68,062 kg	45,000 kg	25,312 kg
A	X		X		
B	X			X	
C	X				X
D		X	X		
E		X		X	
F		X			X

FINANCIAL AND ECONOMIC ANALYSIS OF AN ANIMAL TRACTION MILL AND A DIESEL-POWERED HAMMERMILL

Net Present Values (1,000 CFAF)

	Financial w/o Financing			Financial w/ Financing			Economic (High Value of Time)			Economic (Low Value of Time)		
	10%	15%	20%	10%	15%	20%	10%	15%	20%	10%	15%	20%
ATM												
A	744	528	377	648	485	373	1,416	1,053	843	1,147	843	629
B	261	151	75	166	107	71	623	433	301	478	320	211
C	503	339	226	407	296	222	1,007	733	541	805	576	415
D	990	721	532	894	678	528	1,662	1,246	953	1,393	1,036	785
E	175	83	21	79	40	17	536	366	247	392	253	157
F	548	376	256	453	333	253	1,053	770	572	851	613	446
Diesel												
A	555	252	46	(17)	(75)	(96)	2,551	1,812	1,294	1,752	1,188	795
B	(1,225)	(1,138)	(1,068)	(1,797)	(1,465)	(1,209)	95	(107)	(242)	(433)	(520)	(572)
C	(2,551)	(2,174)	(1,896)	(3,123)	(2,501)	(2,038)	(1,809)	(1,594)	(1,432)	(2,106)	(1,826)	(1,618)
D	2,609	1,857	1,330	2,037	1,530	1,188	4,605	3,416	2,578	3,806	2,792	2,079
E	32	(156)	(282)	(540)	(483)	(423)	1,352	875	544	824	462	214
F	(1,844)	(1,622)	(1,454)	(2,416)	(1,949)	(1,596)	(1,102)	(1,042)	(990)	(1,399)	(1,274)	(1,176)

Diesel-Powered Grain Mill
(A) Local, High Capacity Use Rate, Average Fee
(1000 CFA), June 23, 1989

	Yr.0	Yr.1*	Yr.2*	Yr.3**	Yr.4***	Yr.5**	Yr.6*	Yr.7*	Yr.8**	Yr.9***	Yr.10**	
Building	55.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Land	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Equipment	1,265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total capital cost	1,331.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel fuel (2 l/h, CFA 220/l)	0.00	158.40	158.40	158.40	158.40	158.40	158.40	158.40	158.40	158.40	158.40	
Lubr. oil (9.5 l/t, CFA 210/l)	0.00	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	
Engine repairs	0.00	100.00	200.00	100.00	200.00	100.00	200.00	100.00	200.00	100.00	200.00	
Mill repairs	0.00	50.00	100.00	50.00	100.00	50.00	100.00	50.00	100.00	50.00	100.00	
Total oper.cost	0.00	444.18	594.18	444.18	594.18	444.18	594.18	444.18	594.18	444.18	594.18	0.00
Operator salary	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Replacement costs	0.00	0.00	0.00	0.00	0.00	0.00	980.00	0.00	0.00	0.00	0.00	0.00
Repayment of loans	0.00	0.00	634.00	634.00	634.00	634.00	0.00	0.00	0.00	0.00	0.00	0.00
Total fixed costs	0.00	100.00	734.00	734.00	734.00	734.00	1,080.00	100.00	100.00	100.00	100.00	
Loan proceeds	1,197.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production (1.65 h/d, 330 d/y, 125 kg/h)	0.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	68,062.00	
Service fees (CFA 15/kg)	0.00	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	1,020.93	0.00
Salvage value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
Net cash flow (w/o fin)	(1,331.00)	476.75	326.75	476.75	326.75	476.75	(653.25)	476.75	326.75	476.75	326.75	11.00
Cumulative	(1,331.00)	(854.25)	(527.50)	(50.75)	276.00	752.75	99.50	576.25	903.00	1,379.75	1,706.50	1,717.50
Net cash flow (w/fin)	(133.10)	476.75	(307.25)	(157.25)	(307.25)	(157.25)	(653.25)	476.75	326.75	476.75	326.75	11.00
Cumulative	(133.10)	343.65	36.40	(120.85)	(428.10)	(585.35)	(1,238.60)	(761.85)	(435.10)	41.65	368.40	379.40
Discount rate	15%	20%	10%									
NPV (w/o fin)	252.38	45.99	554.72									
NPV (w/ fin)	(74.63)	(95.52)	(17.18)									
Time saved (0.63 h/3 kg)	0.00	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	14,293.02	
High value of time (CFAF 25/h)	0.00	357.33	357.33	357.33	357.33	357.33	357.33	357.33	357.33	357.33	357.33	
Low value of time (CFAF 15/h)	0.00	214.40	214.40	214.40	214.40	214.40	214.40	214.40	214.40	214.40	214.40	
Net cashflow (econ, high time value)	(1,331.00)	834.08	684.08	834.08	684.08	834.08	(295.92)	834.08	684.08	834.08	684.08	11.00
Cumulative	(1,331.00)	(496.92)	187.15	1,021.23	1,705.30	2,539.38	2,243.45	3,077.53	3,761.60	4,595.68	5,279.76	5,290.76
Net cashflow (econ,low time value)	(1,331.00)	691.15	541.15	691.15	541.15	691.15	(438.85)	691.15	541.15	691.15	541.15	11.00
Cumulative	(1,331.00)	(639.85)	(98.71)	592.44	1,133.58	1,824.73	1,385.87	2,077.02	2,618.16	3,309.31	3,850.45	3,861.45
Discount rate	15%	20%	10%									
NPV (econ. high time value)	1,811.80	1,294.39	2,550.73									
NPV (econ. low time value)	1,188.03	795.03	1,752.33									

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Animal Traction Mill for Servicing Grinding
A-- Flat Fee (Cf 450/mo), High use Rate (25 kg/h)
(1000 CFA), June 23, 1989

	Yr.0	Yr. 1*	Yr. 2*	Yr.3**	Yr.4***	Yr.5**	Yr. 6*	Yr. 7*	Yr.8**	Yr.9***	Yr.10**	
Village land	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Equipment												
Mill body	96.00											
Tube for mill frame	19.00											
Half cart axle, hub, bearings, wheel, tyre	40.00											
Shaft for center of rotation wooden bearings, hardware	20.00											
Cement, labour for construction of track plus foundation for center of rotation	60.00											
Labor for fabrication	25.00											
Transport for installation	10.00											
Inflation adjustment (10%)	27.00											
Manufacture profit	30.00											
Total capital cost	327.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Operator salaries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cashier (2 d/mo.,12mos/y, CFAF 240/d)	0.00	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	
Replacement costs	0.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	0.00
Total operating costs	0.00	30.76	30.76	30.76	30.76	30.76	30.76	30.76	30.76	30.76	30.76	0.00
Repayment of loans (r=13.5%, t=4 y, 1-y grace pd.)	0.00	0.00	138.58	138.58	138.58	138.58	0.00	0.00	0.00	0.00	0.00	0.00
Loan proceeds (90% of capital cost)	294.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Amount milled (48 wks/y, 7d/wk, 4 h/d)	0.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	33,600.00	
Membership fee (CFAF 450/mo., 40 users)	0.00	216.00	216.00	216.00	216.00	216.00	216.00	216.00	216.00	216.00	216.00	0.00
Salvage value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
Net cash flow (w/o fin)	(327.00)	185.24	185.24	185.24	185.24	185.24	185.24	185.24	185.24	185.24	185.24	20.00
Cumulative	(327.00)	(141.76)	43.48	228.72	413.96	599.20	784.44	969.68	1,154.92	1,340.16	1,525.40	1,545.40
Net cash flow (w/fin)	(32.70)	185.24	46.66	46.66	46.66	46.66	185.24	185.24	185.24	185.24	185.24	20.00
Cumulative	(32.70)	152.54	199.20	245.86	292.52	339.18	524.42	709.66	894.90	1,080.14	1,265.38	1,285.38
Discount rate	15%	20%	10%									
NPV (w/o fin)	150.74	75.06	261.22									
NPV (w/ fin)	107.49	71.18	165.72									
Time saved (0.43 h/3kg processed)	0.00	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	2,588.60	
High value of time (CFAF 25/h)	0.00	64.72	64.72	64.72	64.72	64.72	64.72	64.72	64.72	64.72	64.72	
Low value of time (CFAF 15/h)	0.00	38.83	38.83	38.83	38.83	38.83	38.83	38.83	38.83	38.83	38.83	
Net cash flow (econ, hi time value)	(327.00)	163.56	163.56	163.56	163.56	163.56	163.56	163.56	163.56	163.56	163.56	20.00
Cumulative	(327.00)	(163.45)	0.11	163.67	327.22	490.78	654.33	817.89	981.44	1,145.00	1,308.55	1,328.55
Net cash flow (econ,low time value)	(327.00)	137.67	137.67	137.67	137.67	137.67	137.67	137.67	137.67	137.67	137.67	20.00
Cumulative	(327.00)	(189.33)	(51.66)	86.01	223.68	361.34	499.01	636.68	774.35	912.02	1,049.69	1,069.69
Discount rate	15%	20%	10%									
NPV (econ. hi time value)	433.17	301.16	622.71									
NPV (econ.low time value)	320.20	210.71	478.11									