The Hand Operated Bridge Press for Groundnut and Shea Nut Processing: A Financial and Socio-Economic Appraisal

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CONTENTS

ABBREVIATIONS

CMA	Christian Mothers' Association
COCOBOD	Ghana Cocoa Marketing Board
MOFA	Ministry of Food and Agriculture
NGO	Non Governmental Organisations
PBC	Produce Buying Company

Exchange Rates:

£1 = 1600 cedis
£1 = US$1.57

SUMMARY AND RECOMMENDATIONS

(i) This report provides a financial and socio-economic appraisal of a hand operated bridge press for the extraction of oil from shea nuts and groundnuts.

(ii) Financial analysis indicates that the bridge press may be viable for the processing of shea nuts, especially in more remote parts of northern Ghana where access to water and fuelwood is restricted. It appears to have limited potential for the processing of groundnuts.

(iii) Sensitivity analysis suggests that seasonal variations in the price of shea nuts may affect returns to processing by as much as 40%.

(iv) The marketing of shea nut butter does not immediately appear very efficient, suggesting that final demand for the product may be limited. This idea is further supported by the fact that shea butter does not have any industrial uses in Ghana nor is it processed industrially. Exports of shea butter are limited.

(v) It is women who process groundnut and shea nuts, traditionally in the household compound. They use family labour in the process.

(vi) The limited resources of processors leave them with little surplus to invest in new technologies. A group approach would almost certainly be required to spread the capital costs over a number of processors. Group activity, and its promotion by the MOFA and NGOs, appears to be common in the Northern Region.

(vii) Access to credit from the formal sector is limited by the socio-economic status of the processors. A number of donor funded projects may have improved this situation for some communities, but this will not be sustainable over time. Generally the banks are asking for more security for loans than in the 1970s and early 1980s.

(viii) A strategy for the sustainable operation of the bridge press is proposed which emphasisies financial viability, sensitivity to market demand for the processed product, appropriate levels of financing, group lending and careful attention to capacity building, both among groups of processors in the village and among the local NGOs.

1. INTRODUCTION

Background

1. The present report presents the findings of the socio-economist who visited Ghana in March 1995 as a member of a team to carry out an appraisal of two technologies with potential for field use in Ghana. These were (a) a mincer/extruder for extraction of oil from groundnuts; (b) a bridge press for the extraction of cocoa butter and shea butter.

2. Other members of the team were an oilseed technologist, an engineer and a Ghanaian counterpart specialist in small-scale food processing operations from the Technology Consultancy Centre at the University of Science and Technology in Kumasi.

3. The specific terms of reference for the socio-economist were to (a) assess the niche for the technologies and the market for the products; (b) to identify individuals and/or groups capable of running operations based on the technologies; and (c) to assess the financial and social parameters necessary for sustainable operation.

4. Problems with the production of a prototype mincer/extruder meant that it was not available for pilot testing during the team's visit. As a result this report is only concerned with the bridge press. In Section Two financial analysis is used to assess the performance of the press relative to traditional methods of shea butter and groundnut oil extraction, both of which are commonly processed in northern Ghana. Cocoa butter processing was not assessed as this is not a common activity in the Northern Region of Ghana where the team was based during the visit of the socio-economist.

5. Section Three assesses the market for groundnut and shea butter products and in Section Four the market for the bridge press itself is examined. In the final section, financial and social parameters for sustainable operation are considered and an approach for promoting the press is proposed.

Methodology

Field work

6. About half the socio-economist's time in Ghana was spent with the team's technologists observing the operations of both the traditional processing and bridge press technology in the villages of Kunyavila and Vittin near Tamale. The data thus derived were used in the financial analysis. The opportunity was also taken to interview processors, both individually and in groups, in order to gain a better understanding of their work and the organisation of the village.

7. The remainder of the visit was spent interviewing key informants (see Appendix 1) and visiting markets in Tamale and Accra. This was to provide background on marketing and technology adoption.

Financial analysis

8. In northern Ghana shea butter and groundnut oil extraction are traditionally women's activities, carried out using manual technologies at the village household/compound level. As these are labour-intensive, women's labour is a major input.

9. However difficulties arise when an attempt is made to value women's labour. The village compound is not primarily a wage based economy. Rather women use their authority to mobilise the labour they have control over (their own, that of their children and possibly that of other wives and their children in the compound) in order to allocate it to household tasks (fetching water and fuelwood, preparing food, minding children) and to productive activities on the basis of the relative returns from these. Wage labour (on a husband's or another farm) might be one option, especially at times of intense agricultural activity (planting and harvest), but for much of the year it is likely that the compound is self-employed.

10. In these circumstances the adoption of a wage rate to value labour may be of limited use. It will also be difficult to determine in practice. Thus rather than attaching a value to labour itself, financial analysis in Section One is used to show the relative labour productivity of different technologies (i.e. returns per unit of labour). In this way financial analysis can be used to approximate individual decision making about resource allocation at the compound level.

11. Net income per kg of raw material processed is also measured. As this does not include monetarised values of inputs not purchased with cash, it is a measure of "cash productivity", measuring the net cash returns to cash expended on purchased inputs.

2. IDENTIFYING THE NICHE FOR THE TECHNOLOGY

(a) Shea butter extraction

(i) Traditional process

Description

12. Shea butter is extracted from the seed of the shea tree which grows wild on the savannahs of northern Ghana. The fruit is collected by women and children, the pulp is removed and the shell around the seed is cracked open to release the nut. Processors may collect the nuts themselves or purchase them in the market.

13. The nuts are pounded and roasted before milling. During the milling process the material reaches a sufficiently high temperature to cause the cells containing the oil to break down and release the oil. After milling, the material resembles molten chocolate.

14. A small amount of water is added and the paste is beaten manually in a large basin (which holds about 8 kg of paste) for as much as 45 minutes or an hour until the processor judges that the butter is about to separate. Large quantities of cold water are added which causes the butter to float to the surface. More water is used to rinse the butter which is finally skimmed off by hand.

15. The butter is boiled for more than an hour to reduce the moisture content. The oil once cooled sets as butter which is either moulded into small pieces for immediate sale in the village or at the market, or placed in calabashes, (local gourds) which can weigh up to 20 kg and which are sold to itinerant traders or to traders at the market.

Conversion rates

16. Field observations made at the village of Vittin gave an oil extraction rate of 0.43 kg of oil (after boiling) per 1 kg of shelled shea nuts processed.[1]

Main inputs

17. The main inputs are shea nuts, water and firewood. The process is highly labour intensive.

18. In the following financial analysis, data drawn from field observations are used to quantify inputs and provide estimates of the processors' returns.

19. A number of points should be noted in relation to this:

(a) Water and firewood are not purchased by processors. The only purchased input is shea nuts, although some processors may use their own supply during the "harvest" season. Therefore two alternative measures of financial worth are used: (i) returns per purchased kilo of shea nuts; (ii) returns to labour input (see paragraphs 10 and 11).

(b) With regard to (i), results are significantly affected by seasonal variability in the price of shea nuts. Sensitivity analysis is used below to indicate how returns vary at different times of the year.

(c) With regard to (ii), field observations and interviews with the women in the village of Kunyavila (the village in which the bridge press was pilot tested) suggest the following time sequence for the processing of one large basin of shea nuts (i.e. one head load weighing approximately 25 kg):

- pounding before roasting: 0.5 hours
- roasting: 1.0 hour
- milling (including waiting time and time to clean the mill) 1.0 hour
- beating the paste 3.0 hours
- rinsing and separating 1.0 hour
- boiling the oil 1.5 hours

[1] Observations were based on the processing of milled shea nuts. In our calculations, this weight was adjusted to allow for milling losses. It is also likely that raw material losses would occur between purchase and processing, especially if the raw material was stored for any length of time.

- moulding into bars/calabash 1.0 hour

PROCESSING SUB TOTAL 9.0 hours

In addition, estimates of time spent collecting water and fuelwood should be added, as well as walking time to and from the mill.

- **Water:** Approximately 90 kg of water are used to process 25 kg of shea nuts, equal to about 3 head loads. As the women walk about 1 km to the water source, a round trip of about 0.5 hours, total time spent collecting water is equal to 1.5 hours.

- **Fuelwood:** One head load of wood used. Time to collect equal to 1.0 hour.

- **Travelling to the mill:** The mill was a little over 1 km from the village. Round trip of 1.0 hour.

Thus the total labour time required at Kunyavila village to process 25 kg of shea nuts using traditional methods is 12.5 hours.

(d) This estimate will vary in different locations given that time spent collecting water and fuelwood and travelling to the mill is related to access. Ninety six per cent of respondents in a study of 138 rural women in three districts of the Northern Region (Williams *et al.*, 1991) claimed to use wood fuel, over half of whom reported walking between 3 and 11 km to obtain it. In the same survey, women claimed to walk between half and 24 km for water. In the village visited during the field trials, the women were walking about 1 km to get water from a stream as a recently installed well in the village had dried out during the dry season.

In the financial analysis, sensitivity analysis is used to indicate how these differences affect returns to labour.

(e) Price of shea butter

As noted above, shea butter is traded by volume in calabashes and not by weight. There is no standard size calabash (although a standard bowl measure was in use in the market for measuring shea nuts and other commodities). Traders therefore rely on experience to determine prices by eye. For the researcher, the absence of scales in the

market added to the difficulty of arriving at a price for shea butter based on weight. Prices also vary by season with the seasonal variation in shea nut prices (see paragraph 22 below). At the time of the visit (March), prices were at their peak.

Two different methods were used to estimate the price processors receive for the shea butter. Several traders in the market in Tamale indicated that the price paid to village women for a medium sized calabash was 14,000 cedis (this was during March when prices are at their highest). One of these calabashes was taken out of the market on loan to be weighed. It weighed 15 kg. This gives a price per kilo of 933 cedis.

In the village itself, processors moulded the butter into small pieces which they sold individually for 20 cedis or in threes for 50 cedis. Given an average of 48 pieces per kilo, this gives 960 cedis if all the pieces are sold individually, or 700 if they are sold in threes. The average price per kilo is 830 cedis.

The two estimates are similar. In the financial analysis, an average of the two is used, that is 882 cedis per kilo.

Financial analysis (see Appendix 2 for spreadsheet)

20. The net income per kg of shea nuts processed is 156 cedis. Expressed in terms of returns to each woman hour, the traditional process yields 308 cedis per hour.

Sensitivity analysis

21. Sensitivity analysis was carried out to indicate the expected changes in returns resulting from variations in the price of shea nuts (lean season price = 500 cedis; harvest season price = 300 cedis) and in the time spent collecting fuelwood and water by the processor. Results are given in the table below:

Assumption	***Net revenue per kg of shea nuts***	***Return to labour in cedis per woman hour***
a) Time spent collecting inputs (hours)		
3.5 (base case)	178	308
7	178	241
10.5	178	198
b) Price of shea nuts		
Lean season (base case)	178	308
Harvest season	260	470

(ii) Bridge press process

Description

22. The bridge press is a simple, manually operated screw press made from cast iron. A piston is lowered onto plates which are contained in a metal cylinder.

23. To extract oil, the shea nuts are prepared in the same way and milled to a paste. This is then mixed with a small quantity of water and put into bags which are placed on the plates in the press. Pressure is applied and the oil is released and flows into a trough at the base of the press. The maximum capacity of the press is 15 kg of shea paste.

24. After extraction, the oil is not boiled as little moisture is added to it during processing. Once it has set, it is marketed in the same way as above.

Oil extraction efficiency

25. Pilot testing of the bridge press at Kunyavila village indicated a conversion rate of 0.36 kg of oil per kg raw nuts. This preliminary figure is 0.07 kg less than the hand processing method.

Main inputs

26. The bridge press operation requires only very small amounts of water.

27. To process the same volume of shea nuts as given above, the following time sequence is given for the press:

- pounding before roasting: 0.5 hours
- roasting: 1.0 hour
- milling (including waiting time and time to clean the mill) 1.0 hour
- pressing (including filling and emptying bags) 1.5 hours
- moulding into bars/calabash 1.0 hour

PROCESSING SUB TOTAL 5.0 hours

Neither water nor fuelwood are needed after the paste has been prepared. Additional time is only added for walking to and from the mill, equal to 1.0 hour round trip.

Thus the total labour time required at Kunyavila village to process 25 kg of shea nuts using the bridge press is 6.0 hours, which is less than half the time required if traditional methods are employed.

Loan repayment costs

28. Mr.Peter Donkor from the University of Science and Technology in Kumasi estimated the cost of the bridge press to be 210,000 cedis.

29. The base lending rate in Ghana is 29% (March 1995), and, according to the agricultural officer at Barclays Bank, interest rates on agricultural loans are at least 5 or 6 points above this. An interest rate of 35% is used in calculations (equivalent to 2.53% per month).

30. The loan repayment cost is dependent on the interest rate per period, the number of periods over which the capital is recovered, and the capital cost of the equipment itself.

31. It is assumed that the loan is made for one year, and that repayment is made in twelve equal monthly payments during the year. This gives a monthly repayment cost of 20,512 cedis. The total repayment cost is 246,150.

32. Assuming that a woman is working alone, and that she works eight hours a day for six days a week, she will be able to process eight 25 kg batches of shea nuts per week which is equal to 416 per year[2]. The loan repayment cost per batch is therefore calculated as follows:

= 246,150/416

= 592 cedis

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[2] This assumes that the women is working full time on shea butter processing throughout the year. In reality she will have other income generating and domestic tasks to carry out and, at critical points during the agricultural cycle, it is likely that she will not have much time for processing activities at all. The assumption therefore represents the maximum possible use one women could make of a bridge press in a year.

33. Another measure of the loan repayment cost is to calculate the pay back period. In this case it is measured as the number of batches of shea nuts that the investor will have to process before she recovers the capital cost of the press and is equal to 101 batches (see spread sheet for detailed calculation).

34. Given that the new technology does not involve a significant increase in scale of operations and a corresponding increase in working capital requirements, these have not been included in calculating the financing cost of the bridge press.

35. However operation of the press does require purchase of bags costing 400 cedis each. Fifteen were required to use the press at maximum capacity. They were made from a strong cotton material and double stitched to prevent bursting. Although later monitoring will provide a more accurate indication of the life of the bags, early results suggested that with adequate care, they would have a life of 50 pressings each.

The cost of the bags per pressing is therefore:

15 x 400/50

= 120 cedis

Financial analysis (see Appendix 2 for spreadsheet)

36. Assuming a one year repayment period, during the first year of operation, net revenue per kg shea nuts processed are 60 cedis and per woman hour, returns to labour are 248 cedis.

37. In the second year, however, after the loan has been repaid, the net revenue rises to 84 cedis per kg of shea nuts.

Sensitivity analysis

38. Sensitivity analysis was used to indicate the impact on net revenue of varying the capital cost of the bridge press. All other assumptions were the same. The results are given in the table below:

	Returns to labour per woman hour (cedis)	Net revenue per kg processed (cedis)
Assumption		
Cost of bridge press		
210,000 (base case assumption)	248	60
105,000	297	72

(iii) The potential niche for the new technology

39. Financial analysis based on the field trials conducted in Kunyavila village does not immediately suggest a potential niche for the bridge press. The reasons for this are that:
(a) traditional methods appear to be more efficient in terms of oil extraction per unit of raw material; and
(b) investment costs reduce returns from pressing considerably in the first year of operation.

40. On the other hand, the press does reduce the processing time, partly because it is less time consuming than manual methods, but also because input in terms of raw materials is much reduced. The further a processor is from supplies of water or fuelwood, the greater the importance of this time and resource saving. At distances of over 2 km from a water source and fuelwood reserves, returns per woman hour to the bridge press are higher than using traditional methods. Where women have to walk 24 km (15 miles - see paragraph 19(4)) sensitivity analysis indicates that using traditional methods, returns per woman hour would be only 46 cedis. This suggests a potential niche for the press in the more arid and resource poor areas of Northern Ghana: by significantly reducing the quantity of inputs required, the bridge press could increase returns per woman hour to 253 cedis, that is by at least 5 times.

41. With regard to the press's oil extraction efficiency, this may be improved through further experimentation and adaptation. Results from Kunyavila represent the first field trials of the press. If improvements could bring the oil yield up to the level of the traditional processing, net returns per kg of shea nuts would be 122 cedis and returns per woman hour would be equal to 502 cedis.

42. If the press was owned by a group of women and kept in continual use, the utilisation rate would jump to 5 pressings per day, equal to 30 a week and 1560 per year.

This would increase net returns per kg of processed shea nuts to 78 cedis and returns to labour to 320 cedis per woman hour, which is slightly above the returns using traditional methods (308 cedis).

43. Capital costs could be further reduced by improving the performance of the bags in the press. The model assumes they have a life of 50 pressings. The potential for extending this will be explored in continuing field trials.

44. It should be noted that the variation in the price of shea nuts has a very major impact on the returns to shea butter production. Bought at harvest prices, returns per kg of nuts processed increase by nearly 50%, from 178 to 260 cedis. This suggests that an intervention which increases processors' ability to store (through inventory loans or improved storage facilities) may have as much potential to increase their incomes as new processing technologies.

45. It was observed by the team that shea butter processing could be achieved successfully without initially roasting the nuts. The final product had a less smokey aroma which was preferred by the women in the village. The rationale for roasting is that the heat produced breaks down the cells in the nuts which contain the oil. This assists release of the oil during processing. When processors did not have access to mechanical milling facilities, this was vital. However where this is now available, the process itself produces sufficient heat to have the same effect. It is likely therefore that for this reason roasting is no longer necessary.

46. Finally, it has been suggested that it may be possible to use the waste product from the paste as a cooking fuel. In areas where fuel wood is difficult to obtain, this may be an important additional benefit. More research is required to establish the burning properties of the material.

(b) Groundnut oil extraction

(i) Traditional process

Description

47. After shelling, the groundnuts are winnowed and roasted before milling. This reduces them to a thick paste to which water is added. The processor kneads the paste and within minutes the oil begins to separate out. The kneading

continues until the processor judges that she has removed all the oil available at this stage.

48. The remaining paste is rolled in to small balls (*kulikuli*) and fried in the groundnut oil. This process releases more oil from the paste. When the balls have cooled they are pounded and the flour dried in the sun. It is then taken back to the mill and ground to a fine flour.

49. Alternatively, the *kulikuli* is rolled into long strips which are deep fried and sold as a snack food.

Main inputs

50. The main input is groundnuts. The price of groundnuts varies by season. In March, which is during the lean season, the price was 1400 cedis a bowl (approx. 2 kg) at Tamale market. At harvest time the price drops to 700 cedis a bowl. Sensitivity analysis is used to examine the impact of this price change on the processor's returns.

51. The process is labour intensive although the oil itself separates quite readily from the paste when the correct quantity of water is added.

52. In Kunyavila, the following time sequence was observed for processing a head load of groundnuts:

• winnowing	0.5 hours
• roasting	0.5 hours
• round trip to mill	1.5 hours
• kneading	1.5 hours
• rolling kulikuli	1.0 hours
• frying	1.5 hours
• pounding	0.5 hours
• round trip to mill	1.5 hours
PROCESSING TOTAL	**8.5 hours**

Oil extraction

53. According to field measurements, 24.95 kg of paste yielded 9.27 kg of oil and 15.35 kg of dried kulikuli flour (5.825 kg of water was added to the paste before kneading, most of which was eliminated during boiling and drying). According to the women, the paste was derived from 13 bowls of groundnuts. Given that the estimated average weight of raw groundnuts per bowl was 2.019 kg, which gives a total

weight for 13 bowls of 26.247 kg, there was a loss during milling of 1.297 kg (5% of the original weight, likely to be paste caught inside the mill).

54. Thus, according to these figures, the conversion rate of groundnuts to oil is 0.33 and to kulikuli is 0.67.

Financial analysis (see Appendix 4 for spreadsheet)

55. The net income derived from processing one kg of groundnuts is 180 cedis. Expressed per woman hour, returns are 555 cedis.

Sensitivity analysis

56. This was used to indicate differing returns with seasonal changes in the price of the raw material. Using harvest time prices, returns increase significantly. Per kg groundnuts processed, they rise to 526 cedis, a 300% increase. For returns to labour, there is a similar increase from 555 cedis to 1625 cedis.

(ii) Bridge press process

Description

57. The same bridge press described in paragraph 23 above was used for the groundnuts.

Main inputs

58. The raw materials used are the same as those described in paragraph 43.

59. The process differs only from that described in paragraphs 43 and 44 in that the paste is not kneaded manually but is put in bags which are pressed. The press can take a maximum load of 15 kg which can be pressed in about 45 minutes, allowing for loading and emptying the bags. To process 25 kg will take 1.25 hours, giving a total time of 8.25 hours (15 minutes faster than the traditional method).

Financial analysis

60. The performance of the press, and particularly the bags, during field trials was disappointing. As a number of bags burst, an accurate measure of oil extraction was not

possible. A major problem was that the consistency of the groundnut paste made it less amenable to use in the press than the shea nut paste which was much stiffer.

61. These technical difficulties, combined with the relatively insignificant time advantage derived from using the press, lead the team to conclude that further trials with the bridge press for groundnut processing were not worthwhile. In the absence therefore of experimental data, a financial analysis of the press cannot be carried out.

iii) The potential niche for the new technology

62. Field observations suggest that the bridge press has limited potential for improving the extraction efficiency of oil from groundnuts. There are no advantages in terms of reduced input and time savings are insignificant. In the absence of any efficiency savings, the technology will yield no additional surplus to offset the investment costs. It does not therefore appear financially viable.

2. MARKETING THE PRODUCTS

(a) Shea butter

(i) The existing marketing system

63. At the village level, shea butter is widely used in northern Ghana for cooking and as a skin cream, particularly by women. It is said to have curative properties and is used to treat skin conditions of babies and small children.

64. The processor who decides to trade the shea butter outside the village can either take it herself to a local market or sell it to an itinerant trader. At the market, the processor will either retail the butter directly in small pieces or sell to a wholesaler.

65. The problems encountered in establishing a unit price for the butter were described in paragraph 19(5). No indicative figures were available form the Ministry of Food and Agriculture because it does not keep data on shea nuts. This has been the responsibility of the Produce Buying Company of the COCOBOD which until 1993 had a monopsony on the purchase of the nuts. However as the PBC has not controlled the trade in shea butter, it has no historic records on volumes traded and prices paid.

66. Three traders were interviewed in the market in Tamale. They operated from warehouses in the market where they bought and stored shea butter for on sale to traders from Techiman, Sunyani and Kumasi who in turn sold the butter to traders from Accra.

67. Of the three interviewed, two traders gave similar prices. They said that they would pay between 12,000 and 14,000 cedis for a calabash from the processors in March which they would sell on to traders from Techiman or Kumasi for between 13,000 and 15,000. In Accra they would expect the same calabash to sell for 20,000. Prices paid to processors in June, when the shea nuts are in harvest, would fall to 8000 cedis.

68. As indicated above, the absence of scales in the market made it difficult to correlate prices with weights. A sample calabash was weighed outside the market to derive a unit price of between 800 and 933 cedis per kg for the processor. This is quite close to the retail prices that the women indicated in Kunyavila village, which averaged 830 cedis per kg. It also coincides with the price quoted by a member of the Karsardjian family who are the major exporters of shea nuts in Ghana.

69. The third trader gave much higher prices: he said that in March he would pay the village processors 26,000 cedis and sell to the market in Sunyani for between 28-30,000. He would pay 18,000 cedis to the processors in June.

70. In Accra itself, a number of shea butter retailers were interviewed in the Makola and 31st December markets. They were retailing small pieces (about 115 g) of shea butter at 200 cedis each. This gives a unit price of 1739 cedis per kilo. One woman said that she received her supplies from a sister in the north to whom she paid 40,000 cedis for 3 calabashes (assuming a weight per calabash of 15 kg, this gives a unit price of 889 cedis per kg). This is in fact no more than the traders were paying the processors in Tamale.

71. The main use for shea butter in the south of Ghana is as a skin cream, particularly during the hot, dry season. It is only used in its raw state and is not processed industrially for use as a base for the manufacture of either cosmetics or edible products. The reasons for this, and the

prospects for the development of new end uses for shea, are discussed below.

ii) The potential for increased demand for industrial use and for exports

72. As a locally manufactured oil which is easily absorbed by the skin, and therefore very suitable as a skin care product, shea butter may have a potential market as a substitute for imported petroleum jelly in the manufacture of cosmetics. A major manufacturing company is in the process of conducting research into this potential and is close to developing a prototype cream.

73. However whether the product is developed will depend on a number of other factors. From the technical perspective, in its raw form shea butter has a strong odour and this would have to be removed prior to processing which would have cost implications. In addition, its chemical structure means that it has a tendency to go rancid which might create further problems during processing.

74. From the economic perspective, high processing costs might combine with supply problems. Technologists interviewed at the manufacturing company indicated that if shea butter were to be used, large volumes would be required on a regular basis to meet demand. For example the company uses palm oil in the manufacture of a number of products, and daily deliveries are around 200 MT. The company itself would not want to invest in processing shea nuts for its own use, and would therefore be looking for a reliable outside supplier of raw butter. The rapid overview of the marketing system described above suggests that in its present form it might not be able to meet this demand.

75. Whether a new supplier emerges will depend on the price available. As a baseline, a domestic supplier would have to be able to supply the manufacturer at a price below that of a competing input. In the case of petroleum jelly (which is imported), the January 1995 price was £540 per MT (CF), equal to 864,000 cedis. Using Tamale prices, a MT of shea butter would cost between 800,000 and 933,000 cedis. If transport, deodorising and processing costs were added, the price might be well in excess of the petroleum jelly figure.

76. Thus the prospects for the use of shea butter in the cosmetics industry are not immediately very promising.

77. Large volumes of shea nuts are **exported** each year. The country's major exporter since market liberalisation, Karsardjian, exported 12,000 MT of nuts in 1994. The main markets are in Europe and Brazil where the nuts are processed and used in confectionary and cosmetic products as a substitute for cocoa butter.

78. The existence of a world market for shea butter does not appear to have prompted Ghanaian investors to process the shea nuts domestically on a commercial scale and export a higher value product: there are no industrial processors of the nuts in Ghana. In an interview, Mr Millsak Karsardjian said that his company might consider setting up a processing plant, but they had not yet done the necessary marketing studies.

79. There has been some interest among some of the NGOs in Ghana (TechnoServe, the Christian Mothers' Association) in promoting the export of shea butter to a niche market for organically produced products. A small quantity (5 MT)of butter was imported by the Body Shop in the UK in 1994. A price of £400 per MT (640,000 cedis) was paid to the Intermediate Technology Transfer Unit in Tamale for the butter which it collected from a number of NGO supported shea butter producing projects. The price (640 cedis per kg) was well below the price paid in Tamale market. No further orders have been received by the Body Shop despite an allegedly positive reaction in the company's UK office to the product.

80. TechnoServe, which has done its own research on shea butter export prospects, believes that the butter is traded from Ghana to Burkina Faso. One or two companies are said to process the butter for commercial use.

(iii) Conclusions

81. A preliminary review of potential domestic markets for shea butter suggests that at its present price manufacturers are unlikely to substitute it for other raw materials in the production of cosmetics.

82. On the export side, the present indications are that exporters are unlikely to switch from exporting shea nuts to processing and exporting the butter itself. More research on the world shea butter market would be useful to gain a better understanding of why this might be the case.

83. The implications of this are that given present limited demand for shea butter a substantial increase in the supply of shea butter on the domestic market as a result of improved technologies may lead to a glut and a fall in price. Anecdotal evidence suggests that this may already be the case: a shea nut butter processing centre in Tamale sponsored by the Christian Mothers' Association which has adopted a mechanised churner to increase output of shea butter has a store of nearly 2 MT of shea butter which it cannot sell. In a report on income generating activities for women in northern Ghana prepared for the IFAD/SRDP project (Paul and Anamoh, 1992), the authors note that there have been times when women who have increased production of shea butter by adopting an improved type of technology have not been able to market their surpluses because of over production.

84. Given this, any programme to promote the use of technologies which will increase the volume of shea butter produced must be very sensitive to the local market for the product. A possible approach is proposed in the final section.

(b) Groundnuts

(i) The existing market system

85. Ghana's international trade in groundnuts is currently minimal. In 1994 official exports of unshelled groundnuts were less than 50 MT. There is also evidence of informal cross border trade from the north of Ghana, particularly into Burkina Faso for processing at oil mills, although the extent of this trade is not known.

86. Most groundnuts are traded internally. Preliminary analysis (Baker, 1995 (draft)) suggests that margins are high (farmgate price 13,500 cedis, wholesale press at Kumasi/Accra 62,500 cedis) but account must be made of losses and storage costs. In the groundnut producing areas, the groundnuts are often processed for oil and kulikuli as described above.

87. Within Ghana groundnut oil is a widely used cooking oil, especially in the north of Ghana. Prices vary across the country and are principally determined by the distance from the producing area. In a recent study (Baker *op.cit.*), a beer bottle of groundnut oil (625 ml) was selling for 800

cedis in Tamale market; 900 cedis in Techiman market and 1,000 cedis in Kumasi market. Groundnut oil is slightly higher in price than red palm oil (selling at 650 cedis in Tamale and 900 in Kumasi). Imported clear palm oil sells for 1,500 cedis. Thus though groundnut oil is more expensive than palm oil, it is still significantly cheaper than the imported clear palm oil. Given this and its importance as a basic food commodity, the market outlook for groundnut oil is positive.

(ii) Conclusions

88. The generally positive market outlook for groundnut products does not alter the position outlined in paragraph 58, that is that the use of the bridge press for the processing of groundnuts is not financially viable.

3. THE MARKET FOR THE TECHNOLOGY

(a) Profile of traditional processors

89. Traditionally woman process shea nuts and groundnuts within the household compound using family labour. The basic equipment required are enamel basins, calabashes, aluminium pots, stirring sticks and drums. No special sheds or other facilities are required.

90. A needs assessment study of 138 women in 19 villages in the Gushiegu/Karaga, Salaga and Savelugu/Nanton districts of the Northern Region of Ghana (Williams et al., 1991) provides some background on the women themselves.

91. Respondents were predominantly Moslems and generally had no formal education. Ninety-two per cent lived in an extended family setting, with 45% in households of 6-10 persons. Seventy-five per cent were married and 60% of these were within polygamous marriages.

92. Half of the women were engaged in farming activities (although none of them owned land), mostly farming between one or two acres. Low productivity, combined with small acreages, meant that output was limited and lean season food shortages often severe.

93. Access to basic facilities was generally poor, with water being the major problem in all villages. The major source was from dams (74%) which were between a quarter and

25 miles from the village. Ninety-six per cent of the women used wood fuel (which is generally free) although over half of them said that they had to walk between 2 and 7 miles to obtain this. The distance to the nearest market ranged from 1.5 miles to 5 miles. Most villages had no means of transportation although bicycles are used by many male villagers.

94. Processing food (cereals, groundnuts) and tree crops were common activities among the women. Seventy per cent of respondents processed shea nuts. Processed items retailed within the village or in nearby towns. Only 10% reported selling to traders.

95. About half of the women saved money (this figure may be higher than average because of the IFAD project in the study districts. Credit is provided through the ADB and BHC banks to villagers who are required to open a savings account before a loan is granted.). Some women save money with the women's groups they belong to. Of those who did not save, the majority (81%) said that they did not have enough money to save any.

96. The potential target group for the new technology is thus one which is quite isolated from many modern services and has limited access to even basic amenities. Food shortages during the lean season are likely to wipe out any savings from more productive periods in the year. Low agricultural productivity and restricted market access generally constrain incomes.

97. In these circumstances one would expect the target group itself to be risk averse and therefore reluctant (and unable) to commit substantial amounts either of its own resources (savings) or those of a third party (loans) to an investment project. For the same reasons the target group would appear a poor lending risk in the eyes of any potential creditor. Any outside agent will need to consider the implications of this carefully in appraising a new technology for the target group.

(ii) *Groups of processors*

98. One strategy for reducing the financial burden of investment would be to target the technology at groups of processors rather than at individuals. This would not necessarily imply that a group would operate as one production unit, but that they would take turns to use the

equipment, an arrangement which would be less disruptive of traditional systems of working.

99. Observations and conversations with women in Kunyavila village suggest that group activities of this kind would have some potential at least in their village. The village women have a *susu* group (*adashi* in the local language) which meets every Saturday evening. About 40 women are in the group and each week they contribute 100 cedis each to a common fund. Half of this money is given on a rotational basis to a member of the group and the rest is deposited in a savings account at the Co-operative Bank in Tamale. These savings are used to purchase groundnuts at harvest which are stored for sale later in the season when the price increases. Though the amounts involved are very small (relative to the cost of the bridge press, for example which costs about US$200) the example does indicate that the women already have experience of a group activity involving financial transactions.

100. Another aspect of group organisation is that it can be used as a mechanism to provide joint liability for loans. Many lending programmes have adopted what is called the *peer group principle* to improve repayment. All group members are required to guarantee repayment of all the loans made to the group. Failure to meet all its obligations leads to the disqualification of the entire group from further loans. Though this system requires careful monitoring, where this has been available it has improved the flow of resources to the poor in many different countries.

(iii) *MOFA extension and NGO networks*

101. Another element of a marketing strategy would be to use the knowledge of existing networks of extension agents and local NGOs to identify communities likely to adopt the new technology successfully. In the needs assessment study (Williams et al., 1991), 96% respondents belonged to organised women's groups co-ordinated by a variety of NGO and MOFA extension agencies. This high coverage probably owes something to the operation of the IFAD programme in the districts where the study was carried out, but it is also an indication of the development effort which has already been directed at rural communities in northern Ghana. Before any new intervention is undertaken, existing projects should be

carefully reviewed to identify their strengths and weaknesses as well as any potential for joint programmes[3].

4. FINANCIAL AND SOCIAL PARAMETERS FOR SUSTAINABLE OPERATION

(a) Financing the investment

(i) The potential role of savings

102. Paragraph 92 indicates that among women in rural northern Ghana there is already a savings culture which could assist them to finance a new investment. In Kunyavila, the savings of 40 women each week were 4,000 cedis, of which 2,000 was deposited at the bank. At this rate it would take them 2 years to buy the bridge press outright.

103. Given competing demands for the use of this money (particularly during the lean season when many families experience food shortages) it seems unlikely that the women would want to commit so much to the press. An alternative might be for the group to raise a deposit (perhaps 30% of the price of the press) and borrow the rest.

(ii) Access to credit

104. Potential sources of credit would be (a) banks; (b) the major donors (IFAD/SRDP); (c) NGOs.

105. The attitude of the banks to rural lending (outside of donor funded programmes) has altered in recent years as government policy has shifted sharply away from promoting rural development through targeted agricultural lending (often with the aid of subsidised interest rates and lending targets) to a much more cautious strategy of risk minimisation.

106. This is illustrated by the attitude of the Co-operative Bank in Tamale, where the women of Kunyavila hold their savings account. In the 1970s and early 1980s it

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[3] A Ghanaian organisation, the Integrated Social Development Centre, is at present seeking funding for a project to develop the institutional capacity of local NGOs in Northern Ghana. It has approached Oxfam and Action Aid for support. Nigel Ede, Country Representative for Action Aid, believes that his organisation is likely to support this initiative and recommends it to other donors.

nearly collapsed as a result of numerous bad loans made to co-operative societies. Today its lending operations are much reduced. To get an investment loan an applicant must have a savings account at the bank, must be able to demonstrate the profitability of the proposed investment, must prove that he/she has the requisite book keeping and financial skills to run a business and that the turnover from the proposed investment will generate sufficient surplus to repay the loan. Interest rates are 36% (7 points above the minimum lending rate) and the maximum repayment period is ten months.

107. Unassisted, a group of illiterate rural women with no experience of formal business practice would not be able to secure a loan on these conditions.

108. In the Northern Region a number of major donor funded initiatives are trying to meet the demand for credit among those excluded from the formal sector. Since 1987 the IFAD's Smallholder Rehabilitation and Development Programme (SRDP) has provided loans to groups of processors through the Agricultural Development Bank and the Bank of Housing and Construction (NB the banks are not lending their own funds in these operations but on-lending IFAD money).

109. A key aspect of the SRDP has been the involvement of local NGOs as intermediaries between the rural communities and the banks. This has assisted in bridging the gap between smallholders and banks.

110. Although the performance of the SRDP as a whole has been mixed, groups of women processors have generally had a much better repayment record than groups taking loans for production credit.

111. The SRDP finishes at the end of 1995. An important test of the sustainability of the programme will be whether the participating banks continue to lend to the programme's target groups from their own funds. If they do not, an important source of rural lending in the region will be lost and it may prove very difficult for groups to finance investments in the future.

112. A major new World Bank initiative, the Agricultural Services Investment Programme, may partially fill the gap. In principle this is intended to assist rural communities with projects for water, access roads, markets and agro-processing and storage. However discussions with the Project

Manager in Tamale suggested that the projects handled by ASIP will be much larger scale investments than a hand operated press: the average budget is expected to be around 4.5 million cedis.

113. A number of NGOs, both local and international, have their own credit programmes in the region. Action Aid has a seed bank programme in the Upper East Region. The Christian Mothers' Association (CMA) has a number of investment projects that it is financing, including a shea butter processing project.

114. However this project illustrates the problems that some NGOs have run into with micro-financing: the CMA has incurred a debt of some six million cedis for a project which has generated no income in the last 8 months because a market cannot be found for the shea butter.

115. This suggests that to take advantage of the local knowledge and expertise that NGOs can offer, donors may have to begin by providing training in other areas like basic business skills to the NGOs themselves.

(b) Establishing and maintaining cohesive groups

116. The existing level of group activity, especially among women, in the region combined with a network of outside support from the MOFA and NGOs, suggests that a group based approach to lending may have some potential. As mentioned in paragraph 95, group lending does not necessarily imply joint enterprise. The women could agree to use the press on a rotating basis whilst each would remain responsible for purchasing her own inputs, providing labour and marketing the output. Agreement would be required only on a service fee to meet loan repayments.

117. Experience of many other group based projects (see for example **The Provision of Agricultural Services Through Self-Help in Sub-Saharan Africa**, Coulter et al., December 1994) should provide some caution in developing such projects. The process of establishing effective groups can take time and it may be more appropriate in the first instance to attempt projects which do not involve significant investment. Once the group has demonstrated its ability to work together, it can graduate to more investment intensive activities.

(c) A proposed strategy for sustainable operation

118. The first step is to establish that the technology offers sufficient returns relative to the capital cost, bearing in mind the very low investment capacity of the target group involved.

119. In the case of the bridge press, financial analysis above suggests that for groundnut processing it does not have this potential, but it may do so for shea nuts, especially in remote areas. On the other hand, whilst groundnut products offer more marketing potential, the market for shea butter may be demand constrained.

120. Thus whilst it might be worthwhile to give further consideration to the development of the press for shea butter processing, the marketing situation requires a cautious approach. Caution is also required if a group approach is to be adopted, for reasons discussed above.

121. The potential for lowering the cost of the bridge press itself should also be explored. Sensitivity analysis in paragraph 38 indicates that returns would increase by about 30% if the press cost half its present price. It would also be closer to the very limited savings capacity of the target group.

122. It is proposed therefore that initially a small pilot project be undertaken. Working closely with local MOFA staff and NGOs, communities which (a) process shea nuts and (b) are already involved in group activities (perhaps a *susu* group or equivalent) would be approached and offered small individual loans (from project funds) on commercial terms and on the basis of a group guarantee (peer group principle) to purchase shea nuts at harvest when the price is low, for processing later in the season when the price is higher (basically an inventory credit system). Some assistance might be required with storage facilities as well as basic training in loan administration and dealing with creditors (and even literacy, given that most women in the villages are illiterate). A training programme might also be required for the NGO itself, although the potential for supporting the initiative of the Integrated Social Development Centre (see paragraph 98, footnote 1) should be explored.

123. Through a project of this kind, processors would benefit from the substantial increases in returns available through advanced purchase of raw materials. If output of shea butter increased as a result, it would also test whether increased output could be absorbed by the existing marketing system. Finally processors would gain experience of a group lending programme.

124. Where groups were successful and established a good repayment record, they could be considered for a larger loan to invest in a (cheaper?) bridge press, should they show interest in this. Rather than funding the loan itself, the project (through the local MOFA staff/NGOs) would link groups with banks to get loans. In this way the group would not become dependent on project loans to sustain its activities but would be integrated within the existing financial system.

125. Finally, a few comments are offered on the potential for the sustainable adoption of the mincer/extruder technology for groundnuts, should a suitable prototype be developed. Fieldwork has indicated that the investment capacity of individual and even group investors is very limited. As argued above, this represents a major constraint to the adoption of the bridge press, even though this is a relatively simple and cheap technology. The prospects for the more expensive mincer/extruder in this part of Ghana are not therefore very promising. Quite apart from the higher cost of the equipment itself, it is motorised, implying considerably greater working capital and investment. Therefore, it is not recommended that further work on this is carried out in Ghana.

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Appendix One: Key Informants

Burkino Abdullah, **Amasachina**, Tamale

Ted Braimah, Accountant, **Intermediate Technology Transfer Unit**, Tamale

Mr Abdulai I Zakaria, Regional Agricultural Economist, **Ministry of Food and Agriculture**, Tamale

Bernard D. Moro, Project Manager, **Agricultural Services Investment Programme**, IDA/MOFA, Tamale

Peter Reiling, Kwasi Poku, John Addaquay, **TechnoServe**, Accra

Stella Nitori, Regional Coordinator, **Christian Mothers Association**, Tamale

Bawah Gami, Samuel Kuug, **Produce Buying Company**, Tamale

Millsak Karsardjian, **Karsardjian Trading Company**, Tamale

Samuel Adongo, Project Manager, **SRDP/IFAD**, Tamale

Blandina Ansoghea, Women's Projects Coordinator, **SRDP/IFAD**, Tamale

Francis Azaglo, Accountant, **Ghana Cooperative Bank Ltd**, Tamale Branch, Tamale

C.B.Asante, Imports Buyer, **Lever Brothers**, Tema

Victor Adjei, Projects Officer, Food and Personal Products, **Lever Brothers**, Tema

Nigel Ede, Country Director, **Action Aid**, Ghana

Appendix Two: Shea Butter Processing: Traditional Method

Shea Butter Processing: Traditional Method	
A) INPUT	
Purchase price of shea nuts at market per kilo (cedis)	
one bowl (kg)	*2.45*
price/bowl (lean season)	*500*
price/kg (lean season)	204
Milling costs (cedis)	
weight of shea nuts paste (kg)	*24.19*
conversion shea nuts to shea paste	*0.98*
weight unmilled shea nuts (kg)	*24.69*
milling cost	*500*
milling cost/kg	20
Labour input (woman hours/kg sheanuts)	
shea nuts (kg)	*24.69*
total woman hours	*13*
woman hours/kg	0.51
B) OUTPUT	
Shea nut butter selling price at market per kilo (cedis)	
price/kg (March - lean season)	882
CONVERSION RATES	
Conversion rate shea nuts (kg) to butter (kg) - as observed 17.3.95.	
shea nuts (kg)	*24.69*
butter (kg)	*10.66*
conversion rate	0.43
C) RECEIPTS	
Receipts per kg processed shea nuts (cedis)	
Butter	*381*
Total income	381
Payments per kg processed shea nuts (cedis)	
Shea nuts	*204*
Milling	*20*
Total cost	225
Net Income per kg shea nuts processed (cedis)	156

Return to labour per woman hour	
Total returns	*3856*
Return per woman hour	*308*
D) SENSITIVITY ANALYSIS	
1) Varying the time spent collecting inputs	
Time collecting inputs in hours	
a	3.50
b	7.00
c	10.50
Total processing time in hours	
a	12.50
b	16.00
c	19.50
Return to labour in cedis per woman hour (assuming lean season price)	
a	308
b	241
c	198
2) Seasonal variation in the price of shea nuts	
Price of bowl of shea nuts	
Lean season	500
Harvest season	300
Return per kg shea nuts (cedis)	
Lean season	178
Harvest season	260
Return per woman hour (assuming 12.5 hours processing time)	
Lean season	352
Harvest season	514

Appendix Three: Shea Butter Processing: Bridge Press

Shea Butter Processing: Bridge Press	
Kunyavila Pilot Run: Processing one headload of shea nuts *	
Tamale, 17.3.95.	
A) INPUTS	
Purchase price of shea nuts at market per kilo (cedis)	
one bowl (kg)	*2.45*
price/bowl (March)	*500*
price/kg (March)	204
Milling costs (cedis)	
weight of shea nuts paste (kg)	*24.19*
conversion shea nuts to shea paste	*0.98*
weight unmilled shea nuts (kg)	*24.69*
milling cost	*500*
milling cost/kg shea nuts	20
Labour input (woman hours/kg sheanuts)	
shea nuts (kg)	*24.69*
total woman hours	*6.00*
woman hours/kg shea nuts	0.24
B) INVESTMENT COSTS	
Press	
Capital cost	*210000*
Repayment interval (years)	*0.08*
Total repayment period(years)	*1.00*
Annual interest rate	*35%*
Monthly interest rate	*2.53%*
Monthly repayment	*20512*
Total repayment cost	*246150*
*Number of times used **	*416*
Repayment cost of press per processing	*592*
Bags	
Cost per bag	*400*
Number of bags	*15*
Number of pressings per bag	*50*
Cost of bags per pressing	*120*
Cost of bags/kg shea nuts processed	*5*
Investment cost per kg shea nuts processed	29
C) OUTPUT	
Shea nut butter selling price at market per kilo (cedis)	

price/kg							882
CONVERSION RATES							
Conversion rate shea nuts (kg) to butter (kg) - as observed 17.3.95.							
shea nuts (kg)							*9.80*
butter (kg)							*3.49*
conversion rate							0.36
D) RECEIPTS							
Receipts per kg processed shea nuts (cedis)							
Butter							314
Payments per kg processed shea nuts (cedis)							
Shea nuts							*204*
Milling							*20*
Pressing							*29*
Total costs						Year 1	253
						Year 2	230
Net Income per kg shea nuts processed (cedis)						Year 1	60
						Year 2	84
Return to labour per woman hour							
Total returns						*Year 1*	*1485*
						Year 2	*2077*
Return per woman hour						*Year 1*	*248*
						Year 2	*346*
Payback period							
Price of bridge press							*210000*
Net revenue/kg shea nuts processed							*84*
Kg shea nuts per batch							*24.69*
Payback period (no.batches)							101
*	This unit was selected because it represents the amount of processing						
	a woman would do in one batch. It is customary for women to carry large						
	basins of materials on their heads, including those for processing.						
**	See paragraph 32.						

Appendix Four: Groundnut Processing: Traditional Method

Groundnut processing: Traditional Method	
Kunyavila Village, Tamale 15.3.95.	
A) INPUT	
Purchase price of groundnuts at market per kilo (cedis)	
one bowl (kg)	*2.02*
price/bowl (March)	*700*
price/kg	347
Milling costs (cedis)	
13 bowls groundnuts	*13*
groundnuts (kg)	*26.25*
milling cost (2 passes)	*500*
milling cost/kg	19
Labour input (woman hours/kg groundnuts)	
groundnuts (kg)	*26.25*
total woman hours	*8.50*
woman hours/kg	0.32
B) OUTPUT	
Groundnut oil selling price at market per kilo (cedis)	
one beer bottle ((l)	*0.63*
conversion factor (kg)	*0.93*
one beer bottle (kg)	*0.58*
beer bottle/kg	*1.73*
price/beer bottle (March)	*1000*
price/kg	1730
Kulikuli flour selling price at market per kilo (cedis)	
one bowl (kg)	*1.88*
price/bowl	*900*
price/kg	478
CONVERSION RATES	
Conversion rate groundnuts (kg) to oil (kg) - as observed 15.3.95.	
groundnuts (kg)	*28.08*
oil (kg)	*9.27*
conversion rate	0.33
Conversion rate groundnuts (kg) to kulikuli flour (kg) as observed 15.3.95	
groundnuts (kg)	*28.08*
kulikuli flour (balls pre drying) (kg)	*18.85*

conversion rate	0.67
C) RECEIPTS	
Receipts per kg processed groundnuts (cedis)	
Oil	*571*
Coolie coolie flour	*321*
Total income	892
Payments per kg processed groundnuts (cedis)	
Groundnuts	*347*
Milling	*19*
Total cost	366
Net Income per kg groundnuts processed (cedis)	526
Return to labour per woman hour	
Total returns	*13814*
Return per woman hour	*1625*
D) SENSITIVITY ANALYSIS	
Seasonal variation in the price of groundnuts	
Price of bowl of groundnuts	
lean season	1400
harvest season	700
Return per kg groundnuts	
lean season	180
harvest season	526
Return per woman hour	
lean season	555
harvest season	1625