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AND PRESIDENT'S SPECIAL INITIATIVES
NATIONAL BOARD FOR SMALL SCALE INDUSTRIES
THE REPUBLIC OF GHANA

THE STUDY ON PROMOTION AND DEVELOPMENT OF LOCAL INDUSTRIES IN THE REPUBLIC OF GHANA

TRIAL PROGRAM IMPLEMENTATION REPORT

APRIL 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

UNICO INTERNATIONAL CORPORATION
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Abbreviations for Trial Program Implementation Report

A	ADF	African Development Foundation
	AEA	Agricultural Extension Agent
	AEE	Ajumako Enyan Essiam
	AfDB	African Development Bank
	AGI	Association of Ghana Industries
	AGOA	African Growth and Opportunity Act
	ALS	Atadwa Loan Scheme
	ASCO	Ayensu Starch Company
	ATC	Agreement on Textile and Clothing
	ATL	Akosombo Textile Ltd.
	AVFC	Activity Venture Finance Company
B	BAC	Business Advisory Centre
	BDS	Business Development Service
	BOG	Bank of Ghana
	Brix	Measurement of the mass ration of dissolved sugar to water in a liquid
C	CBE	Cocoa Butter Equivalent
	CDC	Commonwealth Development Corporation
	COVE	Corporate Village Enterprises
	CSIR	Council for Scientific and Industrial Research
	CTTC	Clothing Technology and Training Centre
D	DA	District Assembly
	DACF	District Assembly Common Fund
	DAE	Department of Agricultural Engineering
	DED	German Development Service (Deutscher Entwicklungsdienst)
	DEG	Deutsche Investments und Entwicklungsgesellschaft mbh
	DIP	District Industrialization Programme
	DIPI	District Industry Promotion Initiatives
E	ECG	Electricity Company of Ghana
	ECOWAS	Economic Community of West African States
	EDIF	Export Development Investment Fund
	EPA	Environmental Protection Agency
F	f.o.b.	Free-on-board
	F/S	Feasibility Study
	FAO	Food and Agriculture Organization of the United Nations
	FDB	Food and Drugs Board
	FEFI	Fidelity Equity Fund I Limited
	FFA	Free Fatty Acid
	FIRR	Financial Internal Rate of Return
	FRI	Food Research Institute
G	GFZA	Ghana Free Zone Authority
	GIPC	Ghana Investment Promotion Centre
	GOG	Government of the Republic of Ghana
	GPRS	Ghana Poverty Reduction Strategy
	GRATIS	GRATIS FOUNDATION
	GSB	Ghana Standards Board
	GTMC	Ghana Textile Manufacturing Company
	GTP	Ghana Textile Printing
	GTZ	German Technical Cooperation (Deutsche Gesellschaft fur Technische Zusammenarbeit)
	GWC	Ghana Water Company Ltd.
	GWSC	Ghana Water and Sewerage Corporation

H	HACCP	Hazard Analysis and Critical Control Point
	HND	Higher National Diploma
	HR	Human Resources
I	IDEAS	Innovation and Development in Enterprise Assistance Schemes
	IFAD	International Fund for Agricultural Development
	IFC	International Finance Corporation
	IMF	International Monetary Fund
	ISO	International Organization for Standardization
	ITTU	Intermediate Technology Transfer Unit
J	JETRO	Japan External Trade Organization
	JICA	Japan International Cooperation Agency
	JITAP	Joint Integrated Technical Assistance Program
	JHS	Junior High School
K	KEEA	Komenda Edina Eguafo Abrem
	KNUST	Kwame Nkrumah University of Science and Technology
L	LLC	Limited Liability Company
M	MASLOC	Micro Finance and Small Loans Centre
	MC	Moisture Contents
	MDA	Ministries Departments and Agencies
	MDPI	Management Development and Productivity Institute
	MEST	Ministry of Environment, Science and Technology
	MESW	Ministry of Employment and Social Welfare
	MFA	Multi Fibre Arrangement
	MOE	Ministry of Education
	MOFA	Ministry of Food and Agriculture
	MOMYE	Ministry of Manpower, Youth and Employment
	MOTI/PSD/PSI	Ministry of Trade, Industry, Private Sector Development and President's Special Initiatives
	MSMEs	Micro, Small and Medium Enterprises
N	NBSSI	National Board for Small Scale Industries
	NES	National Electrification Scheme
	NGO	Non-Governmental Organization
	NOGCAF	Northern Ghana Community Action Fund
	NPV	Net Present Value
	NVB	Net Book Value
	NVTI	National Vocational Training Institute
O	O&M	Operation and Maintenance
	OCC	Operational and Capital Cost
	ODA	Official Development Assistance
	OJT	On the Job Training
P	PAMSCAD	Programme of Actions to Mitigate the Social Cost of Adjustment Loan Scheme
	PDM	Project Design Matrix
	PSD	Private Sector Development
	PSI	President's Special Initiatives
R	R & D	Research and Development
	RCB	Rural and Community Bank
	REDP	Rural Enterprises Development Programme
	REDS	Rural Enterprise Development Support
	RFAs	Request for Applications
	RFLS	Revolving Fund Loan Scheme
	RTSC	Regional Technology Service Centre

S	SHEP	Self Help Electrification Project
	SME	Small and Medium scale Enterprise
	SNV	Netherlands Development Organization (Schweizerische Normen-Vereinigung)
	SPEED	Support Programme for Enterprise Empowerment and Development
	SPGE	Sub-Committee on Productive and Gainful Employment
	SPS	Sanitary and Phytosanitary
	SHS	Senior High School
	SSNIT	Social Security and National Insurance Trust
	SSTS	Senior Secondary Technical School
	SWOT	Strengths, Weaknesses, Opportunities and Threats
T	TBT	Technical Barriers to Trade
	TI	Technical Institute
	TIPCEE	Trade & Investment Program for Competitive Export Economy
	TOT	Training of Trainers
	TP	Trial Program
	TSSP	Trade Sector Support Programme
	TTB	The Trust Bank
U	UCC	University of Cape Coast
	UDS	University for Development Studies
	UNDP	United Nation Development Programme
	UNICEF	United Nations Children's Fund
	UNIDO	United Nations Industrial Development Organization
	USAID	US Agency for International Development
V	VCTF	Venture Capital Trust Fund
W	WATH	West Africa Trade Hub
	WTO	World Trade Organization

TRIAL PROGRAM IMPLEMENTATION REPORT

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Explanation of the Trial Program Implementation Report

This trial program implementation report describes formulation, results and evaluations of the trial programs in four selected regions. The aim of this report is to share information gathered and lessons learned from the programs with the counterparts and stakeholders.

This section explains procedures of selecting industries and programs. The following each chapter describes the details of program implementation.

(1) Selection of Target Industries in the Four Priority Regions

The following 4 industries were selected as temporary target industries in the minutes of meeting agreed between the Ministry of Trade and Industry, and the Preparatory Team of JICA dated on August 18, 2005.

- Greater Accra Region: Garment
- Ashanti Region: Palm oil or Cassava processing
- Central Region: Citrus processing
- Northern Region: Shea butter

The Team for the Study on Promotion and Development of Local Industries in the Republic of Ghana (the team) accepted the minutes and implemented the basic survey especially on those industries selected by counterparts. The team decided not to change the target industries unless a serious problem was found. However, in the case of Ashanti Region, since two candidate industries were proposed, the team selected **Palm Oil processing** as the target industry on consideration of stakeholders' opinions and statistical data.

(2) Trial Program Selection Procedure

On the basis of the results of the basic study conducted during the first field survey, the team's experts developed trial program proposals for the promotion of the target industries. The details of the basic survey are described in the main report. Then, several candidate programs were chosen in consideration of program duration, manpower requirements, availability and capability of the Business Development Service (BDS) supplier at local level, and other relevant factors.

During the second field survey, the workshops were held under participation of stakeholders to conduct problem analysis. It produced a problem tree indicating core problems and their causes. Based on the results of the program analysis and views expressed by workshop participants, the team formulated the master plans for promotion of each target industry in the selected regions. Each master plan contains purpose, strategies and programs and each trial program was selected from these programs[1] in consideration of following factors:

- Involving public and private organizations
- Motivate stakeholders especially beneficiaries
- Sustainability (size and complexity)
- Localities and industrialization

Furthermore, each candidate program was evaluated by the team in terms of necessity and impact, i.e., if the program helps solve problems faced by the local industry. In addition, opinions were collected from the counterpart personnel and local stakeholders in order to confirm the beneficiary's needs and wants, and the levels of urgency and necessity during the workshop. Also, the team evaluated each program's viability and sustainability. The trial programs selected through the above process, including the reason for selection, are shown below.

(3) Ex-post Evaluation of the Trial Program

The ex-post evaluation of each trial program has been conducted on the basis of: (1) verification of the implementation status and conditions (e.g., implementation results and process); and (2) five evaluation criteria (relevance, effectiveness, efficiency, impact, and sustainability).

[1] The government or development partners did not have to be implementation bodies for these programs. It was recommended that the target group discuss with stakeholders including governmental agencies to decide the implementation method and organization.

1. The Trial Program for the Garment Industry in the Greater Accra Region

1. The Trial Program for the Garment Industry in the Greater Accra Region

1.1 Establishment of the Trial Program

1.1.1 Problem Analysis and Formulation of the Draft Master Plan

(1) Core Problems and direct causes

At the workshop conducted on 26 May, 2006, the core problems and their causes were identified. They were compiled into a problem tree shown in Fig.1.1-1.

Core problem: SMEs can not find markets for their products

The direct causes identified were classified into the following factors.

1) Finishing of the product is poor.
2) Low productivity causes low competitive price of the product.
3) Market information is not easy to be obtained
4) SMEs have difficulties in promotion.

(2) Formulation of the draft master plan

Based on the problem tree, the Team formulated a draft master plan (Fig.1.1-2).

The master plan sets the primary objective of increasing overall sales of small- and medium-sized garment manufacturers. As judged from the results of the questionnaire survey, their sales do not show any sign of decline, both at the present and in the near future. Nevertheless, most people in the industry do not believe that their sales can grow without any effort as they face the rise in raw material cost and penetration of import products into the domestic market. In fact, garment exports from the country do not seem to grow firmly, suggesting that the industry is unable to take advantage of African Growth and Opportunity Act (AGOA) and other favorable conditions.

To achieve the objective, the following four strategies were established.

Strategy 1: Making attractive products for the target market
Strategy 2: Increasing the productivity to be cost competitive
Strategy 3: Establishing information channel of the market
Strategy 4: Enforcing the product promotion capability

Under this strategy, fourteen programs are proposed. These programs have been developed on the basis of problem analysis and SWOT analysis (Table 1.1-1). Note that the trial program was selected from those developed under Strategy 2.

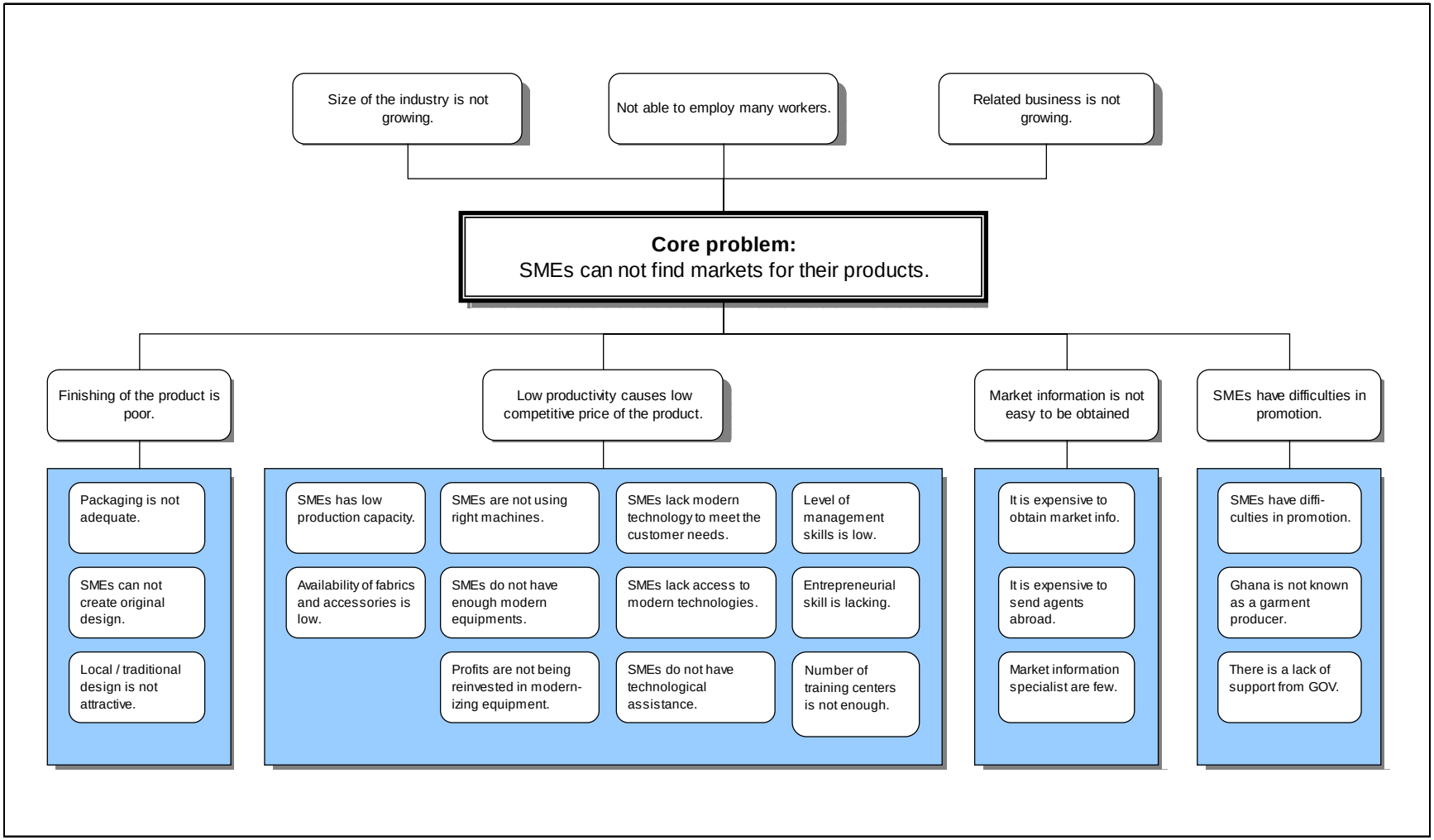


Figure 1.1-1 Problem Tree of the Garment Industry in the Greater Accra Region

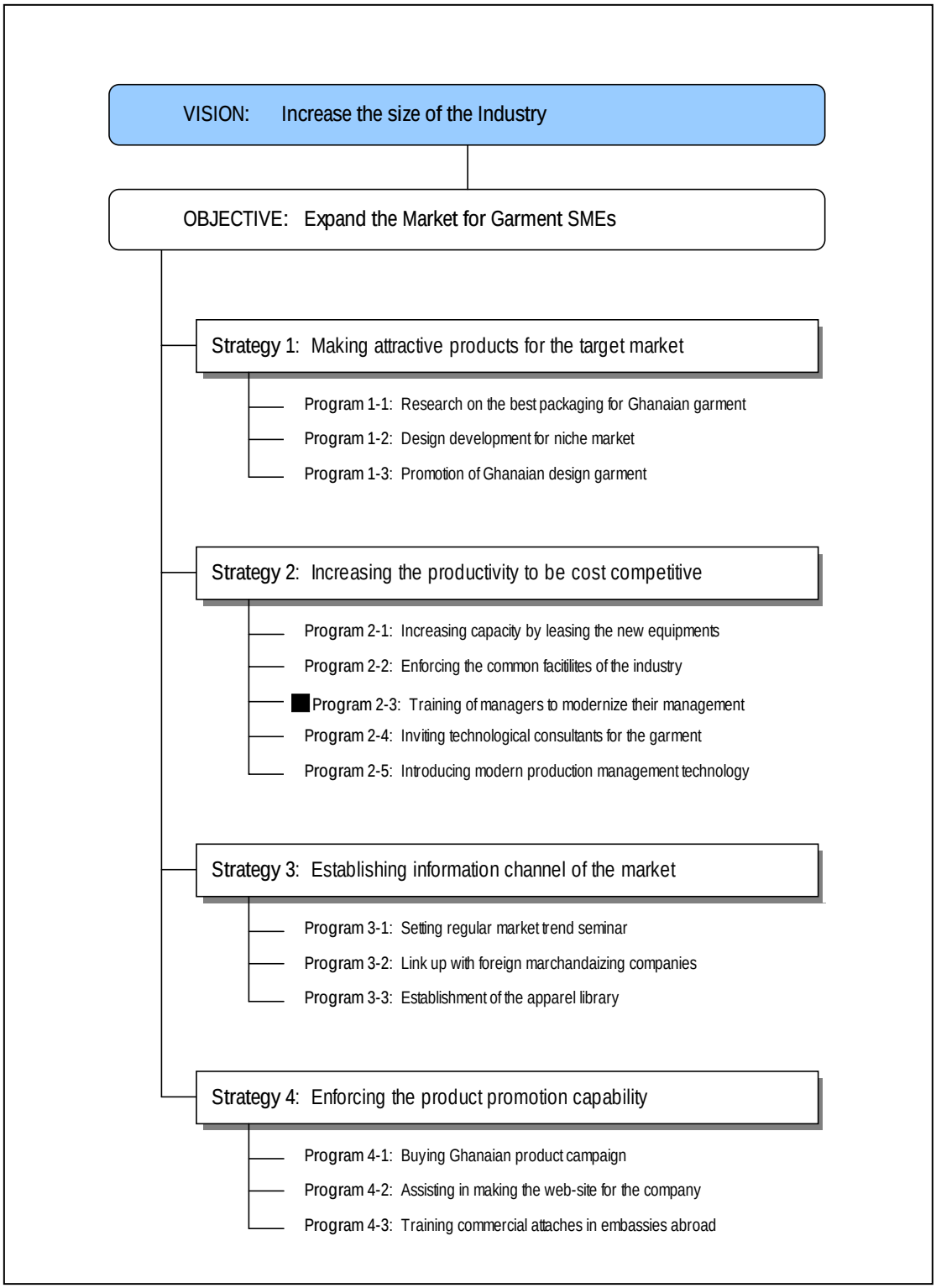


Figure 1.1-2 Framework of the Draft Master Plan for the Garment Industry in the Greater Accra Region

Table 1.1-1 SWOT Analysis: the Garment Industry in the Greater Accra Region

	Market	Production Technology	Raw materials	Human Resource	Development capability	Business Environment
STRENGTHS	• Substantial Afro-centric market in U.S. and Europe.	• Traditional fabrics such as Kente can be obtained.	• Ghana is a key production country of African prints. • Cotton production	• Comparative low wage (Min.19,200 cedi/day) • Workers are obedient and can be taught in English.	• Potential Afro-centric design ability	• Stable democratic government
WEAKNESSES	• Low purchasing power in domestic market • Cheap imported second hand garments dominates the local market.	• Low production efficiency • Old machinery • Inadequate maintenance • Low capability to control production	• High cost of fabrics and accessories. • Unstable raw material supplies	• Lack of work ethic • Low level of skill	• Limited information about world fashion trend	• Difficulties in access to finance due to the high cost. • Lack of management capability • Lack of business information
OPPORTUNITIES	• Duty free export to US market (AGOA). • Free zone regime provides favorable conditions to exporters. • Potential sales channels in Ghanaian communities abroad.	• PSI scheme provides machineries.	• Improvement of business environment attracts additional investment in textile industry.	• Training centers provide more skilled workers. • Training centers establish in other cities.	• New generation designer bring more sophisticate Afro-centric design.	• Promotion policy of PSIs. • Availability of finance scheme such as EDIF
THREATS	• Special treatment for importing foreign fabrics in AGOA comes to the end in 2007. • Competition over the same niche market is getting aggravated.		• Declined local textile industry forces the garment industry to rely on imported materials.			

1.1.2 Selection and Outline of the Trial Program

Program name: Training of SME managers to modernize their management

(1) Reason for selection

A major problem facing the garment industry is the high production cost as result of low productivity. The problem analysis revealed that it was caused by the low level of management capability. Also, some of SME managers who participated in the workshop expressed the need for training in the areas of management and factory operation. Furthermore, some companies visited by the Team failed to perform proper administration and/or management.

The major question is; who will be the program beneficiary or to whom should technology transfer be targeted. The following opinions were expressed by potential beneficiaries and other stakeholders.

- Technology transfer to local consultants is considered to be better than manager training in terms of effectiveness, breadth and continuity.
- There are no qualified consultants. No effective support can be expected from consultants.
- SME managers may not have time to receive training for a long period of time.
- It is more urgent to improve the present manager's capability, rather than younger or next-generation managers.

In consideration of the above opinions, it was decided to make technology transfer to local consultants in the formal training program, who would then provide training for SME managers with the Team. It is considered to be the best way to ensure the program's sustainability. Note that the training program will include corporate diagnosis techniques as well as management "kaizen" and factory operation techniques based on experience in Japan.

(2) Outline of Trial Program

1) Expected Output

a) Organization for manager training is prepared
b) Self-diagnosis and management improvement are implemented by a trained manager
c) Dissemination system of manager training is prepared.

2) Activities

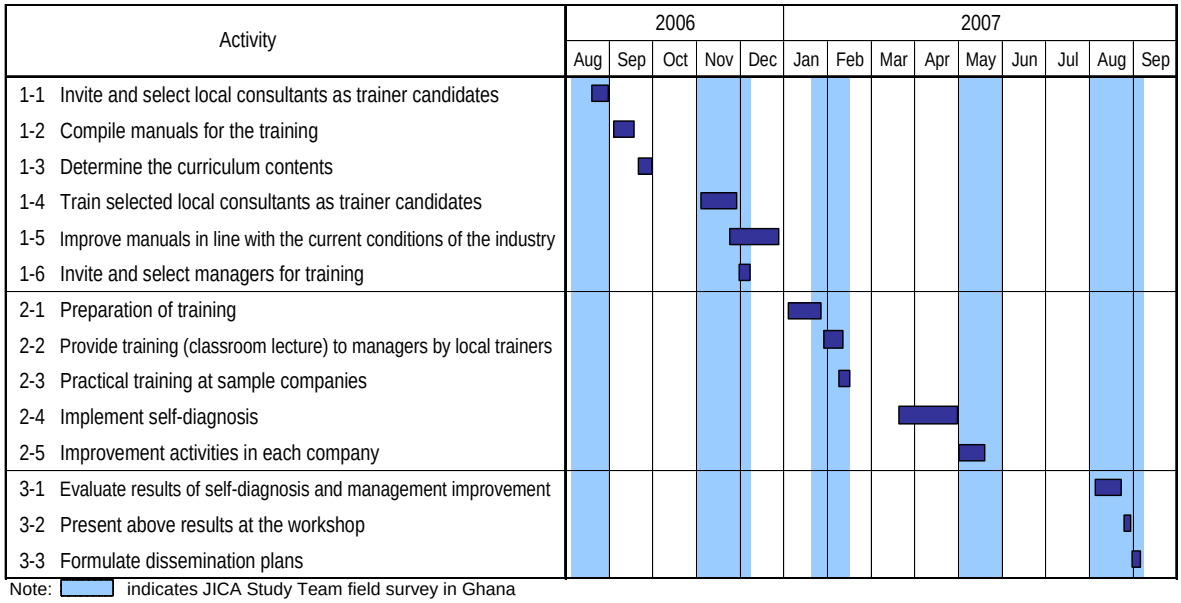
1-1 Invite and select local consultants as trainer candidates.
1-2 Compile manuals and teaching materials for training.
1-3 Determine the curriculum content and prepare the class
1-4 Train selected local consultants as trainer candidates.
1-5 Improve manuals in line with the current conditions of the industry.
1-6 Invite and select managers for training.

2-1 Preparation of training
2-2 Provide training (classroom lecture) of company diagnosis and management improvement to managers by local trainers.
2-3 Practical training (on-site training) at sample companies
2-4 Implement self-diagnoses in each participating company with a trainer
2-5 The Team and trainer instruct improvement activities based on above mentioned self-diagnosis in each company

3-1 Evaluate results of self-diagnosis and management improvement.
3-2 Present results of self-diagnosis and management improvement at the workshop.
3-3 Each trainer formulates a dissemination plan with the knowledge of company diagnosis and management improvement.

See Table 1.1-2 for details.

3) Implementation Schedule



Note: ▭ indicates JICA Study Team field survey in Ghana
As of Nov. 2006.

Table 1.1-2 Project Design Matrix – Greater Accra Garment Industry

Name of trial program : Training of managers toward modernizing management
Target group : Small and medium sized garment companies
Implementation Area : The Greater Accra Region
Implementation period : August 2006～July 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal SMEs gain competitiveness.	• Sales expansion	• Total sales volume	
Project Purpose SMEs managements are modernized.	• Improvement activities are done according to the results of self-diagnosis. • As result of improvement activities the overall condition of management is improved.	• Inquiry about improvement activities • Score of self-diagnosis after improvement	1. Business environment of garment change dramatically.
Outputs			
1 Organization for training is prepared.	• Number of trained trainers • Manuals for training • Content of curriculum	Participants list Manuals Curriculum	1. Trainers change their jobs after training.
2 Trained managers implement self diagnosis and management improvement.	• Number of mangers trained • Improvement plan	• Participants list • Reports	
3 Manager training method is disseminated.	• Number of participants in W/S. • Plan for dissemination • Satisfaction of participants	• Participants list • Reports • Questionnaire	
Activities 1-1 Invite and select local consultants as trainer candidates. 1-2 Compile manuals for the training. 1-3 Determine the curriculum contents 1-4 Train selected local consultants as trainer candidates. 1-5 Improve manuals in line with the current conditions of the industry. 1-6 Invite and select managers for training. 2-1 Provide training (classroom lecture) to managers by local trainers. 2-2 Practical training at a sample company 2-3 Implement self-diagnosis and management improvement. 3-1 Evaluate results of self-diagnosis and management improvement. 3-2 Present results of self-diagnosis at the workshop. 3-3 Formulate dissemination plans.	**Inputs** JICA Study team • Japanese experts • Operating expense - Employment costs of Ghanaian staff - Transportation and accommodation costs - Expenses of training, meetings, workshops - Expenses of training materials Ghanaian counterparts • Counter personnel • Office space, office equipment and furniture • Operating expense - administrative and management costs		1. The government changes the policy for the garment industry. **Pre-conditions** 1. Adequate local consultants agree to become trainers. 2. Adequate participants agree to join the program.

1.2 Training of Managers to Modernize their Management

1.2.1 Training of Trainers

(1) Selection of Trainers

A number of consulting firms and training providers were visited for selecting the trainers and then invited to a workshop held at the Coconut Grove Hotel, Accra, on August 22, 2006.

Out of the 18 consultants/training providers that expressed their willingness to participate in the program, the 10 were selected for the Training of Trainers workshop after the extensive selection process. The process included visiting their offices, obtaining and perusing their curriculum vitae followed by interviews.

Table 1.2-1 List of Trainers (Final)

Company		Trainer	Position	Establishment
1	MDPI	Philip Osei-Antoh	Consultant	Government
2	MDPI	Aaron Komla Vuha	Consultant	
3	EMPRETEC Foundation	Patrick Tetteh	Consultant	NGO
4	AGI	Awurabena Okrah	President of AGI garment	NGO
5	NBSSI	Gladys Seshie	BAC head	Government
6	NBSSI	Anthea Ohene	BAC head	
7	Accra Polytechnic	Vivian Biney-Aidoo	Instructor	Government
8	Integrated Management Consult	Kwame Ashun Quainoo	Consultant	Private
9	Optimal Consult	Francisca Amankwa	Consultant	Private
10	PSI Training Center	Laura Carter	Instructor	Private

(2) Teaching materials

The teaching materials used included the following:

a. Manual on Management Diagnosis Practice
b. Improvement (Kaizen) Procedure
c. 5S Basic Knowledge
d. Trainer Education Seminar Textbook on 5S
e. Management Diagnosis Tips & Check list
f. Production Control Tools for Garment Industry.

Others Include:

a. Video movie on 5S
b. Video movie on Red label
c. Video movie on how to use Signboard
d. Video movie on procurement from Canada
e. Video movie on Garment Production in Japan, Spain, Vietnam and Russia
f. Video movie on factory layout.

(3) Contents of training

The contents of the training included the followings;

1st Week – 13th November 2006 to 17th November 2006.

- Orientation session by Y Yamamoto
- Improvement (Kaizen) Procedure by T Higo
- 5S basic knowledge – T Higo
- Introduction 5S – T Higo
- How to use Red Label – T Higo
- How to use Signboard – T Higo
- Explanation of management diagnosis 1 – Y Yamamoto

- Explanation of management diagnosis 2 – Y Yamamoto
- Review of the company to be visited - T Higo
- Management diagnosis Tips & Check list – T Higo
- Preparation of company visit
- Management diagnosis on site
- Discussion and analysis of diagnosis
- Group presentation

2nd Week – November 20, 2006 to November 24, 2006

- Training Guidance – H Asai
- Method of analyzing the actual situation – H Asai
  - ❖Motion Study – H Asai
  - ❖Time Study – H Asai

- How to utilize data – H Asai
- Production Planning – H Asai

- Machine layout – H Asai

- Actual practice at factory
- Group work
- Group presentation
- Q & A

Attendance for the program was 100% even though some members were not able to attend all day.

(4) Joint activities by trainers

Joint activities by the trainers included practice at the factory level took them to 3 garment manufacturing factories. They carried out the following tasks:

1) Management diagnosis exercise

The trainers carried out management diagnosis exercise. The group was divided into 2, with Group “A” carrying out diagnosis on Marketing while Group “B” did diagnosis on Production. The activities are described as follows;

- Interviews with a manager prior to the course to collect basic information of the company
- Preparation of the Company Visit
- Interviews and collection of further information
- Scoring
- Analysis of the company visit and completion of radar charts
- Proposing recommendation for improvements

Each group presented their result of scoring and analysis. Although it was the exercise and many of them were not well trained in this field, the company was appreciated the feed back of this exercise. It is important for trainers to experience more in management diagnosis in order to make more accurate analysis. The results of the scoring are described as follows;

Table 1.2-2 Scoring Sheet and Radar Chart (Group A, Marketing)

	Trainees					Total	Score(5)
	A	B	C	D	E		
1. Understanding of Market trends and Competitions	3.5	3.0	4.0	3.0	3.0	16.5	3.30
2. Marketing activities	2.5	2.0	3.6	2.0	3.0	13.1	2.62
3. Sales Policy and Sales Plan	2.0	1.0	1.5	1.0	2.0	7.5	1.50
4. Pricing	3.5	2.8	4.0	2.4	2.7	15.35	3.07
5. Response to customer satisfaction as built-in system	2.0	2.5	3.0	2.5	2.0	12	2.40
6. Action for Customer Satisfaction	2.5	2.6	4.0	2.0	2.0	13.1	2.62
7. Customer Information	1.5	1.5	2.0	1.3	1.0	7.3	1.46
8. Capacity Development of Sales Staff	1.0	1.0	1.0	1.5	1.5	6	1.20
9. Goods and Services	2.5	2.0	4.2	2.4	2.5	13.6	2.72
10. Distribution	1.8	1.5	1.2	1.3	2.0	7.7	1.54
Total	22.75	19.85	28.5	19.35	21.7		2.24

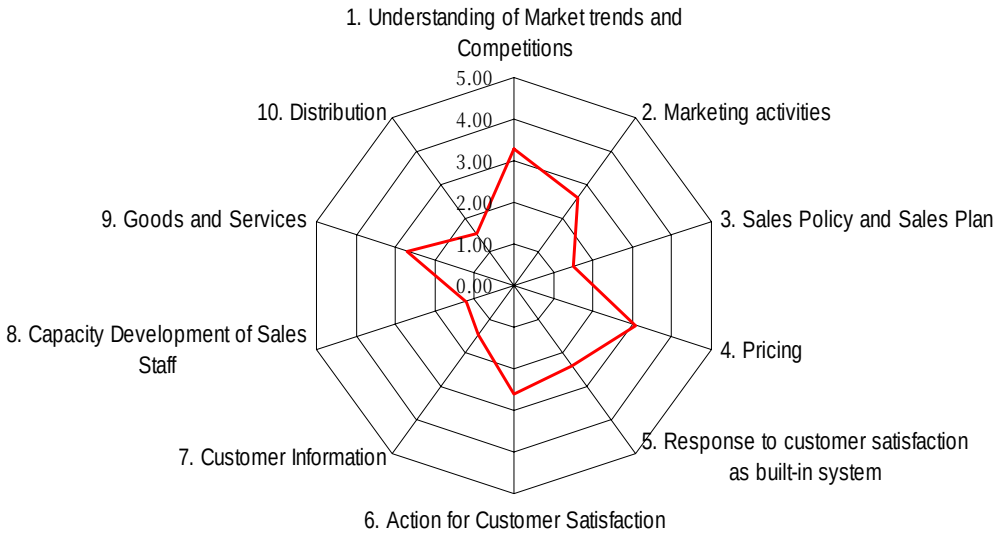
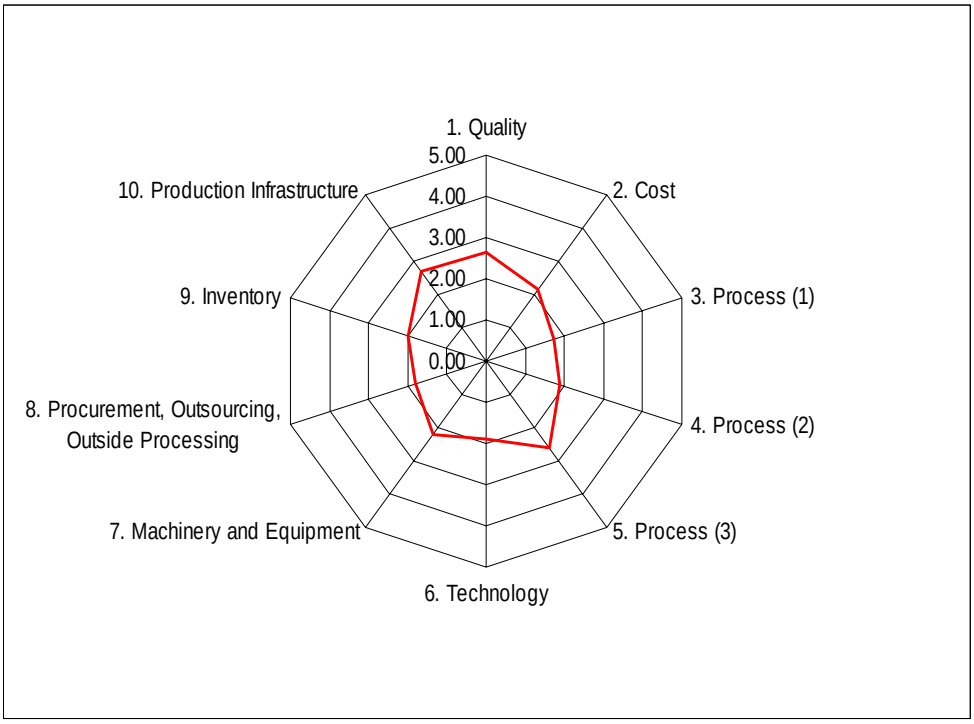


Table 1.2-3 Scoring Sheet and Radar Chart (Group B, Production)

	Trainees					Total	Score(5)
	F	G	H	K	L		
1. Quality	3.2	2.2	2.6	2.4	2.8	13.2	2.64
2. Cost	2.2	2	2.2	2.2	2.2	10.8	2.16
3. Process (1)	1.5	2	2	2	1	8.5	1.70
4. Process (2)	2	2.5	1.5	1.5	2	9.5	1.90
5. Process (3)	2	2	3	3	3	13	2.60
6. Technology	1.6	1.2	1.6	2.4	2.6	9.4	1.88
7. Machinery and Equipment	2	3	1.6	1.6	2.8	11	2.20
8. Procurement, Outsourcing, Outside Processing	2	1.4	1.2	2.2	2.2	9	1.80
9. Inventory	2.4	1.8	1.8	2.6	1.4	10	2.00
10. Production Infrastructure	3.4	2.2	1.8	3	3	13.4	2.68
Total	22.3	20.3	19.3	22.9	23		



2) Operation Analysis, Process Analysis and Time Study

The trainers carried out operation analysis, process analysis and time study on another sample company.

1. Observation: A supervisor of the factory explained what operators were doing in the factory, the flow of work and kind of production is in place.
2. Process Analysis: Collect data on and ascertain the process each operator works on
3. Time Study: Carry out 3 cycles. Take the time of the process before and after
4. Operational Analysis: Select 5 operators and conduct operational analysis e.g. observe each operator every 10 seconds per person for 30 minutes.
5. Find out where the material is coming from and where it is sending to.

Presentation by Group A

The results of operation analysis by the group on line E are as follows:

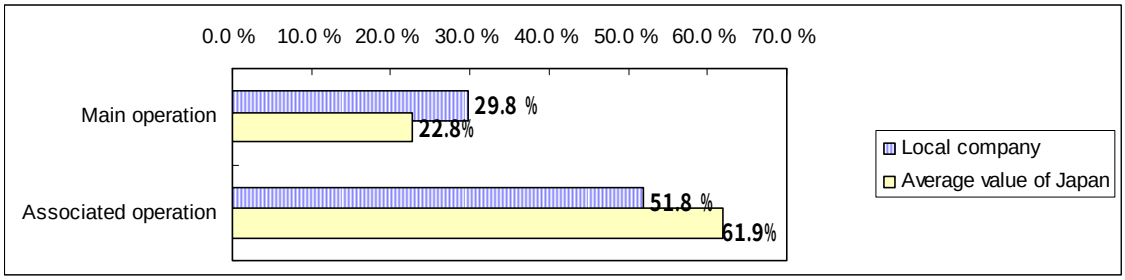


Figure 1.2-1(1) Operation Analysis – Operation (Group A)

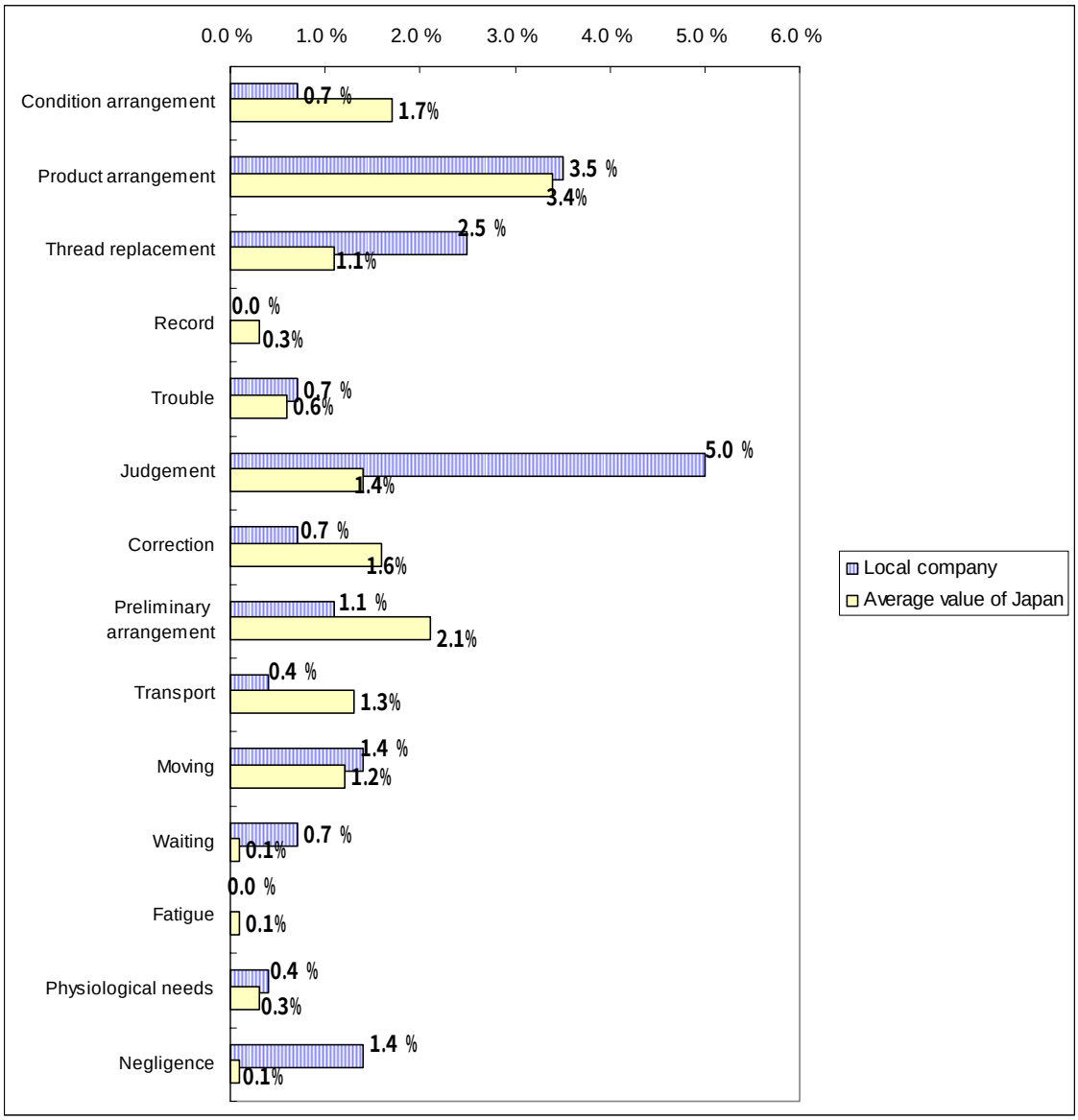


Figure 1.2-1(2) Operation Analysis - Allowance (Group A)

Group A made 17 comments and recommendations based on the above result.

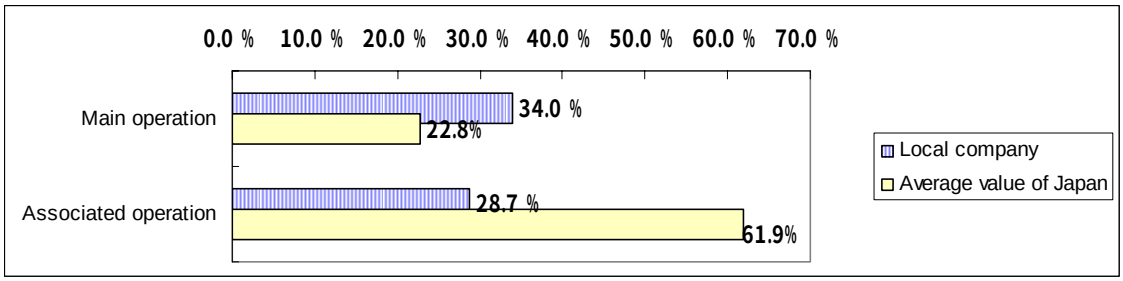


Figure 1.2-2(1) Operation Analysis - Operation (Group B)

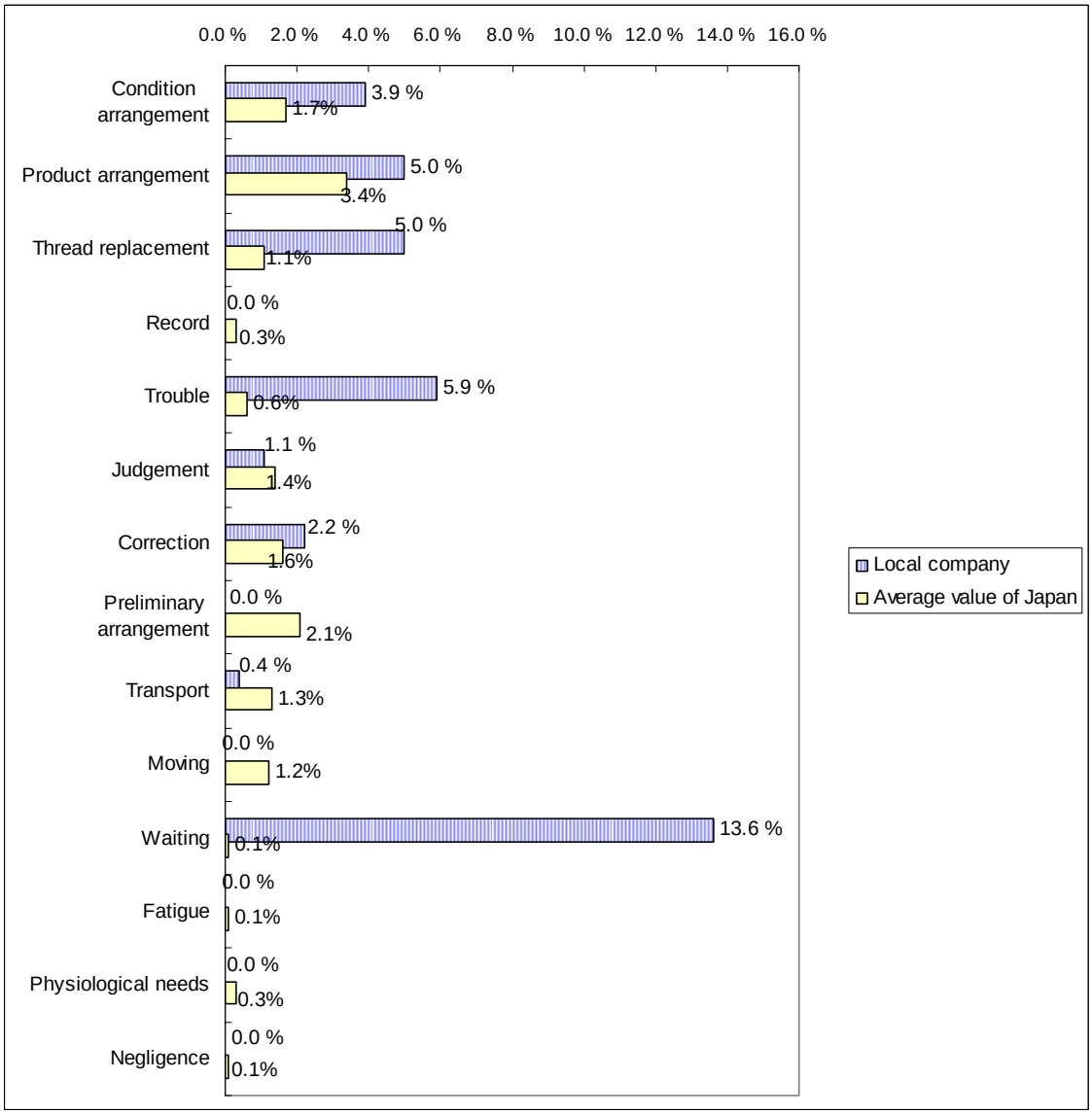


Figure 1.2-2(2) Operation Analysis - Allowance (Group B)

Group B made 15 comments and recommendations according to the above data.

3) Red label operation

A section of the group went to the garment factory after the completion of the workshop to carry out 5S exercise with special emphasis on red labeling. A video movie on 5S was shown to the staff of the company and some of them were taught the right way of making patterns. All these helped the workers to appreciate their weaknesses.

(5) Evaluation of the training of trainers

At the end of the course, the questionnaire survey was conducted in order to understand the opinions of trainers on the training course. The results are as follows;

Table 1.2-4 Evaluation of the Training of Trainers

What you like about the seminar

Answer	Frequency
practical	3
audio-visual	3
provision of materials	2
good course content	2
Total	10

Dislikes about the seminar

Answer	Frequency
duration-short	3
None	2
inadequate slides	1
5s presentation poor	1
Access to relevant references	1
Total	8

Lessons learnt

Answer	Frequency
5s	4
management diagnosis	3
production analysis	1
time study	1
adoption of small groups	1
Total	10

How to improve future seminar

Answer	Frequency
increase the duration	3
should be residential	2
prior notices should be given in advance	1
adequate materials should be provided	1
Total	7

Views about trainers

Answer	Frequency
good	4
all must be proficient in English	3
mastery of the subject	2
good use of audio-visuals	1
Total	10

The results of the survey indicate that most of trainers were satisfied with the course in spite of short duration. Some trainers said that they would use knowledge and materials of this course for their current jobs.

1.2.2 Training of Managers

(1) Selection of managers

A number of garment manufacturing companies were visited for selecting the managers and then invited to a workshop held at the Coconut Grove Hotel, Accra, on 22nd August 2006. 11 Garment manufacturers expressed their willingness to participate in the Training of Managers.

After the workshop at Coconut Grove Hotel, the team visited a number of garment manufacturing companies and spoke to others on the telephone. Out of these, 10 companies, which satisfied requirements of having growth potential and can benefit from our training, expressed their willingness to participate in the Training of Managers. However, out of the 21 companies that expressed their interests 7 companies could not participate in the workshop for various reasons.

The following 14 companies and 18 representatives participated in the workshop:

Table 1.2-5 Participating Firms

	COMPANY	PARTICIPANT		POSITION
1	Sleek Fashion	1	Emmanuel Opoku	Human Res. Manager
		2	Winfred Narh Tetteh	Asst. Prod. Manager
2	Winglow Clothes	3	Regina Sowah	Admin Manager
		4	Daniel Sowah	Ag. Prod. Manager
3	Vistar	5	Vida Sam	Director
4	Jem Afrik Creations Ltd	6	Almond Hammond	Director
		7	Yaw Owusu	Prod. Manager
5	Global Garments	8	Mrs. Philomena Appiah	Director
6	Wadata Fashions	9	Alhaji Dauda Abdullai	Director
7	Masdo Garments Ind.	10	Samuel Adu Odame	Director
8	Festus Garments	11	Festus Asiamah	Chairman
9	Nana Fashions	12	Nana Akua Busia	Director
10	House of Damaris	13	Gloria Eshun	Manager
		14	Samuel Amoah	Prod. Manager
11	Abundant Grace Ltd	15	Doris Crabbe	Director
12	Ginatu Exclusive	16	Mrs. Doe	Director
13	El-Hyat Ent. Ltd	17	Munir Abdallah	Director
14	African Fabrics Ltd	18	Anne Acolatse	Director

(2) Contents of training and trainers

Out of the 10 trainers that were trained during the Training of Trainers' Workshop held at MDPI in November 2006, only one trainer was unable to take part in this Training of Managers by reason of ill health. Whilst the local Trainers did the training, the Japanese experts were on hand to lend support whenever necessary.

The schedule of training and the names of lectures were as follows:

1st Week – 29th January 2007 to 2nd February 2007.

- Orientation session - Y Yamamoto
- Improvement (Kaizen) Procedure Small Group Activity – Philip Osei-Antoh

- Seiri, Seiton, Seiso, Seiketsu, Shitsuke (5S) Basic Knowledge – Gladys Quarshie
- Introduction 5S – Gladys Quarshie
- How to use Red Label – Awurabena Okrah
- How to use Signboard – Awurabena Okrah

- Explanation of Management Diagnosis – Aaron Komla Vuha
- Review of the Companies to be Visited – Patrick Tetteh
- Preparation of Companies to be Visited – Aaron Vuha

- Management Diagnosis on Site (2 companies) – Aaron Vuha & Patrick Tetteh
- Discussion and Analysis of Diagnosis
- Presentation
- SWOT Analysis

2nd Week – February 5, 2007 to February 9, 2007

- Training Guidance
- Method of Analyzing the Actual Situation:
- Operational Analysis – Laura Kattah
- Process Analysis – Vivian Biney-Aidoo
- Motion Study – Francisca Amankwa
- Time Study – Anthea Ohene

- How to Utilize Data – Patrick/Aaron
- Production Planning – Patrick Tetteh
- Machine Layout – Aaron Vuha

- Actual Practice at Factory – Laura Kattah & Vivian Biney-Aidoo
- Group work
- Group presentation
- Q & A

Prior to the training, each trainer had the preparation session with Japanese experts. Some of them made their own power point slides for their classes. In general, trainers taught managers well so managers seemed to understand subjects.

(3) Joint activities by managers

1) Management diagnosis exercise

Management and production were selected for detail diagnosis of the sample company A while human resource affairs and production were chosen for diagnosis of the sample

company B. The participants that went to each company were divided into 2 groups to carry out the diagnosis on the 2 areas after which SWOT analysis was carried out from their findings

Each group presented their result of scoring and analysis. However, because participants lacked diagnosis experience and exposure to high level of management, they had difficulties in scoring the sample company (see (4) Evaluation of the training managers). They tended to score higher than the actual situation. It may indicate that managers need to have a consultant to diagnose their management to have accurate analysis.

2) Operation Analysis, Process Analysis and Time Study

The participants were divided into 2 groups to carry out process analysis, time study and operational analysis on two lines of the factory.

Line E with 20 machines was producing wrap skirts. Line G on the other hand was producing police shirts for the Ghana Police. It had 14 machines but only 9 were operational while the machinists for the remaining 5 were not at post. Because of the incomplete production line, it was not possible to draw the process diagram and find the bottle neck of the production line of police shirts. In addition, the factory had unusual situation of at this time, the result of operation analysis showed quite higher allowance rate and lower efficiency than the result of the last time.

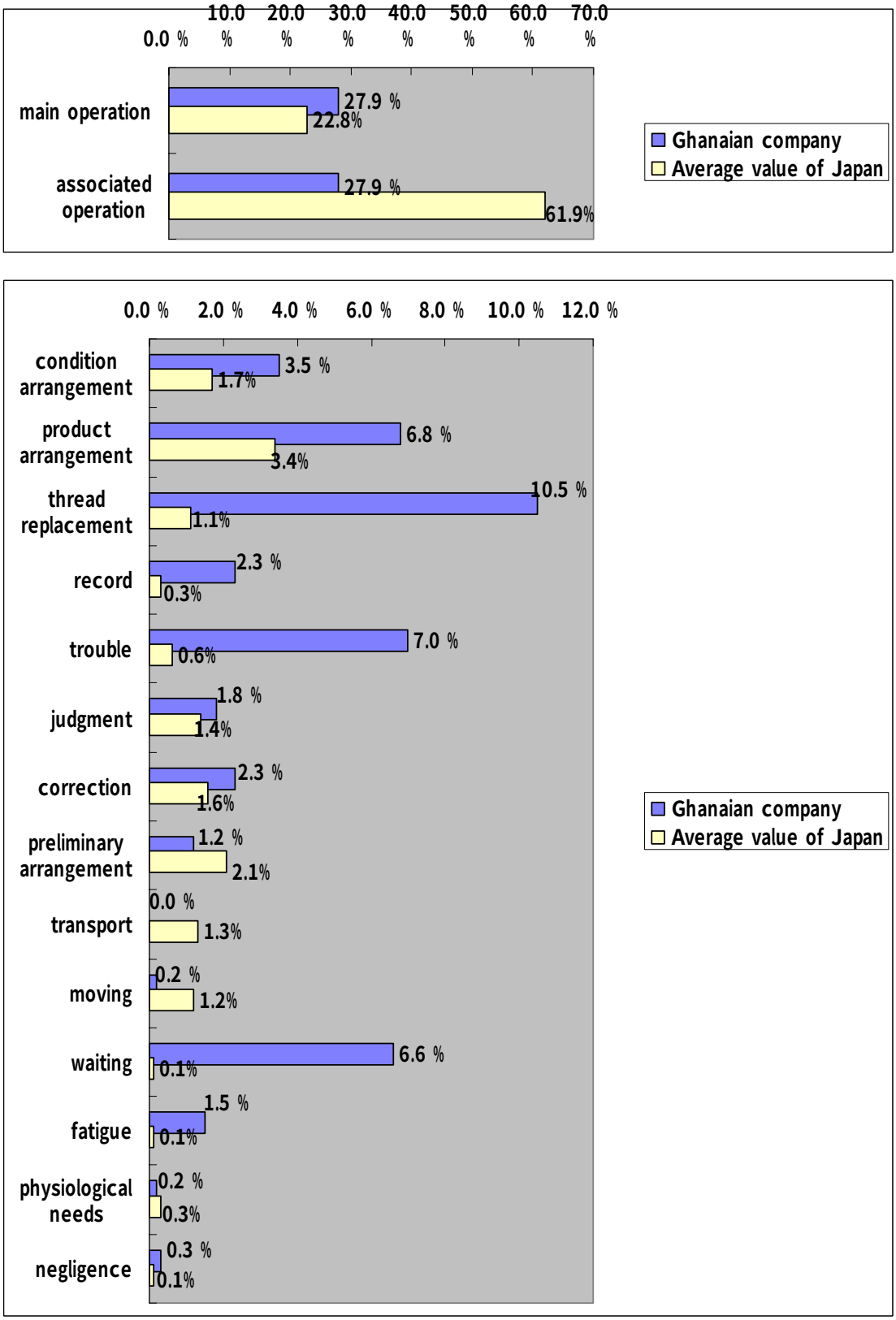


Figure 1.2-3 Operation Analysis (Group A)

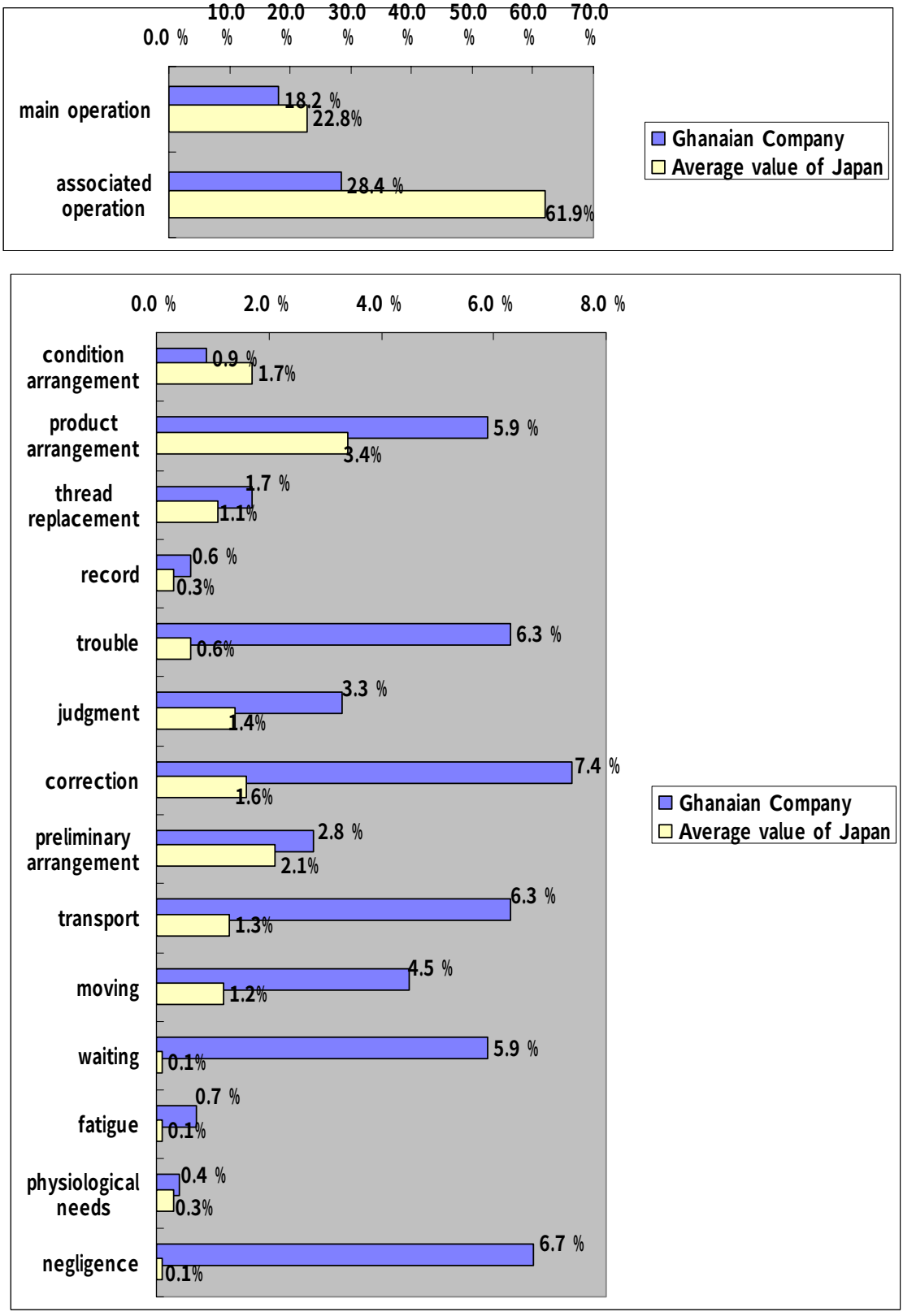


Figure 1.2-4 Operation Analysis (Group B)

(4) Evaluation of the training of mangers

The questionnaire survey was conducted at the end of week to understand opinions of mangers. There are two questionnaires for each week.

1) First week

Q1. Did you find any inconvenience in this text book?

1.Yes	3
2.No.	10

Q2. How do you think of this seminar?

1. Satisfied.	13
2. Satisfied but disagreed in some of the contents.	0
3.Not satisfied	0

Q3. How do you think the contents of this seminar?

Topic	Understand	Understand partially	Disagree	N/A
a. Improvement Procedure	12	1	0	
b.5S knowledge and introduction	11	2	0	
c. Red Label & Signboard	11	1	0	0
d. Management diagnosis theory	9	4	0	
e. Management diagnosis practice	7	5	0	0
f. Discussion and presentation.	13	0	0	

Q4. Do you have any subject to be attached to this seminar?

QC	2
Finishing on Garment	2

Q5. 5 days seminar is

1. Appropriate	9
2. Too short	4
3. Too long	0
4 N/A	0

Q6. Please give your value Comments/Suggestions.

Should be held more often	3
Need more time	2
Should add Quality Control (QC)	1

The result indicates that managers had difficulties to understand the management diagnosis and its practice. And four managers think the course is too short.

2) Second week

Q1. Did you find any inconvenience in this text book?

1.Yes	1
2.No.	12

For those who check "Yes", kindly describe the inconvenience in details.

Q2. How do you think of this seminar?

1. Satisfied.	12
2. Satisfied but disagreed in some of the contents.	1
3.Not satisfied	0

Q3. How do you think the contents of this seminar?

Topic	Understand	Understand partially	Disagree	N/A
a. Process Analysis	11	1	0	1
b.Operation Analysis	13	0	0	
cutie Study	13	0	0	
d.Motion Study	9	3	0	1
reproduction Design	11	0	0	2

Q4. Do you have any subject to be attached to this seminar?

- (International) Marketing 2
- Cutting room operation 1

Q5. 4 days seminar is

1. Appropriate	3
2. Too short	8
3. Too long	0
4 N/A	2

Q6. Please give your value Comments/Suggestions.

- Need financial assistance 4
- Need more time 1
- Should accept more participants 1

Although managers do not have enough knowledge of Industrial Engineering, they understood the production management well. However, more than half of participants felt that the course was too short.

(5) FORUM

At the end of the course, a forum was jointly held by the JICA Study Team and the MOTI/PSD/PSI.

It provided the participants the opportunity to interact with stake holders.

Agenda:

1. Presentation of certificates to both the trainers, and the managers of companies in the garment sector, who completed the training programs.
2. Interaction between the trainees and the stake holders
3. Any other matters.

During the forum the team informed the stake holders about the content of trainings, held at the MDPI premises in Accra. The first training (TOT) trained local resource personnel to carry out the Training of Managers' course which was held at the MDPI premises in Accra from 29th January 2007 to 9th February 2007.

This was followed by presentation of certificates to 10 participants who completed the Training of Trainers' course Certificates were also given to 18 participants who completed the respective modules of the Training of Managers' course.

1.2.3 Follow Up

The team visited companies which sent trainees to the program, to confirm if these trainees had introduced the content of program in their factories (May 2007). In fact, most of mangers (trainees) did start activities for improvement of their work places.

In order to continue the same program (garment production control) in Ghana, Ghanaian counterparts of the trial program revised and modified the teaching materials prepared by the Team. In addition, they produced the videos for operational analysis and time study. Subsequently, they gave trainings to instructors and supervisors of PSI textile and garment training center and they actually used videos in trainings (June 2007).

(1) Follow up for post evaluation

Activities taken by participating companies are described as follows.

<Company A>

The workplace has been rearranged as a result of motion study. This has reduced distances workers have to travel within the workplace, especially from their machines to the ironing table.

The activities undertaken are:

- Implementation of 5S activities; and
- Provision of Bins at vantage points to avoid littering.

The difficulty encountered is:

- Cultural resistance to change as some workers fail to cleanup after work

The major problem currently confronting the company was how to convince the workers to abandon the old system of dressmaking, where everyone seemed a dress from start to finish and to accept the new concept of division of labor which leads to specialization. They also refused to cut the materials completely before they started sewing.

<Company B>

The Management of the company has really embraced the 5S concept and internalized the training program they have received.

They have really appreciated the tremendous improvement derived after undertaking the 5S exercise at the company. The key activities undertaken include:

- A 5S Team of ten members has been formed. The members meet once in a week and management is actively involved;
- All employees have been educated on the 5S concept;
- Company has been repainted;
- Employees have become more disciplined. They have cultivated the "pick-up" attitude;
- Trays to hold work in progress have been introduced to improve the movement of parts of products being made;
- All loose electrical wires have been properly redone.

<Company C>

The key activities undertaken include:

The ground floor of the new factory is completed and is housing ten (10) machines. Management is currently concentrating all efforts on how to improve the frontage as it intends to rent some of the rooms to commercial people in order to raise capital for the industry.

The manager acknowledges that the training he received is very useful to him and would apply the concepts at the new location.

When the construction is completed by the end of 2007, the company would have between 50 – 100 machines.

<Company D>

The company has applied 5S to organize the workplace and this has cut down time wasted in moving around. The company has also introduced division of labor and this has

brought about the specialization for the worker. No worker is allowed to make a dress from beginning to the end. This has helped to increase productivity.

The old machines are being replaced with new ones. By the end of the installation period, there would be fifty-four (54) machines. The replacement program has virtually removed the problems of frequent breakdowns.

<Company E>

The company used 5S concept to organize the workplace. This has reduced the problem of searching for things which had been a big problem before. The workplace is now well organized.

<Company F>

The key activities undertaken include:

- Started implementing 5S while the Director was on the training program
- 5S Team has been established and the Director is actively involved
- New ideas on how to improve have emerged from the Small Groups. Materials which used to be scattered all over have the workplace been well arranged
- Layout has been modified

<Company G>

As a result of the training received by management, the improvements have occurred:

- Improvement in the Evaluation System. Each worker is given a target and his performance is monitored.
- The poor communication among workers has drastically improved after a series of workshops which were organized in-house.
- There is regular interaction between management and the front line supervisors; and the supervisors and the workers.
- There is open discussion on discipline, rules, shop floor problems and how to improve productivity.
- The vision of the company has been explained to the workers.
- 5S concept was implemented and all “red labeled” items have been removed thus creating more space for improved workflow.
- Pocket folding process is now double thus reducing the net processing time.

<Company H>

The company has experienced a lot of improvement since the training. However the improvement process has stalled because the trainee had suddenly died.

The maintenance of the machines is done by workers, having been rained by a qualified technician.

<Company I>

The key activities undertaken include:

- 5S was implemented which has resulted in a very clean, safe and healthy atmosphere.
- The workers are better motivated because of the healthier environment.

Now there is better mass production. However the mass production is mixed into the clothes for those who just walk in with their requests.

<Company J>

The key activities undertaken include:

- Reorganizing the show room;
- Sorting out the necessary and unnecessary items at the workplace;
- Improving the layout of the company.

<Company K>

The key activities undertaken include:

- Formation of 5S group; and
- Implementation of the 5S concept.

The company has not done much because the director had to travel to Tamale to attend to her sick father.

1.2.4 Validation of Training Materials

(1) Objectives of program

The main objective of the course was to validate the course materials.

(2) Target group

The trainees were the trainers of the Presidential Special Initiative (PSI) on Garment. There were nine participants made up of eight females and one male.

(3) Content of training program

- Operation analysis
- Process analysis
- Motion study
- Time study
- Production planning
- Machine layout
- Practical work

(4) Conduct of training program

1) Venue

The program took place at the premises of the PSI Garment Technology Training Center at Industrial Area, Accra.

2) Period and duration

The program lasted for four days and was conducted from May 31, 2007 to June 5, 2007. the program started at 8.30 a.m. and ended at 3.00p.m. each day.

3) Training methodology

The workshop adopted a problem solving oriented type of learning situation. This provided the participants with the opportunity to develop practical skills which they could apply on the job immediately after the course.

Other training methods and techniques employed on the course included:

- PowerPoint presentations;
- Discussions;
- Exercises; and
- Practical work at the factory.

(5) Evaluation of training program

1) Textbook

All the nine participants did not find any inconvenience in the course textbook.

2) Presentation

The participants were of the opinion that the Japanese experts could have participated in the facilitation.

3) Video clips

The video clips which were used as supplementary information were found to be useful.

4) Satisfaction

All participants except one were satisfied with the program.

5) Content

Participants understood the topics as treated during the program.

6) Additional topics for consideration

Additional topic which was proposed for consideration in the future programs is “Cutting room practices”.

7) Duration

All the participants felt the duration for the program was too short.
They however suggest a duration of two weeks.

8) Other comments

Participants made the following additional comments:

- Participants should be made to pay for the program in order to be committed;
- Facilitators from the industry should be used;
- Participants should be motivated;
- Frequent upgrading of supervisors is proposed;

1.2.5 Summary of the Trial Program

Major achievements and results are summarized as follows.

- Training for 20 trainers (4th field survey)
- Training for 18 owners / manages from 14 different companies (5th field survey)
- On the site training of 5S and follow up (6th field survey)
- Training of garment production management technology for supervisor of PSI garment training center (6th field survey)
- Follow up survey on participant companies and guidance (6th field survey)
- Producing teaching materials of garment production management technology (videos and slides) (6th field survey)

1.3 Ex-post Evaluation of the Trial Program in the Greater Accra Region

1.3.1 Verification of the Implementation Status and Conditions

(1) Verification of implementation results

The program was implemented mostly according to the plan without a significant problem. The inputs were also made as planned, but the involvement of NBSSI's district office was limited to selection and participation of trainers.

Outputs have been mostly achieved. As for participation in the training program, the target number was achieved for trainers, whereas the number of participants representing owners and managers fell below the target, i.e., 14 versus 20 companies contemplated for the plan, because some applications were canceled due to work or sickness. No participant left the program before completion.

As for training results, priority was given to implementation of 5S and production management techniques, rather than implementation of self diagnosis. This is because owners could not see direct or immediate effect of self diagnosis, while the course was rather advanced and thus difficult to understand. Note that no owner or manager prepared any improvement plan due to the lack of instruction and guidance by trainers.

Regarding the project purpose "modernization of management of SMEs," actual progress in improvement of production activity and practice – in the form of 5S and layout modification - was confirmed by the follow-up survey. On the other hand, improvement of top management and marketing capabilities has still to be made. In the questionnaire survey conducted at the result dissemination seminar held on June 8 2007, most respondents (27 of 29) agreed that the project purpose would contribute to the accomplishment of the overall goal "to improve competitiveness of SMEs in the apparel industry." To achieve the overall goal, present knowledge and techniques need to be disseminated to all industries and levels. In fact, some efforts have already been seen on the Ghanaian side, including meetings to introduce relevant knowledge. Nevertheless, as the results of the trial program alone are not sufficient to promote full-scale dissemination, the study team proposes follow-up as well as dissemination activities.

(2) Verification of the implementation process

Program activities have been carried out as scheduled. In addition, a training course for supervisors of the PSI Training Center (production management techniques relating to the sewing process) was conducted in response to the request by the counterpart, accompanied by provision of teaching materials.

Technology transfer consisted of training and follow-up activities. As for evaluation by participants, both trainers and owners/managers commented that the training program was too short. The self-diagnosis technique was well received by trainers, whereas owners/managers found it very difficult. In fact, Ghanaian trainers (who served as instructor) and study team members reported low levels of understanding among owners and managers, in particular an apparent lack of technical knowledge. Nevertheless, the results of the questionnaire surveys conducted upon completion of the training program, owners and managers generally gave high ratings and expressed that they had not received such training and they came to realize that they did not know much about business administration and production management.

As for the project management system, there were problems relating to language skills of the study team members and the lack of knowledge on sewing operation among the majority of trainers. These problems were partially overcome by use of visual aids and field training. On the other hand, it should be noted that the level of recognition on the training program among counterpart personnel was relatively low. Major reasons seem to be a

large number of similar assistance programs, which may dilute an impression and impact of the training program, while counterpart personnel are generally content to receive a report from the coordinator retained by the study team. The situation is reflected in the fact that the study team did not hear from the counterpart any opinions on the program's desirable direction after its completion.

As for level of participation by the target groups, both trainers and owners/managers were generally enthusiastic in the program, although the latter's participation fell below the target level. The same level of enthusiasm was observed during the additional training course at the PSI Training Center. On the other hand, companies and organizations that sent participants to the training program did not recognize the importance of training, often preventing managers from applying their training results to actual operation and management.

Meanwhile, trainers served as a major impetus for further development and continuity of the training program as they became awareness of the program's effectiveness in the implementation process. For example, participation of one trainer from PSI Training Center led to the supervisor training program at PSI, which was conducted during the sixth field survey, and then to the development of teaching materials for the continued program. Yet, continued training at the PSI Training Center has still to be implemented smoothly, despite the study team's expectation, for the center's management fails to feel the need.

1.3.2 Five Evaluation Criteria

(1) Relevance

For the following reasons, the relevance of the program is considered to be high. First of all, the training program was designed on the basis of participatory type program analysis. Also, opinions of related parties were heard at a seminar held before the start of the program. In fact, the result of the questionnaire survey conducted at the seminar presenting the program results indicates that three fourth of respondents stated that the program met the needs of the relevant region and community. Thus, the program is relevant as perceived by participants and related parties.

On the other hand, the Ghanaian government views the apparel subsector as industry with high export potential and has designated it as an industry covered by PSI. It is the largest industry in terms of employment. At the same time, it does not grow much and its

management and technology levels have not reached at international standard. Clearly, the industry faces a major challenge to improve competitiveness through modernization of management and improvement of productivity. Thus, the program is in line with the country's industry policy.

Also, the target industry and area have been appropriately selected. Participants – trainers and owners/managers – were recruited through interviews, direct visits, and seminars in order to ensure broad participation from a variety of companies and organizations. However, the result of the questionnaire survey conducted at the seminar presenting program results indicates that 18 out of 27 respondents agreed with the question that the trial program benefited stakeholders equally. This reflects the fact that owners and managers who participated in the program came from relatively large enterprises, while the apparel industry is dominated by microenterprises.

Training provided in the trial program had the same content as the one promoted by Japan in Southeast Asia. As East and Southeast Asian countries have competitiveness in the apparel industry, the training program offers comparative advantage in terms of sewing technology.

(2) Effectiveness

For the following reasons, the program is considered to be highly effective.

- Most outputs have been accomplished, as verified under the follow-up survey. Some companies that implemented 5S, small group activity, layout improvement, and production sharing initiatives have produced some results.
- The project purpose - "modernization of management of SMEs" – is expected to achieve through dissemination of 5S, small group activity, and the production management method to the apparel industry, and various initiatives are already undertaken.
- Many owners/managers in the target group recognize the importance of the program, forming a potential droving force for future continuity. In particular, the representative of AGI's apparel group has communicated effectiveness of the above techniques to other members at the group meetings.
- According to the questionnaire survey conducted at the seminar presenting program results, more than three fourth of respondents believe that the program outputs contribute to the accomplishment of the project purpose.

(3) Efficiency

As viewed from the accomplished outputs, inputs have been generally made in an efficient manner, except for problems relating to some inputs.

While additional inputs have been made upon request from the Ghanaian side, overall efficiency has been maintained as a result of general accomplishment of intended outputs. Although some impediments occurred, e.g., the number of participants fell below the target and some companies were unable to cooperate with the follow-up survey, they did not affect program efficiency.

As pointed out earlier, problems relating to inputs include insufficient time allocated to the training for owners and managers as well as a high level of content that is difficult to understand. Also, trainers did not have skills that were expected. Nevertheless, they did not seriously disturb with the general progress of the program.

Finally, the fact that the study team entirely bore the training cost may affect program efficiency as it may lower the level of commitment among participants, although no direct comparison can be made with similar projects. In practice, however, training programs conducted by donor organizations are usually offered with free of charge, because it is difficult to recruit participants if a fee is charged.

(4) Impact

It is premature to say, upon completion of the program, that it had an indirect effect on the overall goal. It is difficult to achieve the program's overall goal, "improvement of competitiveness of SMEs in the apparel industry," unless management of SMEs is not improved significantly. The program was intended for future continuation and included the development of capacity to conduct the similar training after completion of the trial program, such as the training of Ghanaian trainers and preparation of teaching materials. Thus, the accomplishment of the overall goal depends on the ability of the training institutes to implement the training program successfully. Although they expressed the intent for program implementation at the time of completion, there must be a time lag before actual implementation.

(5) Sustainability

Even if trainers and owners/managers recognize the need for production management technology because of participation in the trial program, it is difficult to continue the program on a permanent basis unless there is an organizational backup. In particular, desirable results can only be obtained when relevant government offices understand the importance of human resource development and provide effective support on a sustainable basis.

The apparel industry in Ghana is now facing intensive competitive pressure from imported garments and may decline or shrink in size unless effective measures are taken to restore its vitality. In particular, the industry needs to improve productivity significantly to the level that allows it to compete in the international market. In this context, dissemination of production management techniques that have been taught in the trial program is essential in the industry's development. Meanwhile, garment factories that make export products hire expatriate managers by paying high salaries. To reduce the labor cost, therefore, they need to have local managers who can handle day-to-day production management.

As the apparel industry continues to be a key industry for the Ghanaian government, which is thus ready to provide necessary support and assistance. In fact, it operates training institutes that have resources to conduct the training program, albeit some problems relating to organization and its management. Potentially, they are capable of continuing the training program on a permanent basis, with some degree of outside support. A major risk is present in the lack of strong leadership, which may cause unforeseeable problems in the human resource assignment and decision-making process.

1.3.3 Conclusion, Recommendations, and Lessons Learned

(1) Conclusion

- The trial program has been implemented according to the plan and has broadly achieved its intended purpose.
- The program has proven that the initiative introduced under the program – 5S, small group activity, and production management techniques – would be highly useful for the apparel industry in Ghana. On the other hand, other initiatives - self diagnosis

and kaizen planning – have failed to gain understanding or acceptance of owners and managers who participated in the trial program.

- The trial program has trained and produced human resources and teaching materials that can be used as the basis of continuing it as a permanent program.
- It has been confirmed that the apparel industry does not have international level of production technology and thus the training program such as the one conducted under the trial program plays an important role in raising their technological base.

(2) Recommendations

- The industry is clearly lagged behind in the area of production management, which prevents improvement of product quality and productivity. Modern production management techniques need to be disseminated to the rest of the industry by using Ghanaian instructors (including those who participated in the trial program) and teaching materials produced under the program.
- 5S and small group activity can be initiated economically and can produce an immediate effect for the apparel industry, while serving as an effective vehicle for workers' training. Thus, efforts should be made to promote them as industry-wide practice.

(3) Lessons learned

- The training program was accepted by participants because of their practical applicability. However, it tried to cover rather broad subjects, some of which were difficult to understand and/or did not meet immediate needs. Clearly, the curriculum should be reviewed and refined in consultation with related parties.
- Among the activities offered in the trial program, field tour and practical training at various factories is proven to be highly effective. Coupled with use of visual aids, participants have gained high level of understanding.
- Under the trial program, partnership with polytechnic schools and the PSI Training Center was limited to the sending of trainers, because it focused on industrial promotion in a specific region. Closer collaboration, e.g., participation from the planning stage, could have improved the program's sustainability.

2. The Trial Program for the Palm Oil Processing Industry in the Ashanti Region

2. The Trial Program for the Palm Oil Processing Industry in the Ashanti Region

2.1 Establishment of the Trial Program

2.1.1 Problem Analysis and Formulation of the Draft Master Plan

(1) Core Problem and direct causes

At the workshop conducted on May 30 2006, the core problems and their causes were identified. They were compiled into a problem tree shown in Fig.2.1-1.

Core problem: Secure Sustainable Market of Palm Oil

The direct causes identified were classified into the following factors.

1) Quality of palm oil does not meet market requirements.
2) Production cost of palm oil is high.
3) The target group has low capability to access market.
4) Supply chain from raw materials until marketing is not streamlined.

(2) Formulation of the draft master plan

Based on the problem tree, the Team formulated a draft master plan (Fig.2.1-2).

The primary purpose of this draft master plan is to secure a reliable market for palm oil. The result of the questionnaire survey indicates that many processors are concerned about the future market prospect. Also, many feel production technology and R&D as area of weakness.

To achieve the objective, the following four strategies were established.

Strategy 1: Improvement of product quality
Strategy 2: Reduction of production costs
Strategy 3: Capacity building for marketing
Strategy 4: Ensuring delivery of product

Strategies 1 and 2 reflect poor levels of production technology. Many manufacturers in the region are engaged in palm oil production without sufficient knowledge. This is a major reason for their inability to meet market needs in terms of both quality and quantity. Note that a total of thirteen programs are proposed under the four strategies on the basis of the problem analysis and SWOT analysis (Table 2.1-1). It includes one trial program that has been selected from programs developed under Strategy 2.

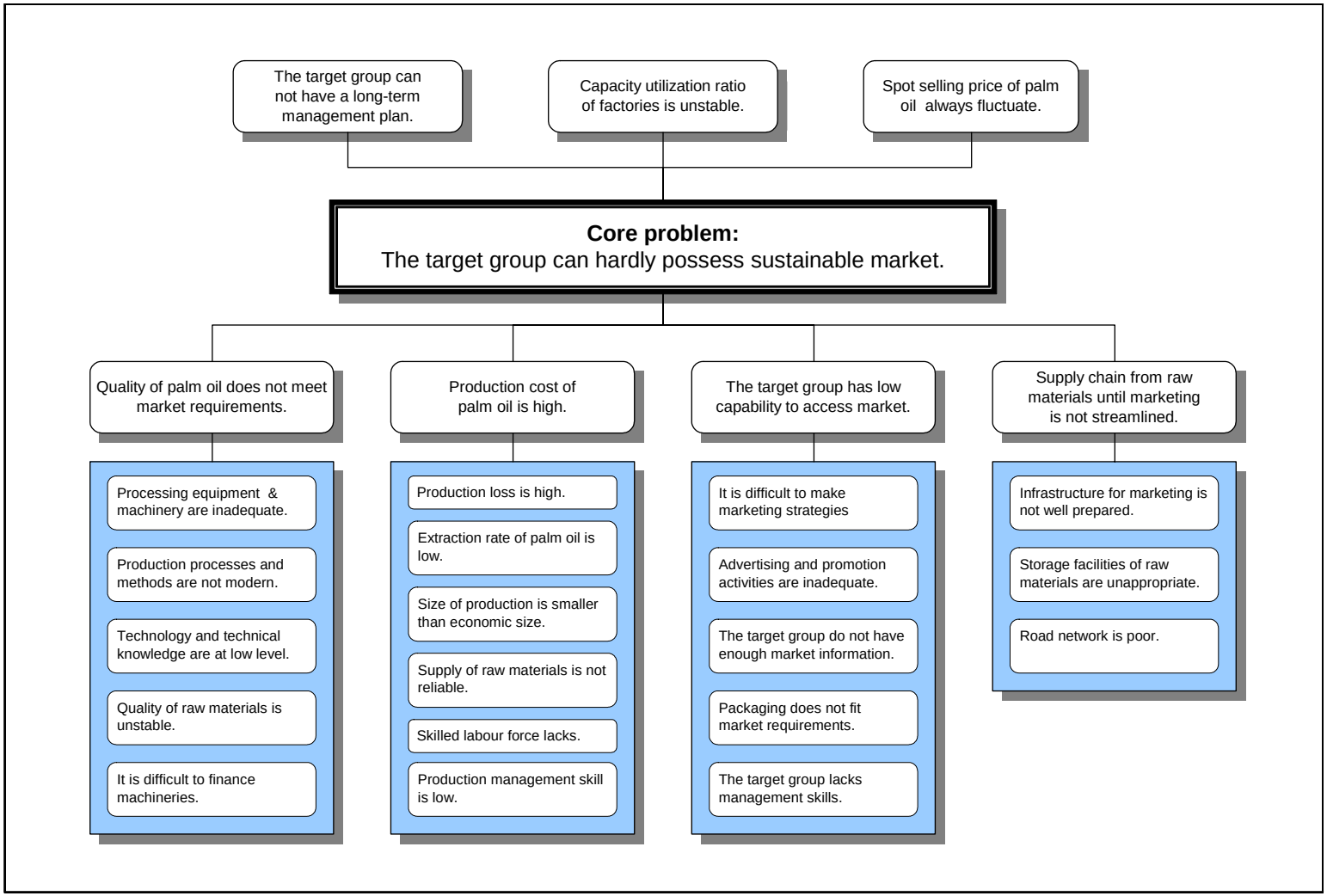


Figure 2.1-1 Problem Tree of the Palm Oil Processing Industry in the Ashanti Region

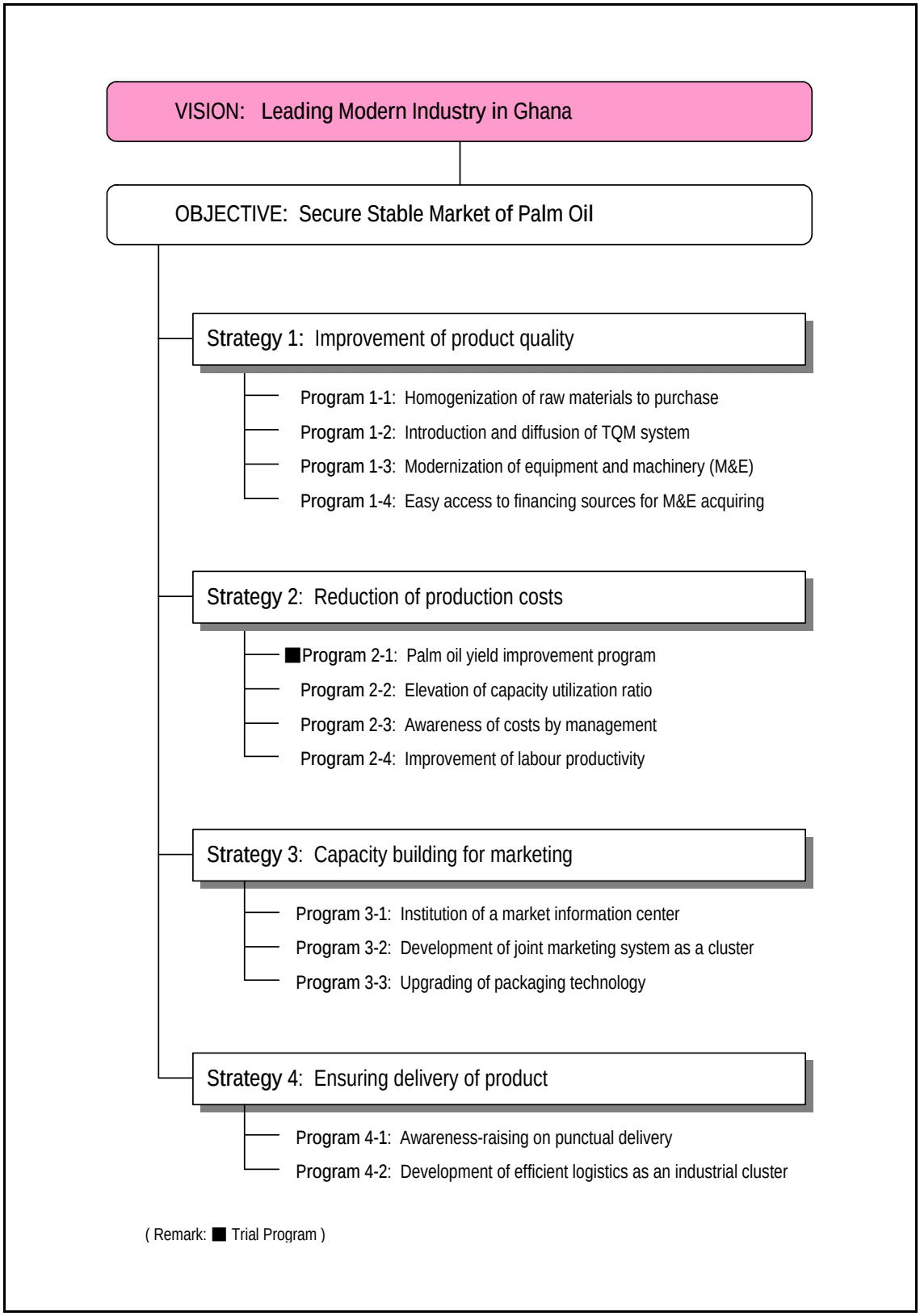


Figure 2.1-2 Framework of the Draft Master Plan for the Palm Oil Processing Industry in the Ashanti Region

Table 2.1-1 SWOT Analysis: the Palm Oil Processing Industry in the Ashanti Region

	Market	Production / technology	Raw material	Human resource	Development capability	Business environment
STRENGTHS	● Easy access to local market ● Increasing domestic consumption	● Availability of affordable processing equipment	● Easy to buy palm fruit around factory.	● Abundant supply of labor.	● Palm and oil Research in domestic universities and research institutes	● Transportation cost from Ghana for EU is cheaper than that of south-east Asia.
WEAKNESSES	● Mostly sold as edible oil. (Limited diversification)	● Production management method is not well developed.	● Small scaled palm plantation ● Dura with low oil content has often been used.	● Lack of technical staff	● Poor development capability in palm oil processing companies	● Lack of transportation means. ● Inferior storage condition for raw material
OPPORTUNITIES	● Production volume is less than domestic consumption. ● Strong demand from other than general consumer.	● Great possibility to increase production by improving extraction rate.	● Promotion of plantation increases volume of palm production.		● Development of palm oil related products	
THREATS	● Import of higher quality edible oil with lower price.		● Setting up a large scale factory may cause the shortage of palm.		● Imports of high quality palm oil related products	

2.1.2 Selection and Outline of the Trial Program

Program name: Palm oil process improvement (KAIZEN) program

(1) Reason for selection

At the workshop on program analysis, high production costs were identified as a major issue, and production loss and the low extraction rate were pointed out as their main causes. On the other hand, palm oil production in Ghana remains at an annual rate of 120,000 tons since 1998, whereas consumption grows substantially. Furthermore, palm oil consumption and imports in the EU – a major export market for Ghana – is on the steep rise. If the Ghanaian palm oil industry can boost production and lower the cost by raising the extraction rate, it will be able to take advantage of the growing demand, creating large impacts on the national economy. In this connection, palm oil manufacturers visited by the Team were generally interested in the program and showed intention to participate in it.

The program accords with the Ghanaian government's policy direction to promote expansion of palm tree plantations under President's Special Initiative (PSI). Also, each district assembly accepts that the program will contribute to reduction of poverty by benefiting not only manufacturers but farmers as well. Finally, some participants expressed the view that the increase in palm oil production would be welcome for local economy as it is a major industry in Ashanti.

As the program focuses on "kaizen" that does not require substantial investment, it is designed to propose and disseminate the methodology that allows SMEs to plan and execute kaizen initiatives by SMEs. It also expects that sustainable development can be secured by disseminating benefits of "kaizen" effectively.

(2) Outline of Trial Program

1) Expected Output

a) The implementation structure consisting of participating companies and research institute is established.
b) The performance of each process in a participating company is clarified.
c) Improvement plans of yield rate based on the analytical work are proposed to participating companies.
d) The results of research are disseminated through printed materials and workshops

2) Activities

1-1 Hold a motivational workshop for palm oil stakeholders (10 SMEs research institutes and others)
1-2 Confirm participating companies and the research institute and establish the implementation structure
1-3 The research institute and the JICA team determine details of the program

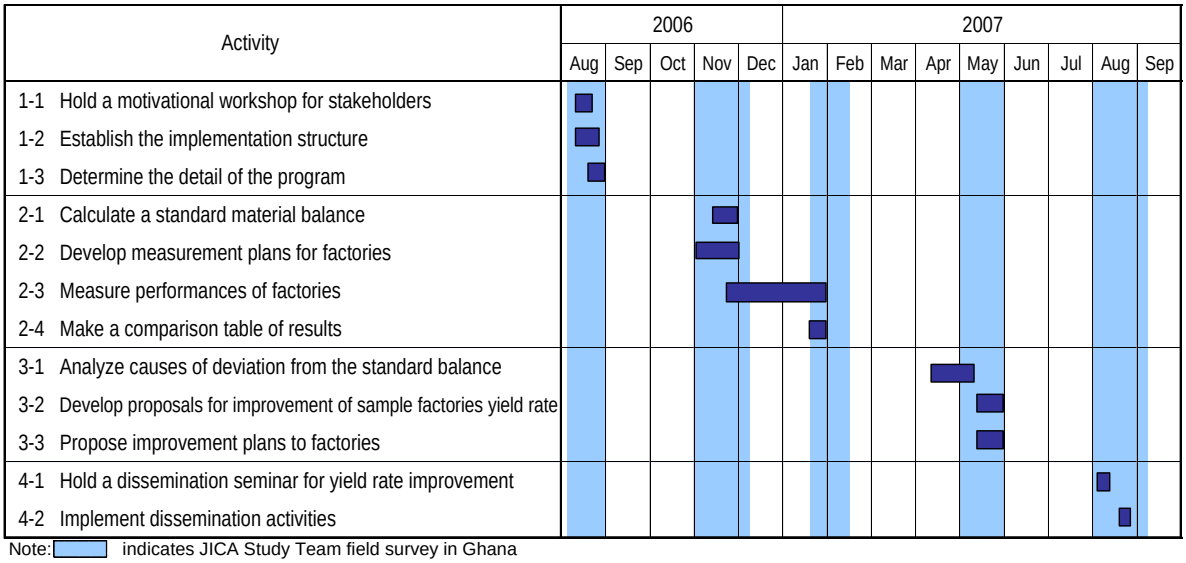
2-1 Calculate a standard material balance1 in each process
2-2 Develop check lists for measurement and measurement plans for sample factories
2-3 Measure material balances and condition of each process according to plans
2-4 Make a comparison table of results

3-1 Analyze causes of deviation from the standard material balance and differences in results of sample factories
3-2 Develop proposals for improvement of sample factory yield rates
3-3 Propose improvement plans to factories

4-1 Hold a dissemination seminar and present improvement of yield rate based on the result of the trial program
4-2 Make the report on research and case studies and implement dissemination activities

See Table 2.1-2 for details.

3) Implementation Schedule



Note: indicates JICA Study Team field survey in Ghana
As of Nov. 2006.

Table 2.1-2 Project Design Matrix – Ashanti Palm Oil Processing Industry

Name of trial program : Increase yield and reduce loss of palm oil process
Target group : Small and Medium sized company with certain mechanical equipments
Implementation Area : The Ashanti Region
Implementation period : August 2006～August 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal The total palm oil production increase	• Increase of palm oil production	• Total production volume	
Project Purpose Increase the yield rate of the target group	• Improvement in the yield rate.	• Inquiry about improvement •	1. The demand of palm oil does not decrease
Outputs			
1 Establish the implementation organization consisting of participating companies and research institute.	• Name of implementation organization and activities • Number of participants companies	• Agreements • Scope of work • Letter of content	1. Supply of oil palm is stable. 2. The demand of palm oil does not decrease
2 The performance of each participating company is clarified.	• The results of measurement of material balance in each company	• Comparison table of measurement results	
3 Participating companies receive the improvement plans of yield rate based on the analytical work.	• Submission of proposal • Satisfaction of recipients	• Proposal documents • Feedback from participating companies	
4 The results of research are disseminated through printed materials and workshops.	• Workshop • Printed materials	• Participants list • Feedback from stakeholders	
Activities 1-1 Hold a motivational workshop 1-2 Establish the implementation organization 1-3 Determine the detail of the program 2-1 Calculate a standard material balance 2-2 Develop measurement plans for factories. 2-3 Measure performances of factories 2-4 Make a comparison table of results. 3-1 Analyze causes of differences in results 3-2 Develop proposals for improvement of sample factories yield rate. 3-3 Propose improvement plans to factories Hold a dissemination seminar. 4-2 Implement dissemination activities.	**Inputs** JICA Study team • Japanese experts • Operating expense - Employment costs of Ghanaian staff - Transportation and accommodation costs - Expenses of research on sample factories yield - Expenses of training, meetings, workshops - Expenses of publishing materials Ghanaian counterparts • Counter personnel • Office space, office equipment and furniture • Operating expense - administrative and management costs		1. The government does not change the policy for the palm oil industry. **Pre-conditions** 1. Adequate no. of participant in the program

[1] The procedure of accounting for the mass of material going into a process versus the mass leaving the process.

2.2 Palm Oil Process Improvement (KAIZEN) Program

2.2.1 General Information

(1) Oil Palm, Palm Oil and Uses

A cash crop targeted under the presidential special initiative (PSI) is the oil palm tree. Oil palm plantations around the world have their roots in the humid lowlands of Africa, Ghana inclusive. It is planned to be a dominant foreign exchange earner since conditions for the cultivation of the crop in Ghana is the same as cocoa. Basically, there are three biotypes within the species which are distinguished by the structure of the pulp and shell. These in turn determine the quality of the palm fruit and the economic importance. The three main types are:

Dura, which possesses a thick shell of 2-8 mm and a relatively small pulp comprising 35-70 % of the nut

Pisifera, which lacks the shell and

Tenera, which is a hybrid variety of the two above varieties.

Crude Palm Oil is extracted from the mesocarp which in turn can be further refined. The refined oil and fat is used in industrial production of non-diary creams, ice cream powder, salad additives and fat spread. It is used as substitute in the formulation of soaps, detergents, margarines and baking fats. Palm oil is also a rich source of vitamins A, D and E which are indispensable in the pharmaceutical industry. The fiber is used in mills (boilers) as fuel and for stuffing car seats and mattresses. The list of products cannot be complete without reference to the nut which comprises a shell and a kernel. The shell of the palm nut is used as fuel and as activated carbon for bleaching purposes. This product is in high demand on the international market. The kernel is a rich source of lauric acid, a vital ingredient for the soap, cosmetic and confectionary industry.

What makes oil palm development more strategic and economically sound is the fact that there exist in Ghana, West Africa, the rest of Africa and the world at large enormous opportunities for palm oil and products processed from it. It is currently estimated that there is an external market for 2.6 million tons of crude oil and allied products from Ghana and the sub-region but only 800,000 tons is produced annually in the sub-region. Indeed, there are even greater long-term opportunities in oleo chemicals and paints. Others are researching into its use as a bio-fuel because of the rising cost of fossil fuels. For example, the energy content of industrial diesel oil per ton is 42.3 GJ and that of palm oil is comparable of value 41.0 GJ. There is scope for the use of the waste for the generation of electricity from boilers or biogas plants. A wealth of technical know-how also abounds locally to be tapped for this industry.

The peak season for harvesting palm fruits is from January to June. The period from July to October is regarded as the mid-season and the lean season is from October to December. During the lean season, production of palm oil is cut down due to a drop in the supply of raw materials. This is being addressed by breeders and also putting much larger areas under cultivation. There is also the need to ensure that seedlings of the tenera variety is produced and sold to farmers for cultivation since it gives the highest yield in terms of fresh fruit bunches and oil. Farmers are also being taught the correct lining and pegging techniques to maximize production on farms. In order to overcome the problem of shortage of fruits for processors, the government is pursuing an aggressive policy to add 20,000 ha of oil palm plantations per year for the next five years.

Hitherto, the emphasis had been on cocoa and very few cash crops with limited push for diversification. Knowledge about the profitability of some agro-industries was limited and access to capital was also difficult. The area cropped under oil palm was too small, and the varieties cropped were also low-yielding (Dura) and took too long to mature, making large scale production of palm oil difficult with regards to the constant supply of abundant and reliable sources of raw materials. Technical know-how was also limited since most processes relied on very basic local technologies which were laborious and inefficient. All these are changing with the current push for the country to become middle income by 2015.

(2) Oil Palm Production in the Ashanti Region

According to the Crops Services Directorate in Kumasi, 52,295 ha of land is under oil palm plantations producing 188,262 tons Fresh Fruit Bunch （FFB）(Table 2.2-1). According to the FAO (2002), the oil palm tree begins fruiting just three years after transplanting.

Table 2.2-1 Estimated Area and Production of Oil Palm in the Ashanti Region (2005)

No.	Districts	Area under Cultivation (ha)	Production of Fresh Fruit Bunches (t)
1	Ejisu Juaben	4,163	14,986.8
2	Asante Akim North	1,821	6,555.6
3	Asante AkimSouth	3,902	14,047.2
4	Sekyere East	3,122	11,239.2
5	Sekyere West	1,301	4,683.6
6	Ejura Sekyedumase	520	1,872
7	Kwabre	1,821	6,555.6
8	Efigya Sekyere	1,821	6,555.6
9	Offinso	3,643	13,114.8
10	Ahafo Ano South	3,122	11,239.2
11	Ahafo Ano North	3,122	11,239.2
12	Atwima Nwabiagya	3,122	11,239.2
13	Atwima Mponua	3,122	11,239.2
14	Amansie East	3,122	11,239.2
15	Amansie West	2,081	7,491.6
16	Amansie Central	3,122	11,239.2
17	Adanse South	3,643	13,114.8
18	Adanse North	3,643	13,114.8
19	Obuasi Municipality	1,041	3,747.6
20	BAK	1,041	3,747.6
21	KMA	0	0
Total		52,295	188,262

(3) Palm Oil Processing Operations

The palm oil process involves harvesting and transporting bunches to a reception point at a mill or factory and stored and these may be loaded into cages in a factory setting. The bunches are then taken through, sterilization, threshing or stripping, digestion, pressing for the palm oil, separation of the fiber from the nuts, clarification of the oil, storage of the oil and disposal of the sludge.

Three variations of palm oil processing were observed. The factories at Adansi and Juaben had a standard process (Figure 2.2-1) with no special packaging. The cooperative mills at Antoakrom, Ntinanko, Ayokoa, Pease and Sekyere East had a common process (Figure 2.2-2) in which threshing was done with machetes, and finally, the remaining cooperative mills at Afotom and Amaning had a similar process but a bunch stripper was attached further removing drudgery from their operations.

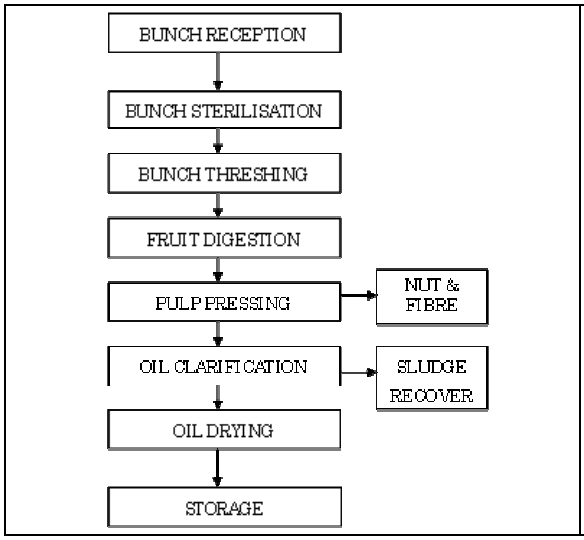


Figure 2.2-1 Palm Oil Processing Units at Factories

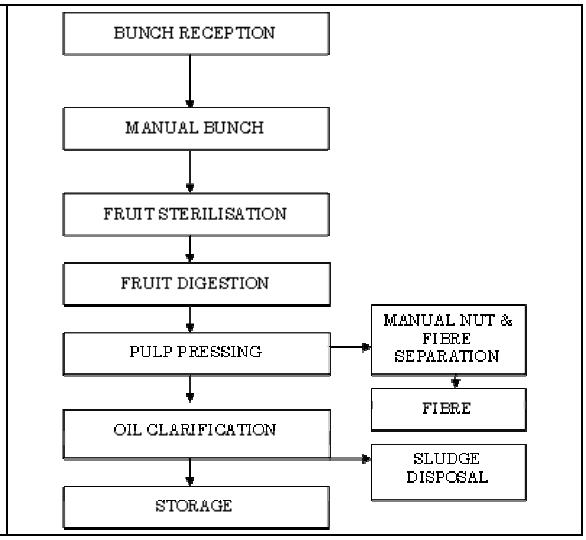


Figure 2.2-2 Palm Oil Processing Units at Most Association Mills

2.2.2 Background Information about Mills Studied

The dominant oil mills in the region are the association type mills as shown in Tables 2.2-2. All the mills are close to Kumasi, the regional capital, which serves as a market for the products. The locations are also noted for intensive oil palm cultivation.

Table 2.2-2 Status of Oil Mills

	Name of Oil Mill	District	Type	Legal Status	Year Established	Year Registered
1	Antoakrom	Amansie West	Association	Private Limited Liability (Cooperative)	1992	1998
2	Sekyere East Oil Mill Limited	Sekyere East	Association	Private Limited Liability (Cooperative)	1995	1995
3	Pease Oil Palm Association	Bosumtwi-Atwi ma-Kwanwoma	Association	Private Limited Liability (Cooperative)	2003	2003
4	Ntinanko Cooperative Oil Palm Farmers Society Limited	Amansie East	Association	Private Limited Liability (Cooperative)	1985	1987
5	Ayokoa (Sir Speedy)	Adansi North	Association	Private Limited Liability	2004	2004
6	Afotom Oil Palm Proc-essing and Marketing Society Limited	Offinso	Association	Private Limited Liability (Cooperative)	1994	2006
7	Amaning Women's Association	Offinso	Association	Private Limited Liability (Cooperative)	1999	Unreg istered
8	Adansi Oil Mills Limited	Adansi North	Factory	Private Limited Liability	1987	1987
9	Juaben Oil Mills Limited	Ejisu-Juaben	Factory	Private Limited Liability	1984	1984

All the mills, except Amaning Women's Association, are legally registered with majority registered under the cooperative act as shown in Table 2.2-2. There are fewer factories in the region though. It is expected that the Presidential Special Initiatives (PSI) on oil palm will lead to the establishment of more oil mills.

Table 2.2-3 Employee Breakdowns of Oil Mills

	Name of Oil Mill	Actual Employees			Casuals	Total
		Male	Female	Managerial		
1	Antoakrom	12	21	1	100	134
2	Sekyere East	5	145	-	150	300
3	Pease	1	14	-	-	15
4	Ntinanko	12	26	7	-	45
5	Ayokoa (Sir Speedy)	6	2	2	6	16
6	Afotom	4	15	-	10	29
7	Amaning	3	11	-	5	19
8	Adansi	18	1	4	3	26
9	Juaben	125	125	6	251	557

The mills offer a lot of employment as shown in Table 2.2-3. The associations in particular offer a lot of employment to women. During the main season a lot of casual employment is offered to inhabitants in the areas of manual stripping of the fruits, fetching water, separating of fiber from nuts, provision of firewood and vending of food. Where no casual labor is provided, the association members assist themselves with free labor known as 'nnoboa' locally to contain cost and maximize profits. The mill at Amaning is the only one of its kind in the study which is wholly controlled by women.

Table 2.2-4 Raw Material Base of Oil Mills

	Name of Oil Mill	Size of company farm (ha)	Type of fruits used (%)	
			Tenera	Dura
1	Antoakrom	230	80	20
2	Sekyere East	Nil	60	40
3	Pease	Nil	90	10
4	Ntinanko	4.5	90	10
5	Ayokoa (Sir Speedy)	50	90	10
6	Afotom	Nil	100	Nil
7	Amaning	Nil	100	Nil
8	Adansi	Nil	90	10
9	Juaben	175	70	30

It is clear from Table 2.2-4 that to start an oil mill, availability of a company farm may help but it is not a necessary condition. All the mills are located in areas with oil palm plantations owned by individuals. The harvested bunches are processed by farmers themselves in the case of association type mills or sold to the factories for processing.

The desirable fruits are tenera which contains 21-24% oil. Unfortunately the traditional dura varieties are still in the system since millers buy fruits with different varieties which are difficult to differentiate just from the looks.

The capacity of the cooperative mills is just a ton per hour. That of the factories is just about 2-3t/h but Juaben Oil Mill is exceptionally large being 13t/h as shown in Table 2.2-5. The sources of funding for the mills are individual member shares, bank loans and the district assemblies. The Rural banks have been assisting in the development of these rural enterprises. Technoserve, an NGO, has also been assisting the mills with technical expertise.

Palm oil processing is a lucrative business. The cost of the fruit per ton is about $70 but crude palm oil sells for about $550/t, the kernel oil for $587/t and the shells could sell for $136/t. The cost of machinery, water, labor and other incidentals need to be factored into the cost though.

Table 2.2-5 Source of Funding and Mill Capacity

	Name of Oil Mill	Source	Capacity of Mill (ton FFB/h)
1	Antoakrom	ADB[2] Loans	1
2	Sekyere East	Technoserve (NGO)	1
3	Pease	Kuntanase Rural Bank	1
4	Ntinanko	Bank loan/Technoserve	1
5	Ayokoa (Sir Speedy)	Family Sources	1
6	Afotom	District Assembly	1
7	Amaning	District Assembly	1
8	Adansi	NIB[3]/ADB loan	2
9	Juaben	NIB	13

[2] ADB: Agricultural Development Bank
[3] NIB: National Investment Bank

All the mills have access to water and energy as shown in Table 2.2-6. The use of untreated surface water should be discouraged. There is the possibility of harvesting rainwater from the roofs of offices/sheds as is done at Afotom and Amaning. In some instances, a borehole could be drilled and a pump installed at about $3500. The bigger mills can think about the generation of electricity with the waste as is done at Juaben. Biogas can also be generated with the sludge.

Table 2.2-6 Utilities for Mills

	Name of Oil Mill	Water	Energy	Electricity
1	Antoakrom	Well	Diesel Engine	Available but no motor to tap
2	Sekyere East	Surface water	Diesel Engine	-
3	Pease	Borehole	Diesel Engine	-
4	Ntinanko	Borehole	Diesel Engine	Available but no motor to tap
5	Ayokoa (Sir Speedy)	Rainwater/ Borehole	Diesel Engine	-
6	Afotom	Rainwater/ Borehole	Diesel Engine	-
7	Amaning	Rainwater/ Borehole	Diesel Engine	-
8	Adansi	Borehole with submersible pump	Diesel Engines	Electric Motors
9	Juaben	Borehole with submersible pump	Diesel Engines	Generates her own electricity

Table 2.2-7 Manpower Training

	Name of Oil Mill	Managerial	Technical	Source of Training
1	Antoakrom	No	No	On-the-job
2	Sekyere East	No	No	On-the-job
3	Pease	No	No	On-the-job
4	Ntinanko	No	No	On-the-job
5	Ayokoa (Sir Speedy)	No	No	On-the-job
6	Afotom	No	No	On-the-job
7	Amaning	No	No	On-the-job
8	Adansi	No	No	On-the-job
9	Juaben	No	Yes	Qualified Engineers employed

It is evident from Table 2.2-7 that there is the need for managerial training for the staff of these mills especially in the area of book-keeping and project management. Similarly, training in all areas of processing is required. The training will help increase extraction rate, encourage sludge recovery, reduce impurities in the oil, reduce perceived excess moisture in the products and also reduce free fatty acid contents. If these companies can be grown with better management, then engineers could be considered for the long term.

Table 2.2-8 Satisfaction with Product

	Name of Oil Mill	Extraction Rate	Oil Quality	Sludge Recovery
1	Antoakrom	No	No	No
2	Sekyere East	No	No	No
3	Pease	No	No	No
4	Ntinanko	No	No	No
5	Ayokoa (Sir Speedy)	No	Yes	No
6	Afotom	No	No	No
7	Amaning	No	No	No
8	Adansi	Yes	Yes	Yes
9	Juaben	Yes	Yes	Yes

Except for the Ayokoa Mills (Table 2.2-8), all the cooperative mills were dissatisfied with the quality of the oil. This is evidenced in the fact that, the factories which produce better quality oils have no problems marketing their oil. Similarly, the extraction rate is lower in the cooperatives which did not do any sludge recovery. A lot of training is required in the cooperatives to improve product quality, extraction rate and also advice on better sludge recovery processes.

All the mills have very basic equipment and sheds/offices to work with (Table 2.2-9). The sheds with about a meter dwarf wall cover an area of about 50 m2 part of which serve as an office and the other part as a storage area. The factories have about 250 m2 of space. The Afotom and Amaning association type mills are the only ones with bunch strippers. But these had no blowers to separate the chaff from the fruits after stripping, so manual labor was used for the separation. Oil mills are specific agro-industries that the extension of electricity to rural areas can facilitate. It is, however, unfortunate that the provision of basic electric motors can obstruct this process especially in cooperative mills. Local companies are available for the design, construction, and installation and servicing of the basic equipment required. These include FATECO, SIS ENGINEERING and DAE of KNUST.

Table 2.2-9 Assets of oil Mills

	Name of Oil Mill	Assets
1	Antoakrom	Sterilization/Clarification Tanks, Diesel Engine, Digesters, Hydraulic Press, Storage Containers, Shed/Office
2	Sekyere East	Sterilization/Clarification Tanks, Diesel Engine, Digesters, Hydraulic Press, Screw Press, Storage Containers, Shed/Office
3	Pease	Sterilization/Clarification Tanks, Diesel Engine, Digesters, Hydraulic Press, Screw Press, Storage Containers, Shed/Office
4	Ntinanko	Tractor, Trailer, Plough, Harrow, Sterilization/Clarification Tanks, Diesel Engine, Digesters, Hydraulic Press, Storage Containers, Shed/Office
5	Ayokoa (Sir Speedy)	Sterilization/Clarification Tanks, 2 Diesel Engines, 2 Digesters, Hydraulic Press, Screw Press, Storage Containers, Bunch Stripper (not in working condition), Palm Kernel Cracker, Nissan Pick-Up (Not Working), Shed/Office
6	Afotom	Sterilization/Clarification Tanks, Diesel Engine, Bunch Stripper, Digester, Screw Presses, Storage Containers, Shed/Office
7	Amaning	Sterilization/Clarification Tanks, Diesel Engine, Bunch Stripper, Digester, Screw Presses, Storage Containers, Shed/Office
8	Adansi	Two Trucks, Electric Motors, Sterilizers, Clarification Tanks, Diesel Engine, 6 Cages, Boiler, Digesters, Hydraulic Press, Storage Containers, Palm Kernel Crackers, Sheds/Offices, Weighing Bridge, Dryer
9	Juaben	Tractors, trailers, Electricity Generating Set, Electric Motors, Sterilization / Clarification Tanks, 8 Cages, Diesel Engine, Digesters, 2 Screw Presses, Centrifuge, Storage Containers, Sheds/Offices, Weighing Bridge, Dryer, Trucks, Articulated Trucks, Crude Palm Oil Refinery, Shear Butter Mill, Drip Irrigation for Oil Palm Seedlings

2.2.3 Field Work as Preliminary Survey

(1) Activities

1) Reconnaissance visits to all the mills have been completed with the help of visits by JICA Study team
2) Background data of oil palm/palm oil industry in Ghana is being compiled
3) A questionnaire has been designed for background information
4) Administration of questionnaires to factories have been executed to all the groups and the data is being analyzed
5) Theoretical training of the enumerators for trial program was done on 16 and 17 October 2006.
6) Practical field training of enumerators could only be done for six (6) of the enumerators because of the intense academic program during the period of the JICA Study Team visit for monitoring. The University will be on holidays in December and the others can be brought into the field work.

7) Checklist for field data collection has also been done and
8) There is a planned itinerary to ensure statistically valid results

The basic tools used for the field work were machete, thermometers (0-200℃), measuring tapes (for length and volume measurements), weighing scales and stop watches.

Samples of palm fruits were randomly selected and cut through to determine the variety and then weighed to determine the percentage of the different varieties being used for the processing.

Fresh fruit bunches were also weighed to determine the average bunch weight and this was followed up with separating and weighing of the fruits to determine the percentage of fruits per bunch.

The mass of fruits or bunches sterilized were also weighed as well as the mass of water or steam that was used for the sterilization for association mills and factories respectively. The duration of sterilization was also timed as well as the maximum temperature for sterilization. In addition, the pressure at which sterilization was carried out was measured for the factories with in-built Bourdon gauges.

The duration of digestion and the temperatures were also monitored. The duration of pressing and the pressures as well as temperatures were also monitored. After pressing samples of fiber were taken for laboratory analysis to determine the oil left in the fiber which could not be extracted.

Finally, the duration of clarification, temperature and the mass of oil produced were determined. Samples of the oil were taken for laboratory analysis of the free fatty acids (FFA) content, moisture content and impurities.

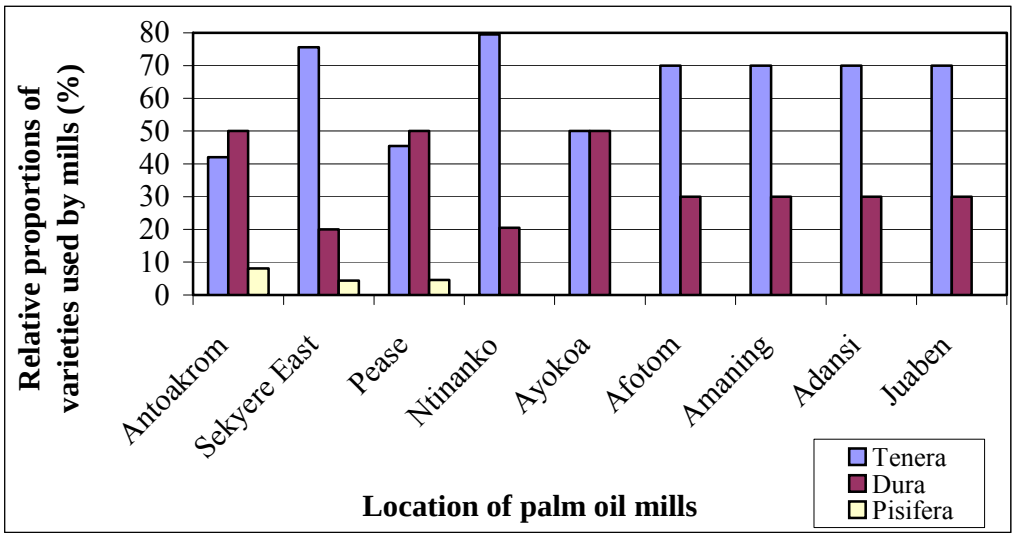


Figure 2.2-3 Varieties of Oil Palm Fruits Used in Mills

In all the mills visited, the dominant fruits used were the preferred Tenera variety which gives an oil yield of 22-24 %, but Dura variety with a yield of 12-14 % is still used. At Antoakrom, Sekyere East and Pease some Pisifera varieties were detected as shown in Figure 2.2-3.

Table 2.2-10 Percent Average Fruits Contained per Bunch at Mills and Percent Average Yield relative to Fresh Fruit Bunch (FEB) Weight

Code	Name of Oil Mill	Fruit Weight per Fresh Fruit Bunch (%)	Theoretical Yield (22-24%) / Measured yield (%)
A.	Antoakrom	64.27 (2.11)	10.36 (1.20)
B.	Sekyere East	65.04 (2.35)	10.82 (3.17)
C.	Pease	64.04 (2.59)	9.27 (2.64)
D.	Ntinanko	64.16 (1.75)	9.77 (2.93)
E.	Ayokoa	65.36 (1.39)	10.60 (2.17)
F.	Afotom	64.42 (2.69)	8.18 (0.84)
G.	Amaning	63.13 (2.58)	8.21 (1.68)
H.	Adansi	63.81 (2.72)	18.85 (0.16)
I.	Juaben	63.50 (1.96)	19.01 (0.07)

Denominator=9 and Standard deviation in parenthesis

The fruit weight per fresh fruit bunch was in the range of 63.1-65.4 % as shown in Table 2.2-10. The yields of the cooperative mills are on the low side (in Table 2.2-10) and this can be rectified with training and some retooling of equipment. However, the occasional higher yields during the measurements showed that this could be pushed to above 17 % at the association mill.

It is obvious from the data that yield is a bit better with the hydraulic presses than the manual screw presses. Similarly, Yields at the factories seemed to peak around 19 %.

It is obvious from Table 2.2-11 that the fruits are kept for too long at the association mills. A maximum period of 3 days is recommended to prevent deterioration and higher FFA in the oil. Sterilization is also done for too long and with too much water at a lower temperature which is not optimal for the efficiency of oil yield. There is temperature loss during digestion and pressing because of the sheer distances between Sterilization and digestion as shown in Table 2.2-11. Clarification temperatures at the association mills also need some fine-tuning.

Table 2.2-11 Field Data Analysis during Palm Oil Processing at Mills

Name of Oil Mill	Fruits storage (Days)	Sterilization	Pressing				Pressure during Pressing (kPa)	Distance from sterilizer to digester (m)	Clarification	
		Water Added (kg)	Temperature (℃)	Time (min)	Temperature (℃)	Time (sec)			Temperature (℃)	Time (min)
Antoakrom	10.4 (2.72)	66.4 (24.23)	98.5 (1.35)	151.4 (9.98)	53.2 (15.39)	60.6 (9.86)	200	37.4	112.6 (15.39)	90.6 (14.42)
Sekyere East	10.1 (2.85)	129.5 (9.82)	99.8 (1.55)	108.9 (17.51)	63.4 (3.24)	55.1 (1.10)	200	28.3	85.6 (3.24)	33.4 (2.46)
Pease	7 (1.83)	50 (3.79)	101.5 (0.71)	127.1 (12.41)	66.4 (3.06)	158.9 (4.56)	22	25.7	108.7 (3.06)	75.3 (3.95)
Ntinanko	8.7 (3.16)	40.45 (5.21)	100.2 (2.53)	119.7 (9.32)	53.3 (4.29)	108.9 (20.27)	200	19.8	102.8 (4.29)	75.4 (17.89)
Ayokoa	8.3 (1.15)	23.1 (3.03)	99.5 (1.43)	71.1 (1.45)	71 (5.40)	50.7 (0.82)	200	20.6	112.3 (5.40)	38.3 (1.25)
Afotom	8.2 (1.55)	31.15 (1.20)	99.8 (1.03)	107.7 (6.02)	72.3 (3.44)	180 (0)	22	11	99.5 (3.44)	56.5 (5.87)
Amaning	10.6 (2.95)	30.5 (1.43)	98.6 (1.90)	111.4 (5.10)	69.3 (2.50)	192 (25.30)	22	11	102.3 (2.50)	43.72 (2.23)
Adansi	1.9 (0.74)	170 (0)	140 (0)	60 (0)	90 (0)	1800 (0)	200	5	90 (0.0)	60 (0.0)
Juaben	1.4 (0.52)	114 (0)	140 (0)	40 (0)	90 (0)	2400 (0)	200	5	90 (0.0)	60 (0.0)

Denominator=9 and Average Data with Standard deviation in parenthesis

Capacity utilization (Table 2.2-12) deals with how much of the installed capacity of the mill is used for production. For most of the mills this is limited by the availability of fruits especially during the lean season and downtime of machines during breakdowns or routine maintenance. The Juaben oil Mills Limited does a 24-hour production in three shifts of 8 hours each in a day. Adansi Oil Mills Limited only does the normal 8-hour working day.

For the association mills, the Afotom and Amaning Mills only work on Tuesdays and Fridays. There was also lack of Sterilization tanks for members to increase the cooking to feed the digesters. This was true in all the association mills. So capacity utilization is marginal. The

members at Afotom and Amaning spend more time on cocoa and food crop farms. In all the association mills the installed capacity was quoted as one ton per hour giving a maximum production of 8 tons per day. Capacity utilization was, however, assessed for the association mills by relating the production to what could be digested and processed daily. The digester at Pease was too small.

Table 2.2-12 Capacity Utilization at Mills

Code	A.	B.	C.	D.	E.	F.	G.	H.	I.
Capacity Used (%)	60	60	60	60	60	24	15	80	250

The oil left in the fiber was determined using the soxhlet apparatus. 2g of the fiber was put on a thimble and the oil in it continuously extracted with 40/60 petroleum ether of volume 250ml for 8 hours. Since the ether boils at 40℃, extraction was done below this temperature. The initial weight of the flask was taken from the combined weight of the flask and the final content after the extraction. The difference was multiplied by 100 and divided by the original mass of fiber of 2g to obtain the percent oil in the fiber. GSB Standard

Table 2.2-13 Laboratory Analysis of Quality of Palm Oil and Oil Left in Fiber at Mills

Type of Mill	FFA (%)	Moisture content (%)	Impurities (%)	Oil Left in Fiber (%)
GSB Standard	5.0-5.5	0.45	0.045	4.5-5.0
Association	11.38 (1.84)	1.10 (0.32)	7.21 (2.01)	18.81 (1.02)
Association	10.53 (2.31)	0.62 (0.11)	10.05 (0.75)	18.78 (1.03)
Association	9.49 (1.56)	1.02 (0.16)	8.66 (0.88)	21.83 (0.68)
Association	10.43 (2.02)	1.05 (0.17)	8.21 (1.18)	20.20 (0.97)
Association	11.58 (2.41)	1.02 (0.17)	10.56 (0.77)	18.77 (1.05)
Association	10.56 (2.00)	1.21 (0.28)	8.82 (1.14)	24.01 (2.31)
Association	10.46 (1.83)	1.47 (0.21)	8.57 (0.70)	24.31 (2.52)
Factory	4.48 (1.47)	0.38 (0.11)	0.40 (0.15)	3.52 (0.52)
Factory	4.31 (1.12)	0.46 (0.09)	0.41 (0.12)	3.49 (0.56)

Denominator=9 and Standard deviation in parenthesis

Apart from the free fatty acids content at the factories (Table 2.2-13) which were within the recommended average of 5-5.5 %, all the others were just too high. To target the international market, FFA will have to come down to about 2-3 %. This will mean processing the fruits in far fewer days than is currently the case. Currently fruits are stored for up to 14 days at some places.

This does not include the period harvested bunches are kept in the farm. They are piled up and some are stored in fertilizer sacks in the open. These generate a lot of heat leading to faster deterioration, moldiness and bruising which cause higher free fatty acids. Storage is slightly better at Ntinanko and Sekyere East where FFB's are stored on wooden platforms.

The standard for impurities is 0.045 %. Unfortunately, the dirt content is way too high but better at the factories. Much of this is due to poor storage of bunches and lack of patience for the settlement before skimming-off the oil. The introduction of filters at the cooperatives will be helpful.

The pressing of oil from the pulp present a problem of nuts in the fiber which is a limitation on how much pressure can be exerted. Pressures of 200kPa are exerted by the presses at the factories. In the case of manual screw presses, the pressures are up to 22 kPa which is woefully inadequate.

2.2.4 Hypothetical Proposal of Improvement Measures

(1) Encouraging the use of Tenera as the preferred fruit

The yield of Tenera is high in the range of 22-24%. This is the preferred fruit for palm oil production. Unfortunately, there is this tradition of not destroying economic crops during land preparation. Also squirrels and other animals disperse the palm fruits to all sorts of places. Wild dura fruits are also harvested for consumption and sale. Some farmers also produce their own seedlings and some unscrupulous people produce seedlings to cash in on the booming seedlings business. No wonder a lot of Dura is available in all the production centers studied. There is the need to intensify education on seedling production and sale. Certified seedling producers must be encouraged and farmers made aware through agricultural extension officers. Finally, buyers of bunches and fruits can be trained to decipher this problem since most mills do not own their own farms.

(2) Reception of fresh fruit

Areas earmarked for the reception of fresh fruit bunches are just plain concrete floors. For the cooperatives, bunches are placed on the soil. The piling and heaping of bunches against the elements for far longer period aid bruising, deterioration and moldiness. This leads to a lot of dirt in the oil since no pre-washing is done. This way, the free fatty acid content increases seriously impacting on the quality. At Ntinanko, fruits are stored on individual wooden platforms by members to assist ventilation. Fruits are also carried and store in fertilizer sacks

which can generate a lot of heat leading to quicker deterioration. Ventilation and quicker processing is needed to prevent these problems.

Reception of bunches leaves much to be desired. The factories have trucks to transport bunches more quickly after harvest leading often to pile-ups with the lower ones going moldy. There is no need to pile-up harvested bunches. This is not the case with the association type millers where trucks are not available except Ntinanko where a tractor and a trailer are used. There is the need to process much more quickly after harvest to bring the FFA down since a value of 2-3 % is required for the international market. Storage of bunches on the bare soil in the sun should be strongly discouraged through education.

Figure 2.2-4 Piling of Fruits Leading to Moldiness

(3) Sterilization at cooperatives

In some cooperatives, boiling/Sterilization is done in the evenings. These are further heated in the morning before digestion. During boiling, the fruits are often drowned in water, a carry over from the tradition method. Fruits stored for longer periods too get rotten, this way a lot of oil is lost to the water. The fiber and empty bunches are used as fuel. At Amaning, lack of market for the nuts implies that they are also used as fuel at times. There is scope for further training in palm kernel oil processing since that fetches more money than palm oil internationally.

(4) Devices of digestion process

Processors have to endure a lot of smoke. This can be averted by designing special ovens with chimneys closer to the digesters to control the menace and also remove further drudgery by reducing the distances boiled fruits are carried reducing the digestion temperature.

Figure 2.2-5 Smoky Environments during Boiling of Fruits

In some instances, the digester is just too small like the one at Ntinanko. A well beaten pulp ensures better extraction which is always not the case. In most cases the inclination of the hopper makes this difficult. Operators control this by intermittently shutting the opening of the hopper into the digester. At Ntinanko, the digested material is placed on some plastic mat before they are picked for pressing. This process leads to loss of temperature. This can be solved by proper installation such as the ones at Antoakrom and Ayokoa.

The mashing of fruits under steam heated conditions in the factory enables the oil bearing cells of the mesocarp to break-up and form a digested mash. This cannot be achieved in an association mill but temperature can be maintained by keeping ovens closer to the digester. The digester and press can be mounted closer like Ayokoa and Antoakrom to facilitate quick pressing without loss of heat.

(5) Better manual pressing

Manual presses with short effort arms are not ideal. This is the situation at Afotom, Amaning and Pease. In the first two, the presses are installed at tight corners making the extension of the effort arm impossible. Quick pressing of material leads to the backflow of oil into the already pressed cake to affect yield. Smaller receptors around the press often lead to spillage. Heaping of the pulp leads to the backflow of oil as well as was observed at Ntinanko.

At Amaning, the fiber is further pressed after separation without further heating to increase the yield marginally.

Figure 2.2-6 Manual Screw Press with Short Effort Arm

(6) Proper clarification

During clarification, further water is added before clarification for areas where water is easily accessible. This delay the process contributing to higher moisture contents since other may want to have their turn. A longer settlement time is needed to allow the impurities to settle, before clarification is commenced to minimize the impurities in the final product. The oil can be skimmed-off before clarification. When the temperature is too hot during clarification, oil is lost through spillage and distillation.

Clarification need to be done at 90℃to enhance separation of the oil from the sludge. The oil settles at the top with the impurities settling below, thus allowing the skimming off of the oil. In the factories the oil was passed through a high speed centrifuge and a vacuum dryer to reduce the moisture content to acceptable standards. Very high temperatures during clarification lead to distillation of oil into the atmosphere as a loss.

(7) Sludge recovery

In the factories sludge recovery is done in open pits. However, the sludge is not treated before disposal into the natural drainage system. The stench and flies from the disposed material could be worrying. More mills are envisaged for the future and the implication is that there will be more environmental problems.

Knowledge of sludge recovery is lacking in all the cooperative mills and the possibility of biogas production from the sludge could be explored.

(8) Temperature of Sterilization

Sterilization need to be done at 140℃for 75-90 minutes (Poku, 2002) to deactivate hydrolytic enzymes responsible for the breaking down of oil to FFA, loosen the fruits from the bunches, coagulate mucilage to facilitate the breaking of oil cells and aid the recovery of oil and precondition nuts to minimize kernel breakage. The require time essentially depends on the duration bunches have been stored, being shorter if fruits are kept for longer periods.. The associations need to deal with smoky working conditions by acquiring brick ovens with chimneys.

(9) Check-points of factory

During stripping the operation at Juaben was almost perfect (23 rpm), this meant that the speed at Adansi will need some checking to reduce losses. Sterilization has to be improved by checking the valves and the air release operations.

Serious education is needed to ensure that only certified seedlings of Tenera are grown in Ghana to optimize palm oil yield. Storage and the general environmental conditions of mills must be improved. Capacity must be improved to minimize the storage of fruits for longer periods. There is the need to train all association type millers to improve on their efficiencies. The factories will need to rehabilitate sensors for monitoring temperatures and pressures as well as all valves and filters. The disposal of sludge is not currently acceptable and serious research is needed to deal with the problem. Millers must be encouraged to go into palm kernel oil production to prevent waste and increase their incomes.

2.2.5 Summary of Recommended Improvement Measures

The duration of storage of bunches and fruits need to be kept to a minimum of 3 days since rotten fruits at the association mill when boiled led to a lot of oil losses with the Sterilization water and higher FFA in the palm oil produced.

Over-Sterilization must be avoided too at the association mills. Boiling with too much water for over 2 hours is not good enough. There were serious fluctuations of temperature because of uneven heat supply from the open ovens. The Sterilization containers were also not covered and very often boiling temperatures were below 100℃.

At the factories, the quality of steam is important since this affects the extraction rate, the quality of oil and the efficiency of the machinery. Trapped air in the sterilizer happens because of the lack of automatic air vents at the factories studied. This can lead to longer than required Sterilization period because the air forms a barrier to Sterilization. Steam temperature and pressure at the factories of 140℃and 300kPa respectively were the recommended standard.

Inadequate Sterilization leads to poor threshing as happened at Adansi leading to the loss of oil to bunches as against nearly no loss at Juaben. However, the clearance between the inner cylinder of the digester and the beating arms had problems leading to lots of undigested fruits and subsequently longer digestion time for all the mills.

Pressures and temperatures were controlled at the factories during pressing. Excess pressure could break the nuts and affect the quality of palm oil. Pressures exerted by manual presses were too small at the association mills.

Clarification was okay at the factories but temperatures at the association mills were too high leading to oil losses through distillation. Temperatures need to be controlled. After pressing at the association mills, there is the need to allow the impurities adequate settling time and the oil skimmed-off before clarification. This will minimize the impurities in the oil at the association mills.

2.2.6 Verification of Improvement Measures

(1) Material and method adopted for the study

1) Method

a) The materials used for the study were weighing scales, measuring tapes, analogue and digital thermometers, digital camera and containers for sampling palm oil and fiber
b) Reconnaissance visits to all the four selected mills were completed with the help
c) Layout of the 4 mills were modified with the cooperation of the mills to improve the palm oil processing
d) Millers at the 4 mills were trained on improved production techniques
e) Actual measurements of field data for the improved production techniques were done for the selected mills using a checklist as shown in the appendix
f) Data for the improved processes were collected in June/July 2007
g) Samples of dry palm oil, fiber and fresh Dura and Tenera fruits were sent to the laboratory for analysis

h) The results of the study is compiled into this report to show the efficacy of the improved production techniques
i) An improvement manual with illustrations has been published to aid association mills produce higher yields as well as quality palm oil
j) A PowerPoint presentation for the final workshop has also been completed.

2) Properties of Palm Fruits

Samples of ten (10) *Dura* and (10) *Tenera* fruits were sent to the laboratory for analysis. Each fruit was carefully weighed. The fiber (mesocarp and exocarp) of each fruit sample was carefully stripped with a knife and weighed. The individual nuts were also weighed. The oil contents were determined by standard laboratory methods described.

3) Main Laboratory Work

Since palm oil is a volatile substance, moisture content was determined using a water bath. 2g of oil was weighed in a crucible of known mass. The oil in the crucible was dried in the water bath for 5 hours at a temperature of 105^{o}C. Afterwards it was cooled in a dessicator to dry and then re-weighed. The difference between the initial and final mass were then determined. The difference multiplied by hundred and divided by the initial mass of oil gave the percent moisture content.

Titrimetry is classically used to determine the acid value (free fatty acid content) of vegetable oils and fats. This acid value is defined as the number of mg of KOH required to neutralize the fatty acids contained in 1 g of the fat. Solvent mixture (95% ethanol/diethyl ether, 1/1, v/v) was used. 0.1 N KOH in ethanol was accurately standardized with 0.1 N HCl (pure ethanol may be also used if aqueous samples are analyzed) and 1% phenolphthalein in 95% ethanol was used. The free fatty acids content was determined by titrimetry. 2 g of oil was weighed into a glass vial and dissolved in at least 50 ml of the solvent mixture. This was titrated, with shaking, with the KOH solution (in a 25 ml burette graduated in 0.1 ml) to the end point of the indicator (5 drops of indicator phenolphthalein), the pink color persisting for at least 10 s. The FFA is the products of Palmitic acid factor multiplied by the titre value and the normality of the KOH and all divided by the mass of oil used of 2g.

The impurities in the oil samples were determined by filtration. Filter paper of known mass was placed in a funnel and 2g of oil put in it. Filtration was done with 1:1 petroleum ether and diethyl-ether to filter out the oil. The weight of the filter paper and impurities was

then determined. Subtraction of the mass of filter paper was done to get the mass of impurities. The mass of impurities multiplied by 100 and divided by the original mass of oil of 2g gave the percent impurities.

The oil left in the fiber was determined using the soxhlet apparatus. 2g of the fiber was put on a thimble and the oil in it continuously extracted with 40/60 petroleum ether of volume 250ml for 8 hours. Since the ether boils at 40^{o}C, extraction was done below this temperature. The initial weight of the flask was taken from the combined weight of the flask and the final content after the extraction. The difference was multiplied by 100 and divided by the original mass of fiber of 2g to obtain the percent oil in the fiber.

(2) Analysis of Local and Improved Fruits

An analysis of the fruit and nut weight as well as fiber and oil contents of ten (10) local fruits (*Dura*) and ten (10) improved fruits (*Tenera*) are presented in Table 2.2-14:

Table 2.2-14 Properties of Local (Dura) and Improved (Tenera) Palm Fruits

Measured Item	Dura	Tenera
Range of fruit weights (g)	2.90-6.62	12.64-30.22
Average fruit weight (g)	4.78 (1.33)*	21.61 (6.05)
Fiber weight/fruit (g)	1.48 (0.38)	12.22 (2.15)
Fiber/fruit (%)	31.07 (1.13)	58.36 (7.47)
Nut weight/fruit (g)	3.31 (0.95)	9.39 (4.03)
Nut/fruit (%)	68.93 (1.13)	41.63 (7.47)
Palm Oil content/fruit (%)	20.30 (1.37)	36.06 (1.01)

n=9 *Standard deviations in parenthesis

The local fruits were smaller averaging 4.78g whilst the improved varieties averaged 21.61g in mass. The improved fruits had more fiber and oil per fruit than the local variety. The oil per improved fruit (*Tenera)* was on the average 36.06 % making it ideal for commercial palm oil production. The oil per local fruit (*Dura*) was 20.3 %. Thus when there are too many local fruits during commercial palm oil production, yield will suffer.

(3) Recommended Flow Process for Association Mills

For association mills using manual or mechanical threshers, the flow process in Figure 2.2-7 is recommended to optimize yield.

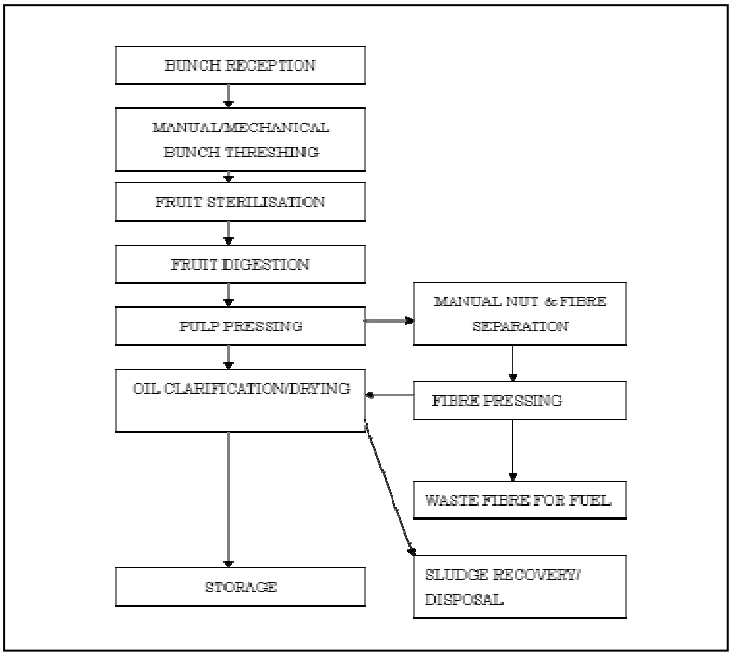


Figure 2.2-7 Recommended Palm Oil Processing Units for Association Mills

(4) Layout of Association Mills

The layouts of all the mills were modified to some extent to ensure optimal temperature for higher oil yields during the palm oil production. Table 2.2-15 shows the changes that were made in terms of distances between the equipment.

It is recommended that the oven and digester distance should be at a maximum distance of 10 m (see Figure 2.2-8). This will reduce the carrying of fruits for longer distances which resulted in severe temperature drops to affect the yield of palm oil in the old production techniques studied during Phase I. The digester and press must similarly be close to prevent further temperature drop. The sum total of these modifications minimized the drudgery associated with the process and more importantly ensured high enough temperatures in the digested mash during pressing to improve yield.

Table 2.2-15 Modifications on Existing Equipment Positions

Mill	Distances (m)			
	Sterilizer-Digester		Digester-Press	
	Old Method	Improved Method	Old Method	Improved Method
A	11.0	10	3.5	3.5
B	37.4	10	33.4	4.4
C	19.8	10	3.4	3.4
D	25.7	10	9	2.7

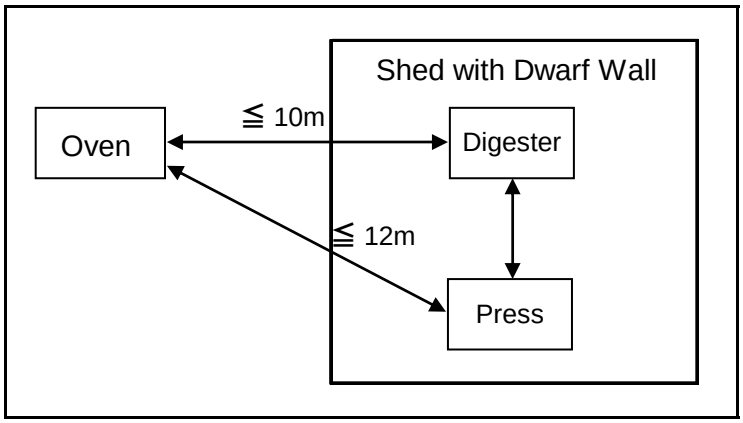


Figure 2.2-8 Schematic Layout for Association Mills

The other problem is the use of inefficient local ovens by essentially placing three stones to form a tripod for the sterilization/clarification/drying tanks. This led to a lot of smoke in the environment. It is recommended that more efficient ovens should be built with bricks to deal with the unhealthy smoky environments as shown in (Technical Manual for Improved Palm oil Processing for Association mills hereinafter the manual). If improved ovens are built, then the distances between the digester and sterilizer could even be closer.

Since distances to the digesters were close, temperatures of digested material were above 70^{o}C which is a pre-requisite for keeping the palm oil in a liquid state to optimize yield. The digester and press were equally close, thus the temperature of the fiber and nuts after pressing was even around 70^{o}C. Boiled fruits were also not heaped before digestion but were carried in reasonable bits straight to the digester after sterilization.

(5) Sterilization and Digestion

One hundred kilograms of fruits were boiled in 45 kg of water for 2 hours to soften the fruits to give-off their characteristic aroma. Sterilization was improved by first boiling only the water before introducing the fruits to reduce sterilization time. A comparison by boiling with the fruits in the water from the beginning showed a delay in sterilization time of about 30 minutes. The presence of fruits at the onset in the water increases sterilization time. Fruits were also pre-washed before sterilization (Figure 2.2-9).

Figure 2.2-9 Washing of Fruits to Remove Dirt

Fruits were well covered to ensure boiling temperature of at least 100oC. It is better to add about 45% of the material volume of the fruits as water. Where there are no weighing scales, a third of the tank to be filled with fruits for sterilization must be filled with water. Because of the layers of covering (plastic sheet/sack/metal cover) and no heaping during sterilization (see the manual), temperatures reached 100oC in all situations. This kept the fruits hot before digestion (see Table 2.2-16).

Table 2.2-16 Temperatures after Sterilization

Mill	Temperatures Ranges after Sterilization (C)		
	Boiled Fruits	Digested Material	Fiber/Nuts after Pressing
A	84-90	74-78	68-72
B	83-90	72-77	70-73
C	88-91	78-80	73-76
D	86-98	75-80	70-76

(6) Pressing

The effort arms of the manual presses were extended with galvanized iron pipes to the length of the existing effort arm by about 0.5-1.0 m each side to improve pressing and minimize human effort. An attempt to use bamboo for the extension failed, but more mature bamboo could serve the purpose. Heaping of mashed pulp in the basket for pressing was avoided to prevent pressed oil from falling back into the fiber and nuts to reduce yield. Pressing was gently done to avoid spillage onto the floor and was continued until no more material oozed out. The cake was ejected afterwards and immediately separated manually

into fiber and nuts. When enough fiber to fill the cage of the press was obtained, a final pressing was recommended.

(7) Clarification

The purpose of clarification is to recover crude palm oil by the separation of palm oil from the mixture of oil, sludge and water. The action transfers soluble and insoluble matter into water on an oven after adding some volume of water. If clarification is too long, all the water will be vaporized. Heating in the range of temperatures in Table 2.2-17 from about 56°C to about 104°C was good enough. The heating aimed at making a mixture of water and oil by heat convection and improving the fluidity of water and oil. The mixture of water and oil reaches 100°C, and up to the suitable temperature within 40 minutes, when the heating power is good enough. **After that few bubbles will be seen coming up to indicate that clarification is complete**. Immediately put the fire off. It is recommended that this is done in a maximum time of about one hour. And then leave the clarified material to calm for about 30-60 minutes more and then skim the layer of oil into a clean drying container. The whole clarification process from the beginning to the end should take a maximum of two hours.

Table 2.2-17 Temperatures for Clarification

Mill	Temperatures Ranges for Clarification (°C)	
	Before Clarification	Maximum Temperature Reached
A	56-63	101-103
B	56-63	102-104
C	56-60	102-104
D	58-63	102-104

(8) Quality Criteria

Ideally, Association Mills should strive to meet the Ghana Standards Board requirements as shown in Table 2.2-18 and even better. The earlier report for the *Kaizen* showed that some of these may not be realistic since fruits are not processed immediately and other technical constraints. However, some targets which are realistic were achieved during the Phase 1 study. Therefore, in order to improve access to the local and international market, the quality of palm oil produced by association mills must be improved to the following minimal achievable realistic targets (Table 2.2-18) by following the procedures recommended for quality palm oil production in the training manual. These targets were achieved with the improved methods.

Table 2.2-18 Achievable Realistic Targets Following Procedures in this Manual

No.	Quality / Extraction Criteria	Realistic Targets	Optimal Criteria
1.	Free Fatty Acids (FFA) (%)	<7.5	≤5.0-5.5*
2.	Moisture Content (%)	<0.5	≤0.45*
3.	Impurities (%)	<3.0	≤0.045*
4.	Extraction Rate (%)	>17.0	22-24

*Ghana Standards Board (GSB) requirement for quality palm oil

(9) Yield

The yield of palm oil nearly doubled in most cases as shown in Figure 2.2-10 and Table 2.2-19. This clearly shows that by following the improved methods, millers stand to gain a lot financially. It is the result of not leaving fruits to rot and keeping temperatures very high up to pressing. The extension of the effort arms for manual presses and changing of oil in hydraulic presses to the correct hydraulic oil contributed to this.

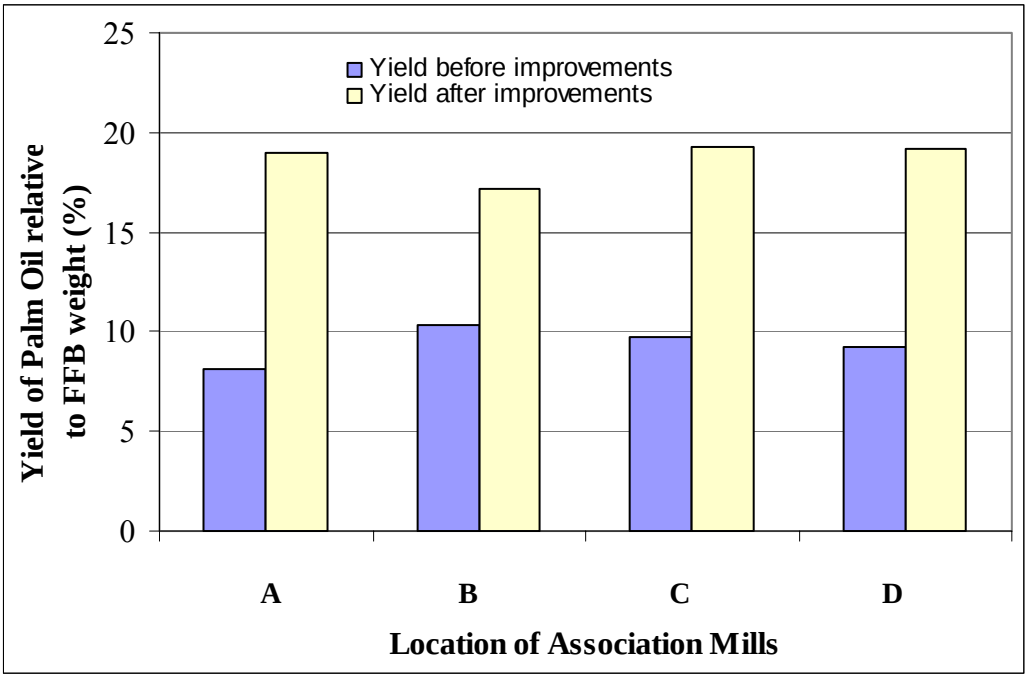


Figure 2.2-10 Percent Average Yield of Palm Oil Relative to Fresh Fruit Bunch Weight before and after Implementation of Improvements

Table 2.2-19 Yield of Palm Oil Relative to Fresh Fruit Bunch Weight before and after Implementation of Improvements

Mill	Yield (%)	
	Theoretical Yield: 22-24	
	Old Method	Improved Method
A	8.18 (0.84)	18.94 (0.98)
B	10.36 (1.20)	17.16 (3.52)
C	9.77 (2.93)	19.31 (0.57)
D	9.27 (2.64)	19.21 (1.01)

Standard Deviation in Parenthesis

(10) Free Fatty Acids

The FFA of the oil produced as shown in Table 2.2-20 also improved. It is suspected that the fruits were kept for much longer periods at the farm and later kept at the mill for three (3) days. Millers should therefore strive to keep within three days from harvesting to processing to achieve the standard in Table 2.2-13 recommended by the Ghana Standards Board.

Table 2.2-20 Free Fatty Acids (FFA) Contents of Palm Oil Produced before and after Implementation of Improvements

Mill	FFA (%)	
	Old Method	Improved Method
A	10.56 (2.00)	6.41 (0.76)
B	11.38 (1.84)	6.30 (0.72)
C	10.43 (2.02)	6.65 (0.73)
D	9.49 (1.56)	6.41 (0.76)

Standard Deviation in Parenthesis

(11) Drying and Moisture Content

By drying until all the bubbles died down, the moisture contents were brought within recommended standards as shown in Table 2.2-21 for all the mills. The drying process must be carried out in about 30 minutes. The fire temperature must be managed to keep drying temperature around 120-130^{o}C (Table 2.2-22). Drying to high temperatures will waste time and energy and also destroy the quality of oil. The volatile components of the palm oil vaporize at higher temperatures to destroy its quality.

Table 2.2-21 Moisture Contents (MC) of Palm Oil Produced before and after Implementation of Improvements

Mill	MC (%)	
	Old Method	Improved Method
A	1.21 (0.28)	0.33 (0.10)
B	1.10 (0.32)	0.35 (0.09)
C	1.05 (0.17)	0.30 (0.11)
D	1.02 (0.16)	0.30 (0.10)

Standard Deviation in Parenthesis

Table 2.2-22 Maximum Temperature Ranges during Drying

Mill	Maximum Temperature Reached (^{o}C)
A	128-158
B	128-139
C	104-144
D	110-129

Figure 2.2-11 shows sample drying temperatures with time. At Afotom, the drying temperature rapidly went up. This was due to the fact that actual clarification time was too long which virtually dried up all the water in the sludge-oil mixture. Therefore, excessive length of clarification is not good. Drying takes about 30 minutes but it completed when there are no more bubbles.

The drying process must also be carried out in a very short time but in the case of Ntinanko, the fire temperature was too low. Millers must make sure that fire temperatures are well managed. The drying process at Antoakrom was good. That of Pease was even ideal. The temperature reached over 120^{o}C to nearly 130^{o}C in 30 minutes in a fairly uniform controlled manner.

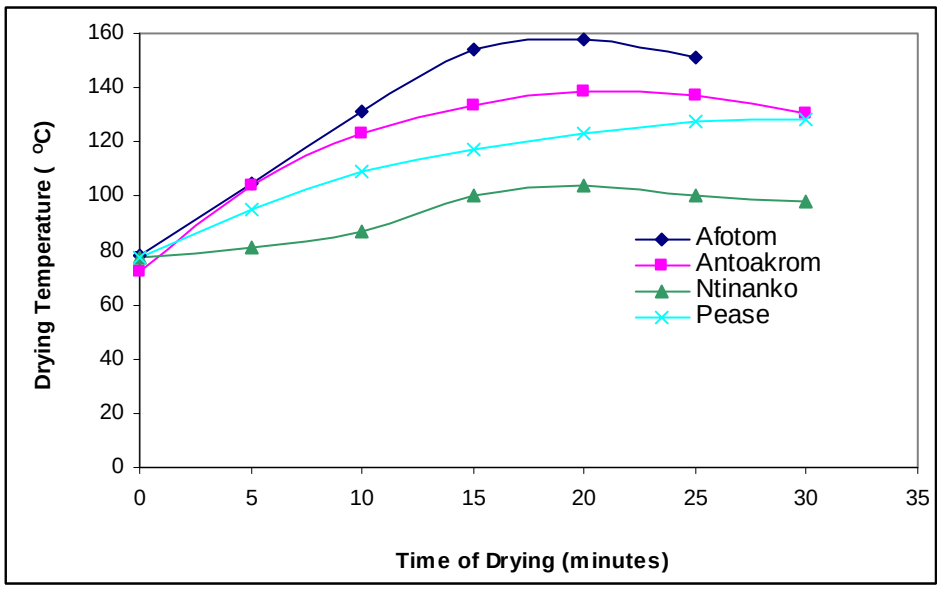


Figure 2.2-11 Correlation of Drying Time with Temperature

(12) Impurities

The level of impurities reduced substantially (see Table 2.2-23) simply by pre-washing before boil and also using cleaner containers at all stages. However, this is well below the recommended GSB standards as shown in Table 2.2-13. If fruits are processed within the recommended three days, it might help. Skimming of the oil layer after clarification must minimize some of the sludge getting in with the oil to be dried. This was the cause of too many particles after the drying process. The technique of skimming of particles after drying must also be improved.

Table 2.2-23 Impurities in Palm Oil Produced before and after Implementation of Improvements

Mill	Impurities (%)	
	Old Method	Improved Method
A	8.82 (1.14)	1.50 (0.88)
B	7.21 (2.01)	2.00 (0.56)
C	8.21 (1.18)	1.78 (0.64)
D	8.66 (0.88)	1.41 (0.52)

Standard Deviation in Parenthesis

(13) Oil Lost to Fiber

The efficiency of extraction improved tremendously with the improvement techniques as shown in the low level of oil left in the fiber in Table 2.2-24. There is a limitation on how much oil can be squeezed given the pressure available and the presence of concretions in the form of nuts. No matter the pressure, some oil will still stick to the fiber.

Table 2.2-24 Oil Left in Fiber after Pressing before and after Implementation of Improvements

Location of Mill	Oil Left in Fiber (%)	
	Old Method	Improved Method
A	24.01 (2.31)	6.21 (0.86)
B	18.81 (1.02)	5.48 (0.82)
C	20.20 (0.97)	6.23 (1.37)
D	21.83 (0.68)	5.28 (0.70)

Standard Deviation in Parenthesis

(14) Sludge Recovery and Disposal

The sludge was never thrown away after clarification. It was poured into a 200 liter oil drum (45 gallons) or a reasonably sized container, covered and left for 1-4 days. It is better to avoid longer periods to prevent decay and the emission of offensive odor. A new oil layer appeared on the sludge afterwards, and this was skimmed into a drying container. An equal quantity of clean water was added to the oil skimmed and dried. The quality of this oil is low. It is therefore not palatable or edible so it is best sold to the local soap industry. This can also boost the incomes of millers.

Finally, the sludge must be disposed off in pits dug for the purpose not into natural drains or water ways. The water in the sludge will infiltrate into the soil. When the pit is full, it should be covered with soil to control the stench, flies and scavengers and also to ensure a relatively clean environment.

(15) Conclusions of verification

As a result of the detailed study, a training manual has been produced to assist association type mills produce high quality palm oil with much higher yields.

The study showed that the moisture content and FFA can be improved considerably following the training manual. The yield of palm oil can also be improved by some 50-100 % following the recommended procedures to improve returns with minimal layout changes costing next to nothing. Impurities were drastically reduced though not to the recommended GSB requirements. All these will hopefully improve access to the market. Aside of this, the oil recovery from the sludge for the local soap industry will boost the incomes of millers.

The main difficulty at the mills was the mountains of palm nuts crying to be processed into palm kernel oil. Some nuts are sold at very low prices to small scale processors using outdated techniques to produce low quality palm kernel oil. Some are even used as fuel whilst others go to waste despite the fact that palm kernel oil costs higher than palm oil on the international market.

Wooden platforms used for the storage of fruits and bunches should also be used for the storage of the nuts. Nuts should not be left on the dirty floor to reduce the quality of the enclosed kernels. This is because high quality nuts are necessary for giving high quality kernels. These can be sold raw for additional income. Palm oil producers must also consider producing palm kernel oil by adopting the improvement methods suggested for palm oil.

The other problem at the mills was the poor disposal techniques for sludge and the low level of cleanliness at some of the association mills. Since the sludge contains a lot of hydrocarbon chains, it could be exploited in biogas production for fuelling the operations at the mills after which the waste could safely be used as manure.

2.2.7 Summary of the Trial Program

Major achievements and results are summarized as follows.

- Measurement of yield rate at 10 sample companies to understand the present situation. (4^{th} to 5^{th} field survey)
- Drawing the table of measurement results (5^{th} field survey)
- Finding causes of low yield rate (6^{th} field survey)
- Making proposed measures to improve yield rate (6^{th} field survey)
- Improvement measures were implemented at 4 sample companies (7^{th} field survey)
- Analyzing and verifying the results of yield improvement (7^{th} field survey)
- Making Improvement manuals (100 copies) (7^{th} field survey)
- Holding the workshop for improvement of yield rate (7^{th} field survey)

2.3 Ex-post Evaluation of the Trial Program in the Ashanti Region

2.3.1 Verification of the Implementation Status and Conditions

(1) Verification of implementation results

Inputs have been made generally according to the plan and the schedule.

As for the improvement of yield that is set as the project purpose, 70% - 90% improvement was realized among microenterprises and small scale enterprises. On the other hand, the program failed to offer a direct method to improve yield for medium scale enterprises.

As the improvement initiatives implemented under the trial program did not involve substantial investment, their results – yield improvement and increase in production – led to the decline in per-unit production cost. In addition to yield, other improvement activities such as misalignment of traffic lines or transportation of raw materials within the shop can help decrease the overall production cost. In fact, the questionnaire survey conducted at the final workshop indicates that 95% of respondents said yes to the question, "Does the results of the trial program contribute to reduction of production cost?"

(2) Verification of the implementation process

Activities have been conducted in accordance with the plan. The study team was responsible for overall project management, whereas the coordinator and the contractor (KNUST) for implementation and operation. The study team members monitored the progress according to the schedule, checked actual implementation results, and evaluated the results of research activity. In the course of implementation, some delays occurred in reporting and other activities due to miscommunication between the study team and the contractor, but the problem was solved as a result of efforts to restore effective communication. In particular, a good relationship was established as the study team provided appropriate technical advice.

On the counterpart side, MOTI/PSD/PSI was actively involved in preparation for the four workshops, including the recruitment of participants.

NBSSI showed enthusiasm about dissemination of the program result by encouraging the BAC staff to attend at verification of kaizen proposals. While the program adopted a participatory approach, it could not attain sufficient understanding of participants in the initial

stage, who did not show much interest because they were not in an urgent situation to initiate improvement. However, the level of understanding rose among participants with the progress of the trial program, and their mindset seemed to have changed significantly as a result of the kaizen activities.

2.3.2 Five Evaluation Criteria

(1) Relevance

For the following reasons, the trial program is considered to be highly relevant.

- The program was designed on the basis of participatory type program analysis and thus reflects the needs of the target group. The questionnaire survey conducted at the final workshop indicates that 93% of respondents said yes to the question, "Does the trial program's content meets the needs of the palm oil industry?"
- In small-scale palm oil processing, farms are engaged in both raw material supply and oil production, so that the program helps increase their cash income, thereby to promote poverty reduction.
- The palm oil industry is a priority industry for PSI and is thus considered as the country's key industry. At present, PSI is in the process of increasing cultivation of oil palms as well as conversion to species with larger oil content. Therefore, the project that promotes the industry processing oil palm accords with the government's policy.
- Japan's ODA policy for Ghana sets priority to "revitalization of rural areas," "fostering of industries leveraging potential" and "improvement of the public administration system." The program is highly relevant in that it aims to revitalize local communities and foster industries using agricultural resources.
- Production systems of microenterprises and small enterprises vary greatly in type and quantity of equipment owned and the number of workers as well as market access. In selecting the target group, companies operating in Ashanti have been selected by taking into account the above conditions.
- Successful dissemination of the program results outside the target group depends on promotional activities of BAC/MOFA and related organizations. As the results verified after program implementation are more than expected, dissemination is expected to be relatively easily achieved.

(2) Effectiveness

For the following reasons, effectiveness of the trial program is considered to be high.

- It has been confirmed that the project purpose, "to improve yield of palm oil produced by the target group," was achieved through implementation and verification of the yield improvement measures. It is highly likely that it will benefit the target group consisting of microenterprises and small enterprises engaged in palm oil processing.
- The project purpose has been accomplished in that the kaizen proposals were made and verified and the results were disseminated by means of documentation and workshop. However, further promotion and dissemination of the program results, which have been realized under the trial program, should be carried out under the responsibility and leadership of the counterpart.
- At present, the program is free from influence by extraneous conditions.
- There are roughly two impeding factors: 1) willingness and policy of management; 2) follow-up support. Generally, the business owner insists on a traditional method while hesitating to adopt a new one. Improvement methods proposed and implemented under the trial program have presumably been acceptable to owners and managers of the target companies as they did not entail substantial change or investment and implementation results were generally satisfactory to them. Nevertheless, dissemination of kaizen proposals must be accompanied by follow-up support because the proposals cannot be executed by private companies alone. Such support can be provided by the university to which technology transfer is made as well as coordinators, but who bears the cost may present a problem.

(3) Efficiency

Overall, the program has produced outputs that match input resources.

Basic inputs consisted of the study team, coordinators, and the university. They were made smoothly and adequately in terms of timing of mobilization and use. Although direct comparison with similar projects is not possible, this program required smaller investment than other trial programs. Also, there was no alternative method or input. For instance, the university to which the service was entrusted, KNUST, has the highly reputed engineering department, and there is no alternative university or research institute. Finally, results of relevant projects conducted in the past have been reflected.

The program was not influenced by extraneous conditions. The number of participants did not present a problem. Although a company that intended to participate suspended operation, it did not interfere with achievement of results.

(4) Impact

At the end of the trial program, it is not certain if the overall goal can be achieved as a result of program implementation, but there is a good chance. Efforts have been made to promote dissemination of the program results, such as preparation of technical manuals. Nevertheless, program impact is governed by degree and extent of actual dissemination, which depends on the future activity of the Ghanaian government.

Note that the overall goal – reduction of the production cost – can be achieved by other means. For instance, it is important to promote productivity improvement on a continuous basis by repeatedly applying the kaizen steps that were introduced under the trial program. Also, capital investment projects, such as rehabilitation of existing equipment or installation of new equipment, may be required. If such equipment modernization is made on the basis of the kaizen results achieved under the trial program, it will contribute greatly to the accomplishment of the overall goal.

The indirect effect of the program at this stage is that effectiveness of industry-academia cooperation has been confirmed. As a result, a large number of students have participated in the trial program, giving indirect benefits to the university in terms of research and education.

(5) Sustainability

The trial program is expected to continue on a sustainable basis after its completion. In fact, several oil processing companies made inquiry about possible trade with the target group. Needless to say, continuous promotion and dissemination of the program results requires substantial costs, but it is possible to secure a financial source as similar programs have been made by using DA's fund. Also, as economic benefits to the target group are made known to related parties and local communities, it will help facilitate continued program financing. On the other hand, difficulty lies in the implementation system because government organizations, which implement dissemination activities, do not have sufficient experience in providing support for small enterprises that constituted the target group, so that they may not be able to serve as the core of future activity. To improve sustainability, the Ghanaian government needs to promote further kaizen activities in cooperation of coordinators and academics to which technology transfer was made under the trial program.

2.3.3 Conclusion, Recommendations, and Lessons Learned

(1) Conclusion

- The trial program has been implemented according to the plan and has achieved its intended purpose.
- There was no significant problem in the implementation process. The program is considered to be highly relevant and effective.
- Uncertainty lies in impact, which depends largely upon the method for dissemination and continuation as well as its extent.

(2) Recommendations

- A similar program can be applied to other industries.
- The program results are generally applicable to other regions and can easily be disseminated.
- Improvement of the production system leads to sales promotion and industrial growth.

(3) Lessons learned

- Collaboration with universities has significant effects, but it is subject to various restraints such as class schedule. Also, universities are not accustomed to activities like the trial program.
- Like the palm oil processing industry, other industries seem to face the similar situation. One reason is the lack of knowledge on production management and techniques on the management side. At the same time, the program is expected to produce significant results.

3. The Trial Program for the Citrus Processing Industry in the Central Region

3. The Trial Program for the Citrus Processing Industry in the Central Region

3.1 Establishment of the Trial Program

3.1.1 Problem Analysis and Formulation of the Draft Master Plan

(1) Core Problem and direct causes

At the workshop conducted on 6 June 2006, the core problems and their causes were identified. They were compiled into a problem tree shown in Fig.3.1-1.

Core problem: The number of fruit processing factories is too small.

The direct causes identified were classified into the following factors.

1) Production technology for SMEs is not locally available.
2) Knowledge and information for doing business are lacking.
3) SMEs are hard to get capital for new investment.
4) Start-up of business is risky with unknown factors.

(2) Formulation of the draft master plan

Based on the problem tree, the team formulated a draft master plan (Fig.3.1-2).

The primary objective of this draft master plan is to increase the number of citrus processing factories. This addresses the present condition that processing factories are not a stable customer for citrus producers because of their small number, as well as poor operating rates of existing factories. Price fluctuation of citrus products in the market creates a major disadvantage for producers, and the draft master plan is expected to meet expectation of producers to secure a stable market.

To achieve the objective, the following four strategies were established.

Strategy 1: Acquisition of fruits processing technology
Strategy 2: Diffusion of knowledge and information about the industry
Strategy 3: Easy access to initial funding for entrepreneurs
Strategy 4: Reduction of risks for new investment into the industry

Under these strategies, twelve programs targeting investment promotion for the citrus processing industry as well as the fostering of the industry are proposed. These programs

have been developed on the basis of problem analysis and SWOT analysis(Table 3.1-1). They include programs that are designed to play an important role when investment in the industry reaches a critical level. For this reason, the trial program has been selected with strategic focus to facilitate investment through the provision of adequate information for potential investors.

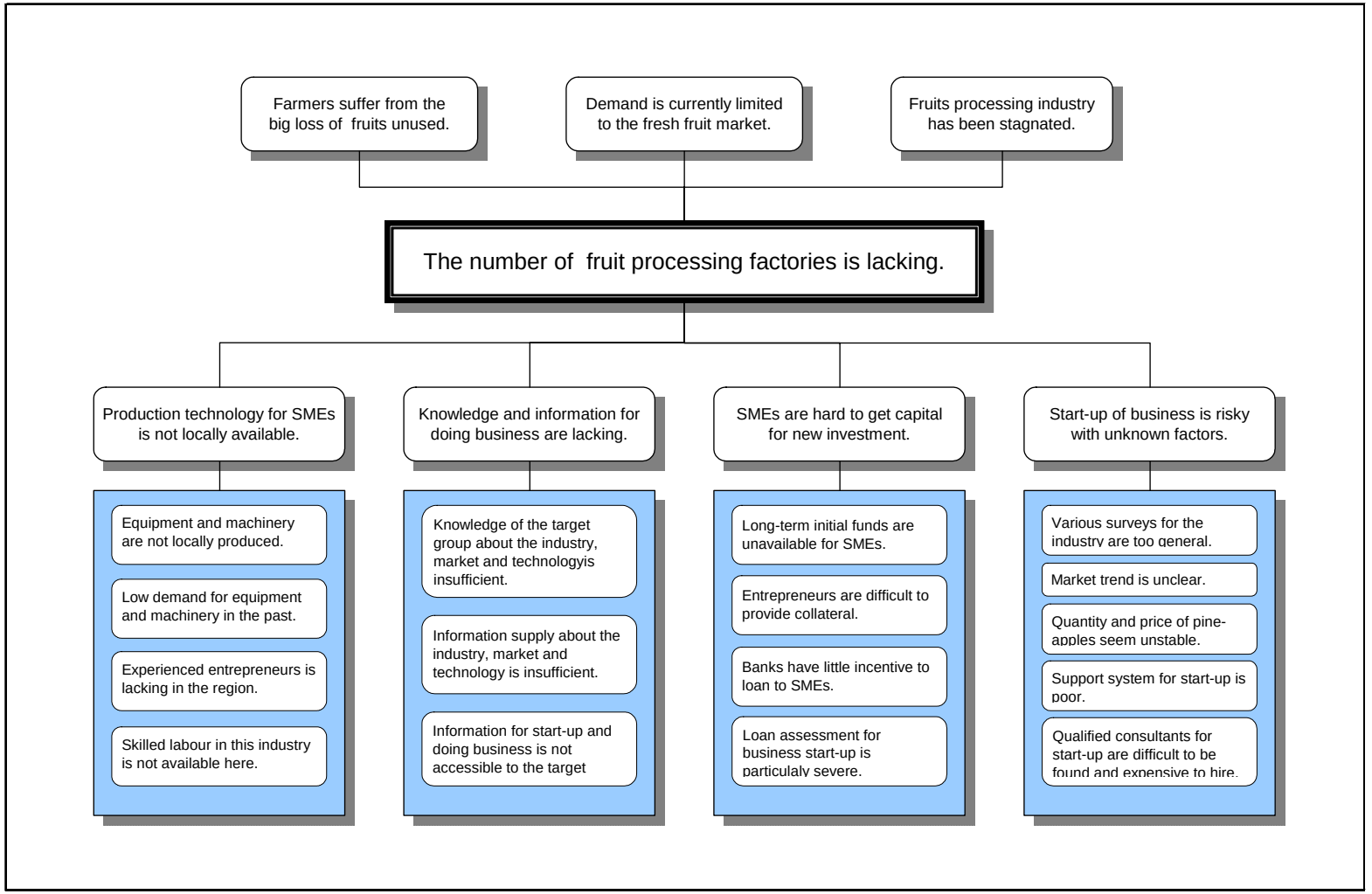


Figure 3.1-1 Problem Tree of the Citrus Processing Industry in the Central Region

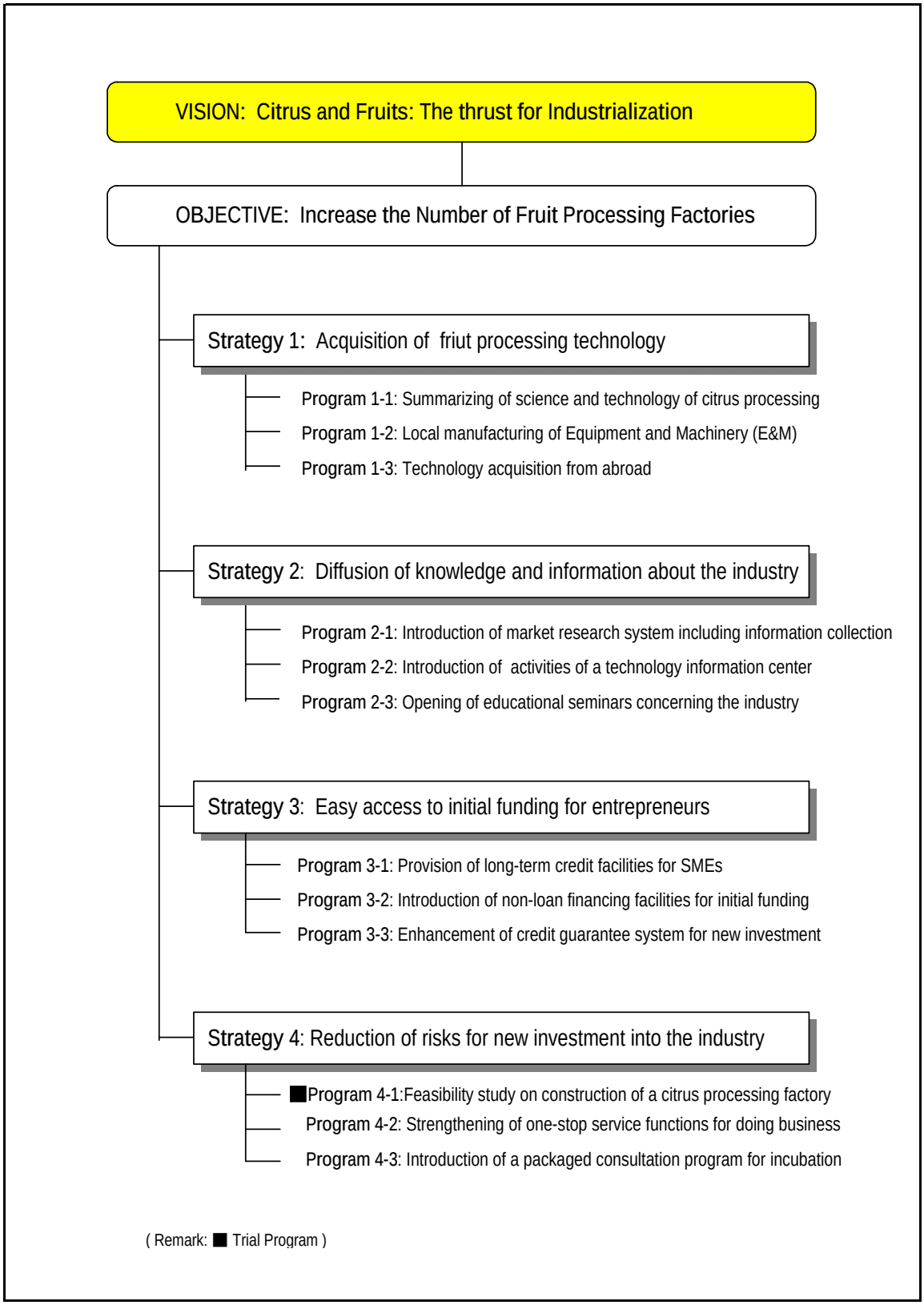


Figure 3.1-2 Framework of the Draft Master Plan for the Citrus Processing Industry in the Central Region

Table 3.1-1 SWOT Analysis: the Citrus or Pineapple Processing Industry in the Central Region

	Market	Production / Technology	Raw materials	Human Resource	Development capability	Business Environment
STRENGTHS	• Easy access to large market such as Accra and Kumasi.		• Abandon orange and pineapple • Price is low during the peak season. • Easy access to raw materials	• Abandon labor force • FRI provides basic knowledge of processing.		• Growing interests in fruits processing from local authority. • Support from professors and students in Cape Coast University (Dept. of Management Studies).
WEAKNESSES	• Domestic demand for processed products is not clear. • The product specification which is accepted by the market is not known.	• No appropriate locally made machinery in terms of capacity and price. • No manufactures specialized in this sector.	• Price fluctuation of raw materials may cause difficulties for processors to get necessary amount of raw materials.	• Luck of skilled person in areas of marketing, finance and production.	• Luck of product development capability	• Luck of own fund for business start-up. • Difficulties in borrowing money. • Troublesome procedure for business start-up. • Performance of a few operating processor in the region discourage the processing business.
OPPORTUNITIES	• Possibility to export to neighboring countries with improved quality and package.		• Increasing demand of fruits encourage breed improvement.	• Some students are willing to start a processing plant.	• GRATIS has the plan to develop machineries for SMEs.	
THREATS	• Importing better quality products with lower price.					• Unstable packaging material supply • Unstable electricity and water supply.

3.1.2 Selection and Outline of the Trial Program

Program name: Feasibility study on construction of the citrus processing factory in the Central Region

(1) Reason for selection

At the problem analysis workshop, the small number of fruit processors was raised as a core problem. The major cause, as pointed out there, was a large risk to start up fruit processing business due to the lack of information required for making an investment decision. In response, the team proposed to carry out a feasibility study (F/S) for fruit processing.

The Team checked directly with the local citrus and pineapple producers' association and confirmed that they hoped for the construction of a fruit processing factory. While the Central Region is known for production of oranges and pineapples, producers are often forced to sell them at fairly low prices due to limited local demand. Because of this, they hope the presence of a fruit processing factory that is ready to purchase fruit products regularly.

Generally, the fruit processing industry can enjoy various advantages when it is located near the source of raw materials, i.e., the transportation cost can be saved significantly as processing near the source reduces the volume of fruits to one third that in the case of remote processing. Besides, fresh juice can be produced because fruits can be processed soon after their harvesting. Also, loss due to rotting or moisture evaporation can be minimized. Moreover, local processing offers a great advantage for Ghana where the means of transportation is limited and costly.

In the Central Region, there are three companies that process fruits to juice and other products, but capacity utilization rates of the two companies (except the one of small size) are fairly low. Reasons for this are, among other things, their excess capacities that are larger than local demand and the lack of research and study prior to construction and startup. The situation indicates that the proper feasibility study is essential in promotion of the fruit processing industry in the future.

(2) Outline of Trial Program

1) Expected Output

a) Marketability of the product is clarified in size, channels and prices.

b) Suppliabilty of raw materials in the Central Region is clarified.
c) Specifications of products, production capacity and a factory site are determined for F/S.
d) Production facilities are designed as a module factory.
e) Project and operation costs are summarized.
f) Project implementation plan is finalized.

2) Activities

1-1 Establish F/S committee among stakeholders
1-2 Design outline of F/S (methodology, schedule and budget)
1-3 Allocate tasks

2-1 Execute the demand survey and marketing channel survey
2-2 Execute the raw material survey for citrus processing in the region
2-3 Investigate farmers' associations about suppliability and their intensions to participate in the project.

3-1 Determine a product(s) with specification to produce
3-2 Determine a production capacity as a module factory
3-3 Determine a factory site for the feasibility study

4-1 Design an appropriate process and estimate machinery costs. Balance between manual work and machinery work, module production design and material balance should be considered.
4-2 Design and estimate auxiliary and off-site facilities.

5-1 Estimate and summarize the total project cost. Preliminary consideration of funding should be considered.
5-2 Estimate and summarize the operating cost

6-1 Make sales and revenue plan
6-2 Project financial statements and analyze financial indicators and ratios
6-3 Finalize the feasibility study with new business and organization plan
6-4 Prepare a feasibility report
6-5 Announce the result of the study at the seminar

See Table 3.1-2 for details.

3) Implementation Schedule

Activity	2006					2007								
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1-1 Establish a feasibility study (F/S) execution committee														
1-2 Prepare an F/S execution plan														
1-3 Assign Institutions responsible for tasks in F/S														
2-1 Execute demand survey and marketing channel survey														
2-2 Execute test marketing if possible														
3-1 Execute raw material survey														
3-2 Investigate farmer's associations about suppliability and intensions														
4-1 Determine a product(s) with specification to produce														
4-2 Determine a production capacity as a module factory														
4-3 Determine a factory site for the feasibility study														
5-1 Design an appropriate process and estimate machinery costs														
5-2 Design and estimate auxiliary and off-site facilities														
6-1 Estimate and summarize the total project cost														
6-2 Estimate and summarize the operating cost														
7-1 Make a sales and revenue plan														
7-2 Project financial statements and analyze financial indicators and ratios														
7-3 Propose organizational system for construction and operation of the factory														
7-4 Prepare a feasibility report														
7-5 Hold a seminar for announcement of the F/S results														

Note: ▭ indicates JICA Study Team field survey in Ghana
As of Nov. 2006.

Table 3.1-2 Project Design Matrix －Central Region Citrus and Pineapple Processing Industry

Name of trial program : Feasibility study on construction of a fruit processing factory
Target group : Local stakeholders interested in building the fruit processing factory
Implementation Area : The Central Region
Implementation period : August 2006～August 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Increase total production of local fruits industry	• Production volume	• Statistics	
Project Purpose Increase potential investors for fruit processing factories	• New investment of fruits processing in the region	• No. of investment	1. Fruits production does not decrease.
Outputs			
1 Establish the local organization to implement F/S.	• Organization members and activities	• Organization chart	1. Domestic economy does not change dramatically. 2. Exchange rate is stable.
2 Clarify domestic and local demands and sales distribution	• Amount of demand and distribution channel	• Report	
3 Clarify sources of raw materials and these prices	• Amount of raw material available and price range	• Report	
4 Decide specifications of products, production capacity and a site proposed	• Specifications, production capacity and plant site	• Report	
5 Clarify the equipments and plant plan	• List of equipments and layout of plant	• Report	
6 Clarify costs of construction and operation	• Costs of construction and operation	• Report	
7 Reveal the result of financial analysis with the sales plan	• Financial analysis • Sales plan	• Report	
8 Realize the investment plan	• Investment promotion plan • Name of potential investors	• Report • List	
Activities (1)-1 Establish a feasibility study (F/S) execution committee (1)-2 Prepare an F/S execution plan (1)-3 Assign Institutions responsible for tasks in F/S (2)-1 Execute demand survey and marketing channel survey (2)-2 Execute test marketing if possible (3)-1 Execute raw material survey (3)-2 Investigate farmer's associations about suppliability and intensions (4)-1 Determine a product(s) with specification to produce (4)-2 Determine a production capacity as a module factory (4)-3 Determine a factory site for the feasibility study (5)-1 Design an appropriate process and estimate machinery costs (5)-2 Design and estimate auxiliary and off-site facilities (6)-1 Estimate and summarize the total project cost (6)-2 Estimate and summarize the operating cost (7)-1 Make sales and revenue plan (7)-2 Project financial statements and analyze financial indicators and ratios (7)-3 Prepare a feasibility report (8)-1 Promote the envisaged project to potential investors (8)-2 Propose the organization for the new business (8)-3 Make decision on execution of the envisaged project	**Inputs** JICA Study team • Japanese experts • Operating expense - Employment costs of Ghanaian staff - Transportation and accommodation costs - Expenses of training, meetings, workshops - Expenses of training materials Ghanaian counterparts • Counter personnel • Office space, office equipment and furniture • Operating expense - administrative and management costs		1. Any crucial problem to make the processing plant is not found. **Pre-conditions** 1. Possibility of investment is very low. 2. Market for processed fruits exists.

3.2 Feasibility Study on Construction of the Citrus Processing Factory in the Central Region

3.2.1 Raw Material Survey

The main objectives of the raw material survey are as follows.

1. To find out whether there is potential to supply enough raw materials all year round to feed the processing plant.
2. To determine whether farmers and the associations are willing to supply raw material to the processing plant when it set up.
3. To determine the type of agreement they prefer.

(1) Orange Production

The summary of the survey is shown in Table 3.2-1.

Table 3.2-1 Orange Production

	Cape Coast Municipality	Assin North District	Ajumako Essiam Enyan District
Average land under cultivation per farmer	14.6 acres	7 acres	12 acres
Current production	3,212 t	2,409 t	3,168 t
Willingness to expand	75%	90%	84%
Potential production	4,587 t	3,278 t	3,960 t
Current problem in farmers	Labor, lack of funds and marketing	High labor cost, lack of funds	Bad road to farms, lack of funds, high labor cost
Waste ratio	32% (Jan.-Mar.) 48% (Jul.-Sept.)	8% to 10.5% (Jul.-Sept.)	18% (Oct.-Dec.) 24% (Jan.-Mar.)
Current distribution channel	Association (63%)	Middlemen (95%)	Middlemen (91%)
Selling price (100 pieces)	¢25,000 - ¢30,000 Av. ¢29,700	¢10,000 -¢ 25,000 Av. ¢15,200	¢7,200 - ¢25,000 Av. ¢13,700
Intention to sell to the factory	100%	97%	100%
Willing to enter a contract	100%	70%	92%
Expected distribution channel to the factory	Association (80%)	Directly to the plant (67%)	Association (75%)
Preferred agreement	Fixed price and volume (85%)	Fixed price and volume (70%)	Fixed price and volume (63%)
Expected contract period	Annual contract (85%)	Unclear	Six months (42%) One year (37%)

Source: Field Survey

Current and potential productions in table 1-3 do not indicate overall quantity of production in the District. Figures were estimated based on only responses. The actual figures could be larger than these since it does not cover 100% of the producers.

1) Cape Coast Municipality

With regard to farming activities, the minimum land under cultivation by a farmer in this District was 6 acres, with the maximum being 50 acres. The average land under cultivation was 14.6 acres per farmer, with a total land area under cultivation being 292

acres. The total land available for cultivation was 417 acres. As many as 15 farmers, representing 75%, were prepared to expand their cultivation. With an average yield per acre of 11 tons, production of the farmers surveyed is currently estimated to be 3212 tons per annum. This could be increased to 4587 tons if the farmers go ahead with their intention to expand production. However, the problems that will hinder the possibility of maintaining the current farm and expanding were given as labor, lack of funds and marketing. Meanwhile, the average waste ratio in Cape Coast Municipality was found to be 32% in the January-March production season and as high as 48% during July-September.

The farmers association itself did not have its own farm. It had a membership of 800 people with an average land size of seven acres per member. The association has been in existence for two years.

The farmers in Cape Coast Municipality used the farmers associations most of the time to sell their produce. Almost 63% of their produce is sold through the associations. The price per 100 pieces of orange ranges between ¢25,000 and ¢30,000, with an average price being ¢29,700.

All the members interviewed in this District are prepared to sell their produce to the processing plant if such a plant was to be established. The majority of the farmers (80%) would like to sell their produce through the association. Also, almost all the farmers (19) are prepared to enter into a contract with the processing plant. By this, 85% of them would like to have an annual contract that would contain a fixed price and volume.

2) Assin North District

The total land cultivated by members was 219 acres. 90 percent of the members indicated their willingness to increase their cultivation in future. This could increase the total land under cultivation to 298 acres. With the average yield of 11 tons per acre, production is currently estimated to be 2409 tons and could be increased to 3278 tons for farmers involved in the survey. The problems that may hinder such an expansion include high cost of labor and lack of funds. The average waste ratio in Assin North was between 8% and 10.5% with the July-September season recording the highest waste ratio.

The three associations interviewed had membership ranging from 18 to 300 farmers with total membership of 618 farmers. The associations had been in existence between three to four years.

In Assin North District, farmers sell their produce to middlemen who come to the farms. As much as 95.3% of their produce is sold to the middlemen. The price per 100 pieces of orange ranges between ¢10,000 and ¢25,000 with an average price being ¢15,200. Nearly 97% of the farmers in this District indicated their intention to sell to a processing plant if one was set up in the District. The majority of the framers (67%) would like to sell their produce directly to the processing plant. Only 33% would prefer to sell through the intermediation of the association. All the farmers are prepared to enter into a contract to supply their produce with 70% of them preferring to have a contract that has a fixed price and volume and 30% preferring fluctuating price and volume. There was no clear majority with regard to the terms of contract as respondents selected all the options.

3) Ajumako Enyan Essiam (AEE) District

The total land available for cultivation to the farmers interviewed was 360 acres with the minimum land available to a farmer being two acres and the maximum being 69 acres. The total land under cultivation was 288 acres. The minimum land cultivated by a farmer was two acres and the maximum being 52 acres. Current production of the farmers surveyed is estimated at 3168 tones and potential output for all the farmers in the association is estimated to be 3960 tones per annum. The waste ratio in the District ranges between 17.6% in the October-December season and 24% in the January-March season.

Almost 84% of the farmers in this District were prepared to increase the size of their farms. The problems that farmers are likely to meet when they decide to expand include: bad roads to farms, lack of funds, high labor cost, market for produce and the land tenure system.

In AEE District 8 associations interviewed had membership ranging from 13 to 94 farmers with total membership of 326 farmers. The associations had been in existence between 2 and 7 years. The farmers in AEE District most of the time sell their produce to middlemen who come to the farms. About 91.3% of their produce is sold to middlemen. The price per 100 pieces of orange ranges between ¢7,200 and ¢25,000 per 100 pieces of orange with an average price of ¢29,700.

All the farmers in this District interviewed were willing to sell their produce to the processing plant when it was established with 92% prepared to enter into a contract to supply. Out of 24 farmers surveyed, five, representing 21% were prepared to deal directly with the processing plant. However, 75% of the farmers were interested in transacting

business with the firm through the associations. 63% of the farmers preferred fixed price and volume with 37% preferring fluctuating price and volume. The preferred terms of contract ranges from three months to one year. Five farmers (21%) preferred three months contract. 42% of the farmers preferred six months contract whereas 37% preferred one year contract.

(2) Pineapple Production

The summary of the survey is shown in Table 3.2-2.

Table 3.2-2 Pineapple Production

	Mfantsiman District	KEEA District
Average land under cultivation per farmer	12.7acres	11 acres
Current production	7,650 t	5,510 t
Willingness to expand	100%	100%
Potential production	15,720 t	8,360 t
Current problem in farmers	Lack of funds, high labor cost, market, difficulty in land acquisition and weed control	Lack of funds, high labor cost, market, difficulty in land acquisition
Waste ratio	11.5% (Oct.-Mar.) 17% (Apr.-Jun.)	none
Current distribution channel	Middlemen (79%)	Middlemen (90%)
Selling price (1 piece)	¢400 - ¢500 Ave. price ¢450	¢1,700 - ¢3,000 Ave. price ¢2,300
Intention to sell to the factory	100%	100%
Willing to enter a contract	97%	96%
Expected distribution channel to the factory	Association (50%) Directly to the factory (43%)	Association (72%) Directly to the factory (28%)
Preferred agreement	Fixed price and vol. (83%) Fluctuating prices and volume (17%)	Fixed price and vol. (96%)
Expected contract period	Six months to one year (100%)	One month (50%) Six months to one year (36%)

1) Mfantsiman District

With regard to land available for cultivation, the minimum land size was two acres and the maximum was 260 acres. The total land available to the farmers interviewed was 786 acres. Land cultivated with pineapple by individual farmers ranges between 2 acres and 130 acres with total land cultivated being 382 acres. Total land available for cultivation was 786 acres. With an average production of 20 tones per acre for pineapples, current production of the farmers involved in the survey is estimated at 7650 tones and this could be expanded to 15,720 tones in future. The waste ratio in Mfantsiman District is between 11.5 from October to March and 17% in the April-June production season. Asked whether the farmers intend to increase cultivation of pineapple, all the farmers answered in the affirmative. Some of the problems envisaged by farmers to hinder future expansion were lack of funds for expansion, high labor cost, market for produce, difficulty in land acquisition and difficulty in weed control.

The minimum membership of an association in the District was 15 and the maximum was 108 farmers. The associations surveyed had been in existence between one to four years.

The farmers in Mfantsiman District sell majority of their produce to middlemen. Almost seventy nine percent (78.6%) of their produce is sold to middlemen. The price per one pineapple ranges between ¢500 and ¢2,000. All the farmers interviewed in the Mfantsiman District were willing to supply raw materials to the processing plant if established. Twenty nine (29) farmers, representing 97%, were prepared to enter into a contract to supply the processing plant with raw materials. Only one farmer was not willing to enter into a contract to supply the raw material, although the farmer was willing to supply raw material to the plant without a contract. 43% of the farmers preferred to deal with the processing plant directly. However, 50% (15 farmers) wanted to transact business with the processing plant through their associations. With regard to the type of contract preferred, 83% of the farmers wanted a fixed price and volume with the contract term between six months to one year. Only 17% of the farmers preferred fluctuating prices and volume with a contract term between six months to one year.

2) Komenda Edina Eguafo Abrem (KEEA) District

The minimum land cultivated by a farmer in this District was three acres and the highest was 30 acres, with average cultivation being 11 acres. The total land under cultivation at the moment is 275 acres out of an available land of 418 acres. With an average production

of 20 tones per acre, current production is estimated at 5510 tones for farmers covered in the survey. This can, however, be increased to 8360 tones as all the farmers in the KEEA District surveyed were willing to expand their farms. Some of the problems that may prevent farmers from expanding include lack of funds, high cost of labor and access to land. There was no waste in KEEA, as all respondents indicated zero in their response.

Three associations in KEEA District were involved in the survey. The minimum membership of an association in the District was 22 and the maximum was 32 farmers. The associations surveyed had been in existence between two and six years.

In the KEEA District, middlemen are the main channel of marketing. 90% of pineapple produced in this District is sold to middlemen. The price of one pineapple ranges from ¢1,700 to ¢3,000 with an average price of one pineapple being ¢2,300.

All the farmers interviewed (100%) were willing to supply raw materials to the processing plant if one was set up in the District. Almost all the farmers in KEEA District (96%) indicated they were willing to enter into a contract with the processing plant should one be set up. Only one farmer did not answer that question. When asked to indicate their preferred contract, 72% of the farmers wanted to deal with the firm through their associations and seven farmers (28%) were willing to enter into direct negotiation with the firm. Most of the farmers (96%) favored fixed price and volume as the form of contract to enter into. With regard to the period for the contact, there were varying degrees of response. Whereas 50% of the farmers favored a period of at most one month, 36% preferred a period of six months to one year.

(3) Summary of Findings

The following are the major findings of the raw material survey.

1) There is a greater potential for all the farmers surveyed to increase their production capacity, as the majority of the farmers were willing to expand provided there is market for their produce and financial assistance.
2) Almost all the farmers were willing to supply raw materials to a processing firm if one was set up in their District. The least percentage in term of support was 97%.
3) A majority of the farmers (70% to 92%) were interested in entering into a contract to supply the processing factory with raw materials.
4) The most preferred contract was fixed volume and price (63% to 100%) and most of the farmers wanted this agreement to last between six months to one yea.

5) Waste ratio was higher among orange farmers (ranging from 8% to 48%) than pineapple farmers (12% to 17%).
6) The prevailing problems facing farmers are lack of funds, high cost of labor and marketing of produce.
7) The prevailing channel of marketing orange and pineapple among farmers is middleman.
8) The selling price of 100 pieces of oranges ranges from ¢7,200 to ¢30,000, whereas that of one piece of pineapple is between ¢500 and ¢3,000.

3.2.2 Survey on Demand for Orange and Pineapple Juice

(1) Introduction

This aspect of the survey covered three categories of organizations in four cities in Ghana. The organizations covered were Schools, Hotels and Restaurants, and Retail, Wholesale and Supermarkets. The cities covered were Cape Coast, Takoradi, Kumasi and Accra. In all, 22 schools, 34 hotels and restaurants and 82 wholesale, retail and supermarkets were used in the survey. The details are shown in the table below.

(2) Hotels and Restaurants

The summary of the demand survey of hotels and restaurants is shown in Table 3.2-3.

Summary of findings

From the survey the followings conclusions could be drawn:

1) The plastic and glass bottles and plastic gallons were more popular with hotels and restaurants surveyed.
2) Most hotels and restaurants have a preference for orange and pineapple juice in 250-300ml and gallons
3) The majority of the juice sold by the various hotels and restaurants were imported from other countries.
4) Respondents also prefer advertising to be done by the manufacturer or marketing intermediaries.
5) These hotels and restaurants are usually interested in buying on credit basis.

Table 3.2-3 Demand of Hotels and Restaurants

Product		Main juice is imported Domestic juice (few) Self-made juice (9%)
Packaging		Plastic bottle and glass bottle are popular 250-300ml and gallon are available for hotels and restaurants
Quantity a month		Orange juice 250-300ml: 3 to 52 crates (24 bottles per crate) 500ml: 24 boxes (12 packs per box) 1 litter: 1 to 1- boxes (6 packs per box) Gallon: 5 to 500 gallons Pineapple juice 250-300ml: 3 to 375 crates (24 bottles per crate) 500ml: 2 to 23 crates 1 litter: 1 to 23 packs Gallon: 5 to 500 gallons
Pricing	Purchase	Orange juice 250-300ml in a paper box: ¢50,000 to ¢60,000 per crate 250-300ml in a plastic bottle: ¢75,000 to ¢120,000 per crate 1 litter in a paper box: ¢120,000 per pack of 6 1 gallon : ¢40,000 to ¢57,000 Pineapple juice 250-300ml in a paper box: ¢50,000 to ¢60,000 per crate 250-300ml in a plastic bottle: ¢75,000 to ¢192,000 per crate 250-300ml in a glass bottle: ¢72,000 to ¢156,000 per crate 1 litter in a paper box: ¢160,000 to ¢216,000 per pack of 6 1 litter in a glass bottle: ¢160,000 per crate 1 gallon: ¢35,000 to ¢60,000
Pricing	Selling	Orange juice 250-300ml in a paper box: ¢72,000 to ¢120,000 per crate 250-300ml in a plastic bottle: ¢5,000 per a bottle 250-300ml in a glass bottle: ¢120,000 to ¢240,000 per crate 500ml in a paper box: ¢170,000 to ¢240,000 per a pack of 12 500ml in a plastic bottle: ¢48,000 per bottle (?) 500ml in a glass bottle: ¢25,000 per bottle 1 litter in a plastic bottle: ¢40,000 to ¢250,000 per pack of 6 Pineapple juice 250-300ml in a paper box: ¢72,000 to ¢120,000 per crate 250-300ml in a plastic bottle: ¢120,000 to ¢288,000 per crate 250-300ml in a glass bottle: ¢120,000 to ¢288,000 per pack 500ml in a plastic bottle: ¢40,000 to ¢250,000 per a crate 500ml in a glass bottle: ¢240,000 per box 1 litter in a paper box: ¢204,000 to ¢300,000 per pack of 6

(3) Wholesalers, Retailers and Supermarkets

The summary of the demand survey of wholesales, supermarkets and retailers is shown in Table 3.2-4.

Table 3.2-4 Demand of Wholesaler, Supermarkets and Retailers

		Wholesaler	Supermarket	Retailer
Purchase Route		Agent (46%) Factory (31%) Agent & factory (23%)	Agent (68%) Wholesaler (22%) Factory (11%)	Wholesaler (60%) Factory (22%) Agent (18%)
Burden of Transportation Cost		Supplier (85%) Themselves (15%)	Supplier (72%) Themselves (28%)	Supplier (70%) Themselves (30%)
Period for delivery		1 to 4 days (57%) 7 days (29%) 10 days (14%)	1 to 3 days (30%) 7 days (40%) 10 days or more (30%)	1 day (32%) 2 to 14 days (47%) 7 days (18%) 20 days (3%)
Terms of Purchase		Credit (50%) Cash & credit (25%) Cash (25%)	Credit (70%) Cash & credit (6%) Cash (24%)	Credit (50%) Cash & credit (25%) Cash (25%)
Discount		Yes (50%) 2.5-5% No (42%)	Yes (41%) 2.5-5% No (55%)	No (74%)
Quantities a month		Orange juice 250-300ml (10-750crates) 500ml (50 crates) 1 litter (4 to 200 crates)	Orange juice 250-300ml (1,000 crates) 500ml (500 crates) 1 litter (500 crates) 1gallon (10 crates)	Orange juice 250-300ml (360 crates) 500ml (60 crates) 1 litter (250 crates)
Price	Purchase	250-300ml (¢45,000-¢144,000 per 25 packs) 500ml (¢40,000 per 12 packs) 1 litter (¢72,000-¢175,000 per 6 packs)		
	Selling	250-300ml (144,000 per 25 packs) 500ml (¢42,000 per 12 packs) 1 litter (¢192,000 per 6 packs)		
Appropriate packaging		Paper (49%) Plastic (29%) Sachet (11%) Glass bottle (11%)		
New Product Packaging		250-300ml: Sachet or paper (31%), plastic (23%), glass (15%) 500ml: plastic (43%), sachet (29%) 1 litter: Paper (50%), glass (7%)		

Summary of findings

The following are the main findings of the survey

1) Majority of the Wholesalers, Retailers and Supermarkets prefer to obtain their supplies from the manufacturer, wholesalers and agents respectively.
2) The respondents prefer the transportation cost to be borne by the manufacturer.
3) The most prevailing reorder period was found to be between one to four days.
4) Majority of the respondents obtain some sort of credit facilities.
5) Finally, they prefer the new products to be 100% pure juice with less acid, sweetness etc.

(4) Schools

Out of the 22 schools interviewed, only 5 currently use fruit juice in their feeding program. The products are bought either directly from the manufacturer or wholesalers. In exceptional cases, however, some schools bought the products from the open market. The schools also said that transportation cost was either borne by the manufacturer, wholesaler or the buyer.

The schools prefer pure juice, sweeter juice, less acidic juice, clearer juice, juice with a little pulp or mixed fruit. Interestingly, the responses for both pineapple and orange were similar. A majority of the respondents preferred pure juice (22%), juice with less acid (18%), and mixed fruit juice (16%).

Respondents were also asked how they would like to obtain the products. Fifteen respondents, constituting 68.2%, said they would buy from the factory, while six respondents (27.3) said they may buy from wholesalers. Eight (36.4%) of the respondents said they would buy on cash basis, whereas nine (40.9%) said they would buy on credit terms. The credit terms range from three days to three months.

3.2.3 Product and Equipment Specification

In this section, product and equipment specifications are explained. Preconditions which are basis of the factory concept and, the product specification are described. In addition, the production process specifications of building and main machines are presented.

(1) Preconditions for a Module Factory

Prior to design the juice processing plant, it is necessary to clarify preconditions. There are three bottlenecks which need to be overcome to build the plant; financing, marketability of products and possibility of raw material procurement in the lean season. Based on the first bottleneck which is the most critical issue to start up the business, the amount of investment should be minimized as much as possible. However, people may criticize that the scale of the plant can not give the high economic impact on the society. Therefore, this module factory should be expandable easily according to the market demand. It is also important to keep relatively high operation rate to generate the profit. The processing capacity of 1 to 1.5 tons a day (3 to 5 tons of raw materials) may not be large enough to enjoy the scale of economics, however, it may be enough to cover the limited market area. According to the result of the questionnaire survey done by UCC, 3 to 5 tons of raw material supply is feasible. However, with regard to unstable raw material supply especially in the lean season, it is better to have equipments that can be used for both orange and pineapple juice processing. For instance, the squeezer can be used for both orange and pineapple by changing a screw. Other processing equipments can be utilized for both citrus and pineapple processing.

Bottlenecks

1. Financing is one of the most critical bottlenecks to start up business.
2. Marketing large amount of the product may be burden for management.
3. Supply of raw material in the lean season is not stable as to quantity and price.

Preconditions

1. The amount of investment for equipments should be less than 90,000 U.S. dollars.
2. The processing module should be expandable.
3. Processing capacity is 3 to 5 tones of raw material a day.
4. Most of equipments can be used for both orange and pineapple juice processing.

(2) Product Specification

The specification of juice can be determined by the balance of sugar content (Brix) and acidity (pH). For instance, Brix 12 means that it contains 12 percent of sugar, while small pH is high acidy makes sour taste. The team analyzed more than 20 kinds of juice in Ghana to understand this balance. Figure 1-1 shows positioning of existing juice on Brix-pH matrix. It indicates that existing packaged juices position in right quadrants while juices served at hotels position in upper left quadrant. From this result, all samples of packaged juice seem to be

synthetic products. The product to be produced in the factory will be fresh juice. It means that the specification of the product should position in left quadrants of the matrix. However, many samples are most likely lacking of sugar content. For future reference, Japanese orange juice has Brix 9.5 to 10 and pH 3.1 to 3.4 which positions between Ghanaian fresh juices and packaged juices.

This balance of sugar content and acidity of the new product should be determined in consideration of local consumer tastes; after making sample juices with different sugar contents and acidity levels, the entrepreneur should evaluate them with a sensory test. It may be necessary to add sugar in the product when the raw material has low pH (high acidity) during the lean season. Vice versa, if it is too sweet in the peak season, perhaps water should be added to meet the target balance. The important thing is that the quality of the product should be always maintained throughout the year.

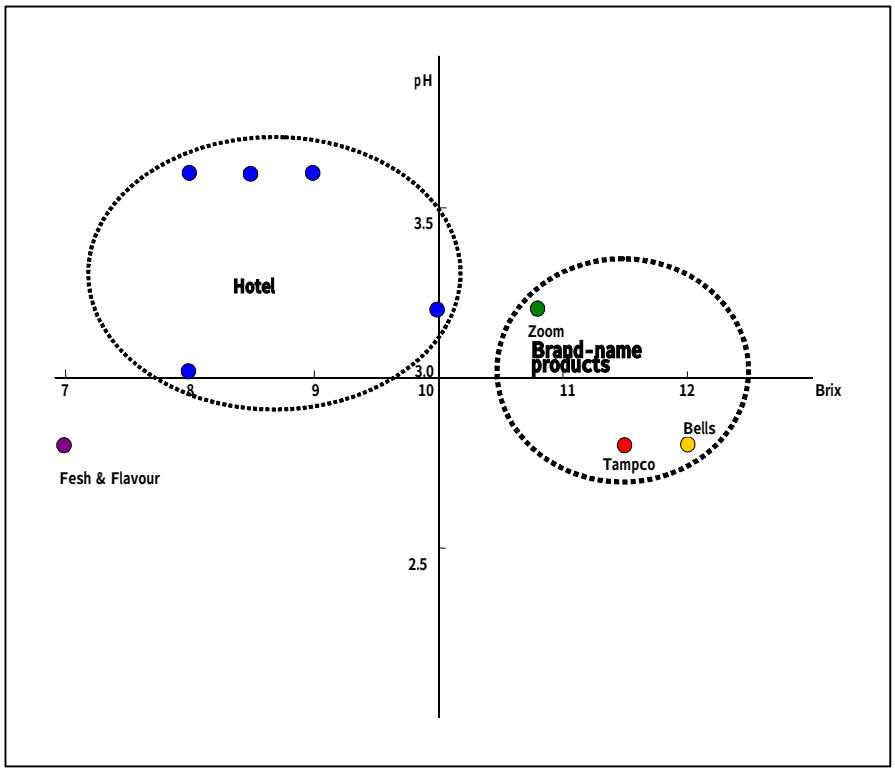


Figure 3.2-1 Positioning of Existing Juice on Matrix by Brix and pH

Regarding packaging material, the factory might use plastic gallon containers for convenience of volume buyers such as hotels and restaurants. On the other hand, plastic sachet seems suitable for main product of the module factory because of following reasons;

- According to the demand survey, the most acceptable quantity of juice to customers is 250 to 300ml. This retail price should be low enough to cater this market. The cost of plastic sachet is not so high that the product can maintain price competitiveness.
- Other ideal packaging such as PET bottle, glass bottle and paper packaging like Tetra Brick style are expensive in term of running cost and equipment investment. In the case of PET bottle and glass bottle, they may cost ¢1,000 and ¢3,000 per bottle. In the case of paper packaging, it may need more than 2 million dollars for equipment. This is beyond the amount which Small and Medium-sized Enterprises (SMEs) can pay. And its minimum capacity is over 100,000 packs per day which SMEs hardly sell in the market.
- Transportation cost of the product corresponds to packaging weight. Compared with other packaging such as glass bottle, PET bottle and paper packaging, sachet is much lighter.
- In the future the factory may consider other packaging. But at the beginning sachet should be adopted with a good surface printed design.

(3) Production Process

a) The processes of the module factory are shown in Figure 3.2-2.
b) The row material does not contact directly with floor and wall. Floor grate is used on floor and wall for getting a good cross-breeze in stack of raw material.
c) This room has several windows avoiding direct sunlight.
d) Washing, peeling and cutting processes are done manually. These processes are the most labor-intensive in the module factory. Washing process is relatively easy to reduce labor using inexpensive semi-washing machine.
e) Finishing process should be installed according to need. If the squeezer can produces clear juice, this process may be omitted.
f) When Brix of raw material is lower than the standard of the product, sugar should be added in juice. This process may be necessary in rainy season.
g) The temperature and time of sterilization may be 80 degree C for 20 minutes. However these conditions should be decided based on the result of trial manufacturing.
h) After temporary storage, juice can be served in two forms; sachet packaging for retailing and plastic containers for hotels and restaurants. In either case, sterilized juice should be filled up at more than 70 degree C.

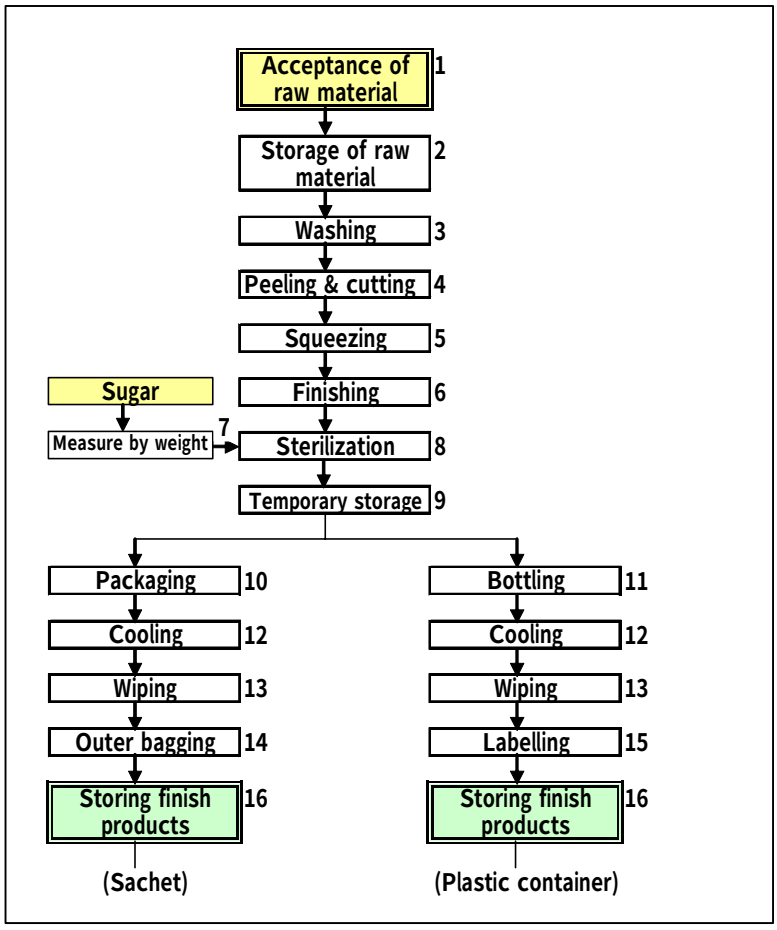


Figure 3.2-2 Process Flow of Orange and Pineapple Juice

(4) Specifications of Building

The module factory has a building with 140 sq m floor. The figure 3.2-3, 3.2-4 and 3.2-5 show the floor plan, the right side elevation and the front elevation of the building respectively. In order to avoid contamination of foreign materials, process starting from peeling to bottling should be conducted in the clean area. For the same reason, these processes are separated from others by wall. In the case of the production capacity expansion, the raw material storage can be built outside the building and peeling and cutting room can be expanded there. Other rooms have enough space to process more than double quantity of materials.

The specifications of machines and equipments are described in Table 3.2-5.

Table 3.2-5 Specifications of Machines and Equipments

Classifi-cation	Item	Q'ty	Specification	Company name
Machine	Squeezer	1	Parts come in contact with fruits made of stainless steel.	Fred-Kwaku Ventures Cottage Industries Italia Ltd.
	Fruit juice finisher	1		Agbemskod Eng.Ltd
	Sterilizer	1	100 litters, with gas burner and stirrer, openable half surface of cap.	Agbemskod Eng.Ltd Cottage Industries Italia Ltd.
	Packaging machine	1	Vertical three sides sealer for sachet, 2,000 packs per hour	Trio Courage Ltd XY-168
	Stainless pump and pipe	1		Agbemskod Eng. Ltd
Equip-ment	Washing tank	1	Two bath with slope conveyer	Agbemskod Eng.Ltd
	Temporary storage tank	1	150 litters	Agbemskod eng.Ltd
	Cooling tank		Two bath	Agbemskod eng.Ltd
	Baskets		For sachet after packaging	Agbemskod eng.Ltd
	Working table 1	1	For manual peeling and slicing of fruit	Agbemskod eng.Ltd
	Working table 2	1	For bottling in plastic containers	
	Working table 3	1	For wiping sachet after cooling in water tank	
	Working table 4	1	For packing sachets into outer package	
	Rack		For storage of finished product	
	Measure 1	1	For acceptance of raw material	
	Measure 2	1	For measuring weight of sugar	

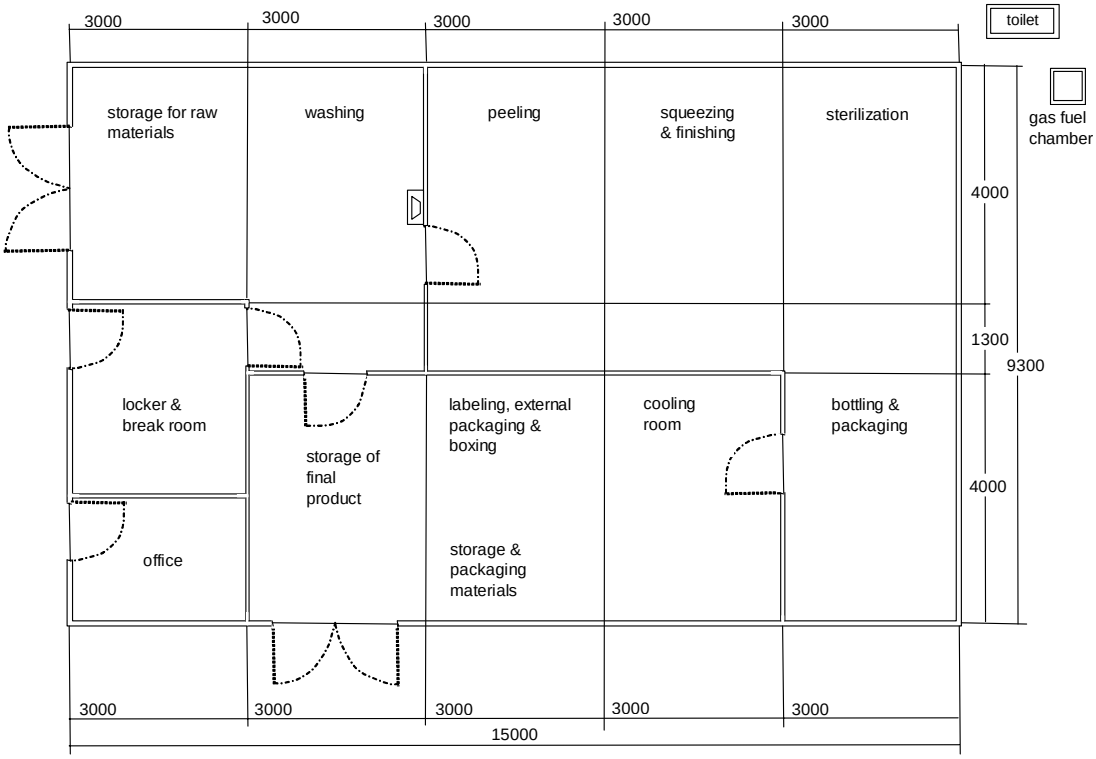


Figure 3.2-3 Floor Plan

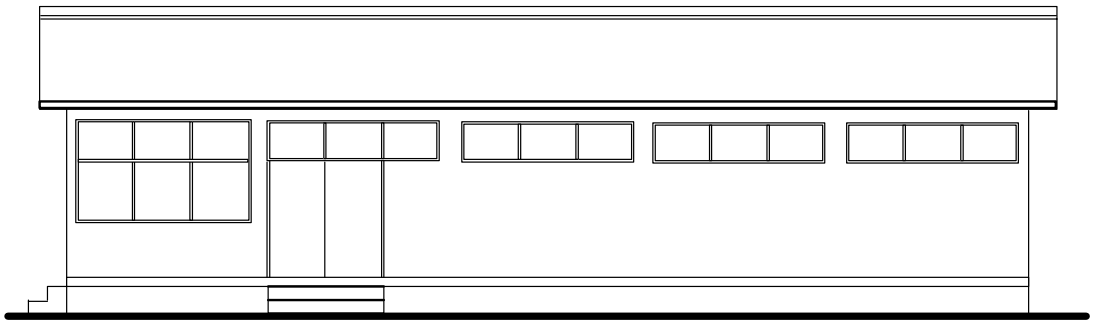


Figure 3.2-4 Right Side Elevation

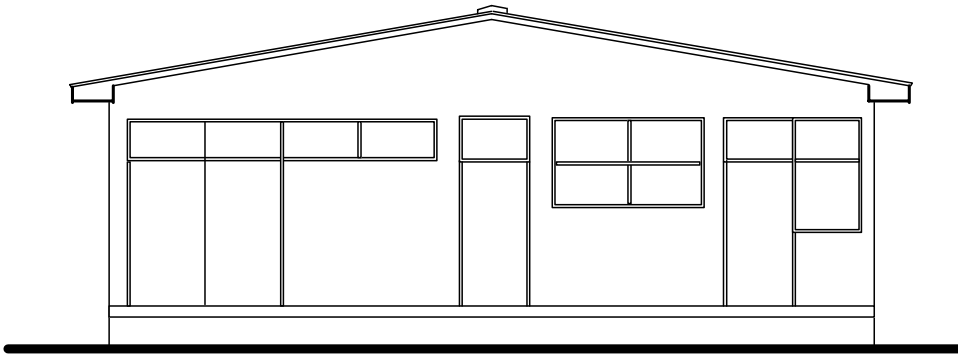


Figure 3.2-5 Front Elevation

3.2.4 Financial Benefit

Revenues of the Project are derived from two sources;

(i) Sales of orange/pineapple juice
(ii) Non-operating revenues such as interest revenue, dividends and gain on sales of securities

However, (ii) is negligible due to the small amount and uncertainness. Accordingly, sales volume of the juice will determine the financial performance of the planned factory. The Study Team simulates in the three patterns of sales in the following conditions unless otherwise specified;

(1) Sales amount

Pattern 1: Sales amount --- 3,000 pcs./day
Pattern 2: Sales amount --- 4,000 pcs./day
Pattern 3: Sales amount --- 5,000 pcs./day

(2) Unit price for 250 ml fresh fruit juice

Selling price to retailers --- ¢2,500 (= $0.27)
Selling price to wholesalers --- ¢2,100 (= $0.23)

(3) Proportion of retail and wholesale quantity

The following five cases shall be examined in each pattern;
Retail sales : Wholesale sales = (100 : 0), (75 : 25), (50 : 50), (25 : 75), (0 : 100)

(4) Working days

5.5 days/week x 4 weeks x 12 months = 264 days

Table 3.2-6 to 8 show the sales forecast of the three patterns.

Table 3.2-6 Sales Forecast (Pattern 1, Sales Volume = 3,000 pcs./day)

(Pattern 1)

(Assumption)

Production Volume: **3,000 pcs./day**

Selling price to retailers: **¢2,500 = $0.27**
Selling price to wholesalers: **¢2,100 = $0.23**

Working Days: 5.5 days x 4 weeks x 12 months = **264 days**

1) R:W = 100:0

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	3,000 (100%)	264	213,840
(Wholesale price)	0.23	0 (0%)	264	0
			Grand Total:	213,840

2) R:W = 75:25

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	2,250 (75%)	264	160,380
(Wholesale price)	0.23	750 (25%)	264	45,540
			Grand Total:	205,920

3) R:W = 50:50

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	1,500 (50%)	264	106,920
(Wholesale price)	0.23	1,500 (50%)	264	91,080
			Grand Total:	198,000

4) R:W = 25:75

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	750 (25%)	264	53,460
(Wholesale price)	0.23	2,250 (75%)	264	136,620
			Grand Total:	190,080

5) R:W = 0:100

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	0 (0%)	264	0
(Wholesale price)	0.23	3,000 (100%)	264	182,160
			Grand Total:	182,160

Table 3.2-7 Sales Forecast (Pattern 2, Sales Volume = 4,000 pcs./day)

(Pattern 2)

(Assumption)

Production Volume: **4,000 pcs./day**

Selling price to retailers: **¢2,500 = $0.27**
Selling price to wholesalers: **¢2,100 = $0.23**

Working Days: 5.5 days x 4 weeks x 12 months = **264 days**

1) R:W = 100:0

Unit Price ($)	Quantity(pcs.)		Working days	Total Annual Sales($)
(Retail Price)	0.27	4,000 (100%)	264	285,120
(Wholesale price)	0.23	0 (0%)	264	0
			Grand Total:	285,120

2) R:W = 75:25

Unit Price ($)	Quantity(pcs.)		Working days	Total Annual Sales($)
(Retail Price)	0.27	3,000 (75%)	264	213,840
(Wholesale price)	0.23	1,000 (25%)	264	60,720
			Grand Total:	274,560

3) R:W = 50:50

Unit Price ($)	Quantity(pcs.)		Working days	Total Annual Sales($)
(Retail Price)	0.27	2,000 (50%)	264	142,560
(Wholesale price)	0.23	2,000 (50%)	264	121,440
			Grand Total:	264,000

4) R:W = 25:75

Unit Price ($)	Quantity(pcs.)		Working days	Total Annual Sales($)
(Retail Price)	0.27	1,000 (25%)	264	71,280
(Wholesale price)	0.23	3,000 (75%)	264	182,160
			Grand Total:	253,440

5) R:W = 0:100

Unit Price ($)	Quantity(pcs.)		Working days	Total Annual Sales($)
(Retail Price)	0.27	0 (0%)	264	0
(Wholesale price)	0.23	4,000 (100%)	264	242,880
			Grand Total:	242,880

Table 3.2-8 Sales Forecast (Pattern 3, Sales Volume = 5,000 pcs./day)

(Pattern 3)

(Assumption)

Production Volume: **5,000 pcs./day**

Selling price to retailers: **¢2,500 = $0.27**
Selling price to wholesalers: **¢2,100 = $0.23**

Working Days: 5.5 days x 4 weeks x 12 months = **264 days**

1) R:W = 100:0

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	5,000 (100%)	264	356,400
(Wholesale price)	0.23	0 (0%)	264	0
			Grand Total:	356,400

2) R:W = 75:25

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	3,750 (75%)	264	267,300
(Wholesale price)	0.23	1,250 (25%)	264	75,900
			Grand Total:	343,200

3) R:W = 50:50

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	2,500 (50%)	264	178,200
(Wholesale price)	0.23	2,500 (50%)	264	151,800
			Grand Total:	330,000

4) R:W = 25:75

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	1,250 (25%)	264	89,100
(Wholesale price)	0.23	3,750 (75%)	264	227,700
			Grand Total:	316,800

5) R:W = 0:100

Unit Price ($)		Quantity(pcs.)	Working days	Total Annual Sales($)
(Retail Price)	0.27	0 (0%)	264	0
(Wholesale price)	0.23	5,000 (100%)	264	303,600
			Grand Total:	303,600

3.2.5 Project Cost

Project cost consisting land acquisition, construction facilities, machines to be installed, vehicle, factory and office equipment, engineering services, registration fees and physical contingency was estimated at the year of 2007.

The total project cost is:
US$ 104, 500 : equivalent to ¢ 961,400,000, as given Table 3.2-9.

Note:

1) As for financing, price contingency (20% of total project cost) shall be added for the future price escalation (inflation).
2) Most of the machineries and equipment listed in the Table are based on ex-factory price and thus the new factory (company) is assumed to pick them up by the pick-up truck described in the Table, classification 4.

Table 3.2-9 Project Cost

Classi-fication	Item	Specification	Q'ty	Unit Price (US$)	Total Amount (US$)	Remarks
1 Land	Land	Close to road, water pipe and electric line and easy to access agricultural community	400m³	$1,000/100m³	$4,000	D.A.
	Land making	Including registration fee	1	$2,000	$2,000	D.A.
2 Building	Building (including electric facilities and	Refer to Fig.3.2-3 ~ 5	140m³	-	$35,865	Architectural & Engi-neering Services Limited
3 Machines	Squeezer	Stainless steel made. Refer to Fig. 1-8 and 9	1	$2,500	$2,500	Cottage Industries Italia Ltd.
	Fruit juice finisher/Press	Screw press s/steel made	1	$400	$400	Fred-Kwaku Ventures
	Sterilizer	100 L, with gas burner and stirrer, openable half surface of cap. Refer to Fig. 1-9.	1	$1,000	$1,000	Fred-Kwaku Ventures
	Packing machine	Vertical three sides sealer for sachet, 2000 packs per hour	1	$6,117	$6,117	Trio Courage Ltd.
	Buffer tank with stirrer	100 L capacity	1	$1,850	$1,850	Fred-Kwaku Ventures
	Stainless pump and pipes	Refer to Fig. 1-9	1	$350	$350	Fred-Kwaku Ventures
	Chain block	100kg capacity, 1.2 to 1.5m	1	$500	$500	Fred-Kwaku Ventures
4 Vehicle	Pick-up truck	1.8 ton	1	$13,000	$13,000	OBI
5 Factory Equipment	Washing tank	Two bath with slope conveyer. Refer to Fig. 1-6	1	$1,400	$1,400	Fred-Kwaku Ventures
	Temporary storage tank	150 L. Refer to Fig. 1-9	1	$900	$900	Fred-Kwaku Ventures
	Cooling tank	Two bath. Refer to Fig. 1-7	1	$2,800	$2,800	Fred-Kwaku Ventures
	Plastic Baskets	For sachet after packaging, refer to Fig. 1-7	1	$500	$500	Fred-Kwaku Ventures
	Working Tables	For 1) manual peeling and slicing of fruit 2) squeezer 3) wiping sachet after cooling in water tank	4	$300	$1,200	Fred-Kwaku Ventures
	Steel Shelf	For storage of products	2	$1,200	$2,400	Fred-Kwaku Ventures
	Measurer 1	For acceptance of raw materials (max. 100kg)	1	$500	$500	Fred-Kwaku Ventures
	Measurer 2	For measuring weight of sugar (max. 20kg)	1	$300	$300	Fred-Kwaku Ventures
	Retractometer	Brix meter	1	$760	$760	Fred-Kwaku Ventures
	Plastic Backet	with handle, 70 L	4	$30	$120	OBI
	Generator	25KVA	1	$12,000	$12,000	OBI
	Gas cylinder	Large size (15 kg)	5	$50	$250	Fred-Kwaku Ventures
6 Office Equipment	Desk	-	4	$100	$400	OBI
	Chair	-	4	$50	$200	OBI
	Telephone	(Including connection fee)	1	$30	$30	OBI
	Fax machine	-	1	$400	$400	OBI
	Bookshelf	with key	1	$200	$200	OBI
	PC	-	1	$1,000	$1,000	OBI
	Printer	-	1	$300	$300	OBI
	Refrigerator	100 L capacity	1	$500	$500	Fred-Kwaku Ventures
7 Engineering Services	Detailed design (2 includes DD cost)		1	$0	$0	5.0% of sum of 2
	Construction Supervisor		1	$1,076	$1,076	3.0% of sum of 2
8 Registration Fee	Food & Drug Board		1	$400	$400	OBI
	Ghana Standard Board		1	$200	$200	OBI
	Registrar general department		1	$200	$200	OBI
(A) Base Cost					**$95,618**	
(B) Physical Contingency : 10% of (A) excluding 1 and 8)					**$8,882**	
(C) Project Cost : (A) + (B)					**$104,500**	
(D) Price Contingency : 20% of (C)					**$20,900**	
(E) Total Financing Required : (C) + (D)					**$125,400**	

3.2.6 Running Costs

In addition to the above project cost, the following running (O&M) costs shall be imperative to manage the juice factory throughout the year. In principle, the factory is supposed to be operated 5.5days in a week, and consequently 264 days in a year (5.5 days x 4 weeks x 12 months) unless otherwise indicated.

(1) Consumable Goods Expenses

Consumable goods expenses for a year are indicated in Table 3.2-10. These items are supposed to be purchased or paid same amount yearly except first year.

Table 3.2-10 Consumable Goods Expenses

Classi-fication	Item	Specification	Q'ty	Unit Price (US$)	Total Amount (US$)	Remarks
Consumable supplies	Sanitary gown	For hygienic work	70	$10	$700	OBI
	Head wear	For hygienic work	70	$5	$350	OBI
	Towel	For hygienic work	70	$2	$140	OBI
	Gloves	For cutting and	70	$5	$350	OBI
	Stainless Steel knife	For cutting fruit	2	$50	$100	Fred-Kwaku Ventures
Stationery	Invoice	Customised printing	10	$10	$100	OBI
	Receipt	Customised printing	10	$10	$100	OBI
	Paper		10	$4	$40	UCC
	Others	Pen, pencil, stapler, clip, stamps, ink,	1	$150	$150	OBI
Others	Gasoline	60 L / week x 4 weeks x 12 month x $1/L	1	$2,880	$2,880	-
	Renewal	licence, utilities…etc.	1	$150	$150	-
Grand Total					**$5,060**	

(2) Labor Costs

As indicated in Table 3.2-10, the number of workers in the factory will be 21: 11 full time employees and 10 part-time employees. In addition to that, four administrative employees would be engaged: managing director, procurement/marketing manager, production/quality assurance manager and an office administrator. Also three supporting staffs would be employed for the factory: housekeeper, guardian and driver.

Salaries of each position are shown in Table 3.2-10. Social Security Fund (SSF) and other allowance are calculated at 12.5% and 10% of the monthly salary respectively.

Table 3.2-11 Labor Costs

Unit = US$

Positions	Number	Unit Monthly Salary	Sub-Total	SSF (12.5%)	Other Allowance (10%)	Total Amount (Monthly Salary)	Total Amount (Yearly Salary)
	(a)	(b)	(c) = (a) x (b)	(d) = (c) x 12.5%	(e) = (c) x 10%	(f) = (d) + (e)	(g) = (f) x 12
1) Administration							
Managing Director	1	761	761	95	76	932	11,185
Procurement/Marketing	1	543	543	68	54	666	7,989
Production/Quality Assuran	1	543	543	68	54	666	7,989
Office Administrator	1	326	326	41	33	399	4,793
2) Factory							
factory workers (Full Time)	11	109	1,196	149	120	1,465	17,576
factory workers (Part Time)	10	54	543	68	54	666	7,989
Housekeeper	1	87	87	11	9	107	1,278
Guardian	1	87	87	11	9	107	1,278
Driver	1	87	87	11	9	107	1,278
Grand Total	**28**	**2,598**	**4,174**	**522**	**417**	**5,113**	**61,357**

(3) Material Costs

Material cost consist of orange, sugar, plastic roll for unit package (sachet) and outer packaging for packing the sachets.

The purchase price of orange shall be adopted as one of the material costs. As indicated in Table 3.2-12, there is a considerable disparity in the selling prices of pineapple in the two Districts, resulting in an uncertainty in deciding on the estimated material cost. On the other hand, as shown in Table 1-3, the selling prices of orange (100 pieces) are relatively reliable and average price of orange is slightly higher than that of pineapple.

Calculation of the material costs shall be based on the following assumptions;

1) Orange
- Price of orange (100 pcs.) = ¢18,000 (=$1.96)
- Extraction ratio (% of juice extracted per orange) = 25%
- One package (sachet) of orange = 250 ml.

2) Sugar
- During the low season (Mar. to Sep.), sugar content of orange is dropped, then sugar will be added to keep the targeted sugar content
- 10 kg of sugar will be required for 1ton of juice
- 1kg of sugar = ¢6,000 (=$0.65)

3) Plastic roll
- 1 roll can produce 9,000 sachets
- 1 roll = ¢496,000 (=$54)

4) Outer packaging
- 1 roll consists of 100 bags, and a bag can contain 50 sachets
- 1 roll = ¢45,000 (=$4.9)

Table 3.2-12 to 14 show annual material costs in the three patterns.

Table 3.2-12 Material Costs (Pattern 1, Sales Volume = 3,000 pcs./day)

Unit = $

Item	(High Season)		(Low Season)							(High Season)			Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Orange	6,968	6,968	6,968	6,968	6,968	6,968	6,968	6,968	6,968	6,968	6,968	6,968	**83,616**
Sugar	0	0	107	107	107	107	107	107	107	0	0	0	**749**
Plastic roll	405	405	405	405	405	405	405	405	405	405	405	405	**4,860**
Outer packagin	65	65	65	65	65	65	65	65	65	65	65	65	**776**
										Total Amount			**90,001**

Table 3.2-13 Material Costs (Pattern 2, Sales Volume = 4,000 pcs./day)

Unit = $

Item	(High Season)		(Low Season)							(High Season)			Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Orange	8,624	8,624	8,624	8,624	8,624	8,624	8,624	8,624	8,624	8,624	8,624	8,624	**103,488**
Sugar	0	0	143	143	143	143	143	143	143	0	0	0	**1,001**
Plastic roll	529	529	529	529	529	529	529	529	529	529	529	529	**6,348**
Outer packagin	86	86	86	86	86	86	86	86	86	86	86	86	**1,035**
										Total Amount			**111,872**

Table 3.2-14 Material Costs (Pattern 3, Sales Volume = 5,000 pcs./day)

Unit = $

Item	(High Season)		(Low Season)							(High Season)			Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Orange	10,780	10,780	10,780	10,780	10,780	10,780	10,780	10,780	10,780	10,780	10,780	10,780	**129,360**
Sugar	0	0	179	179	179	179	179	179	179	0	0	0	**1,253**
Plastic roll	664	664	664	664	664	664	664	664	664	664	664	664	**7,968**
Outer packagin	107	107	107	107	107	107	107	107	107	107	107	107	**1,284**
										Total Amount			**139,865**

(4) Production Expenses

Utilities such as electricity, gas and water are considered as main production expenses. As shown in Table 3.2-15, necessary quantities of the utilities are estimated as below:

1) Electricity : 20 KWH/day
2) Gas : LPG 6m³ (144,000 Kcal)/day
3) Water : 6m³/day

Depreciation is excluded from the financial analysis since the financial analysis is based on the principle of cash-accounting. It is, however, included in the financial statements.

Table 3.2-15 Production Costs

Unit = $

Item	Unit Price	Q'ty/day	Total Cost (Daily)	Total Cost (Yearly)
Electricity	0.12 ($/KWH)	20.0 (KWH)	2.4	633.6
Gas	5.40 ($/m³)	6.0 (m³)	32.4	8,553.6
Water	0.65 ($/m³)	6.0 (m³)	3.9	1,029.6
	Grand Total		**38.7**	**10,216.8**

In addition to the monthly charges, connection fees, including installation and registration fees, are applicable to the first year only. These are;

Electricity : ¢15,000,000 (=$1,630)
Water : ¢3,000,000 (=$326)

(5) Other necessary Expenses

(i) Taxes:
Local government levy (¢350,000=$38) and corporate tax (25% on the net profit) shall be deducted from the sales amount.

(ii) Other O&M costs
- Sales administration expenses such as traveling, communication and advertising expenses are earmarked at 4% of total sales amount.
- Maintenance fee for all the equipment and machines in the factory are also calculated 1% of total sales amount..

3.2.7 Financial Analysis

The financial analysis of the Project was carried out by means of analysis using the Financial Internal Rate of Return (FIRR) and Net Present Value (NPV) methods. The calculation of the FIRR and NPV are based on the projected income and expenditure statement indicated in Table 3.2-16. Assumptions used for the statement and calculation method of FIRR and NPV are given below.

(1) Projected Income and Expenditure Assumption

(a) General

- Project life is seven years.

(b) Income

- Income is generated from the sale of fresh orange/pineapple juice only, and the sales volume per day in the first and second year is assumed to be 3,000 pieces and will increase by 4,000 pieces in the third and fourth year, and finally it will reach 5,000 pieces, which is maximum production volume, in the fifth year and onwards.
- For the first year, since the construction period is estimated at three months, the annual turnover is therefore calculated based on the sales amount of 3 month.

(c) Expenditure

- The same as the calculation of the projected income, material cost shall also be increased in proportion to the volume of the estimated annual consumption.
- For the first year, due to the construction period, the total costs of the following expenses are exceptionally estimated as below;
  - Material costs – for 3.5 months
  - Labor costs – for 4.0 months
- For calculation purposes, all running costs except material costs shall remain same during the project life. This is based on the assumption that productivity of the factory would be gradually improved and full capability could be achieved in the fifth year.

Note that inflation rate or price contingency shall not be considered for the income and expenditure statement to avoid arbitrariness.

Table 3.2-16 FIRR and NPV

#	Year	Total Cost (US$)			[D] Net Profit (US$) / AfterTax	[E] Benefit - Cost (US$) =[D] - [C]	[F] Net Present Value (US$) =[E] / (1+OCC)$^{t-1}$
		[A] Investment Cost	[B] O & M Cost	[C] Total =[A] + [B]			
1	2009	104,500	57,679	162,179	51,442	-110,737	-110,737
2	2010	0	170,930	170,930	205,882	34,952	30,261
3	2011	0	202,233	202,233	274,522	72,289	54,188
4	2012	0	202,233	202,233	274,522	72,289	46,916
5	2013	0	233,658	233,658	343,162	109,504	61,532
6	2014	0	233,658	233,658	333,307	99,648	48,480
7	2015	0	233,658	233,658	333,307	99,648	41,974
		104,500	**1,334,051**	**1,438,551**	**1,816,143**	**377,592**	**172,614**
						FIRR =	**54.3%**

As shown in Table 3.2-16, NPV is US$ 172,614 at the discount rate of 15.5%, which is taken as the typical interest rate of the Treasury bill.

(2) FIRR Analysis

Subsequently, the FIRR will be compared with the opportunity cost of capital (OCC). The risk-free interest rate, namely that of Treasury bills or public bonds, is generally used as the OCC. According to the Bank of Ghana (BOG), the interest rate (as of June 2007) of the Treasury bill is constituted 15.5%, hence, in this Study, 15.5% shall be regarded as the OCC.

As a result of the financial analysis, the FIRR for the planned project is 54.3% which exceeds the OCC 15.5%. Thus the construction of the new fruit juice factory can be financially feasible under the designated condition in the Study Report.

Furthermore, sensitivity analysis was also conducted to check the four types of project risk to the financial feasibility of the project. The result of the calculation is shown in Table 2-12. As the result indicates, in most cases, except the case of investment cost, the FIRR is less than the OCC, which means at least O&M cost and income should be kept up the designated level in Table 2-11.

Table 3.2-17 Sensitive Analysis

	FIRR
OCC	15.5%
FIRR	54.3%
(A) Investment Cost +10%	46.9%
(B) O&M Cost +10%	35.7%
(C) Investment / O&M Cost +10%	32.3%
(D) Income -10%	31.6%

3.2.8 Company Overview

(1) Factory Location

The business is to be located close to easy access to citrus and/or pineapple growing villages in the Central Region of Ghana. The location should be close to a major road network to make it easily accessible and to facilitate easy movement of finished products to market centers. The project site would have access to regular portable water and electricity. There will also be a 25KVA standby generator at the factory since constant flow of power from the Electricity of Company of Ghana (ECG) cannot be guaranteed.

Four hundred square meter (400 m^2) - land would be legally acquired with the support of the District Assembly and duly registered with the Land Commission. A factory building of about 140 sq m would be constructed and furnished. The fig.4, 5 and 6 show floor plan, right side elevation and front elevation of the building. The building is designed such that it can easily be expanded to accommodate higher production volume in the future.

The factory would be built to meet all Food Sanitary and Safety Standards of the Ghana Standards Board (GSB), The Food and Drugs Board (FDB) and the Environmental Protection Agency (EPA).

(2) Project Concept

The Ghana News Agency reported in August 2004 that 60 percent of the oranges harvested in the lush groves of Ghana's Cape Coast region go rotten due to a lack of market. This situation is depriving local smallholders of essential income and forcing young people to migrate to urban areas in search of basic employment.

This project involves the setting up of small scale citrus and pineapple processing factories to produce fresh juice packaged in sachets. The project would later target restaurants and other institutions with its products delivered in plastic gallons.

A substantial impact of the project will be the development of a more consistent buyer for local orange and pineapple out-growers, the vast majority are women. More than 2,000 local farmers will work with the Project as suppliers.

(3) Key Objectives

The followings are key objectives to be pursued;

- To contribute to rural industrialization through small scale cottage industries.
- To deliver higher incomes to citrus and pineapple farmers, offering them ready market for their produce
- To make a good return on the investments of shareholders
- To contribute to national goals of wealth creation.
- To produce a healthy alternative to carbonated soft drinks which has negative attributes on the nation's health and economy.

(4) Critical Success Factors

The following issues have been identified as critical to the successful operation of the business: these are performance requirements necessary for the achievement of project objectives.

a. An efficient production capacity to ensure regular production at all times in the year whiles at the same time attaining economies of scale.
b. Well cultivated relationship with farmers and farmer groups to ensure regular supply of raw materials throughout the year
c. Economical but suitable and attractive packaging targeting the low-end segment of the market where latent demand has not been met by juices and beverages on the market.
d. Consistent quality of products, adherence to strict sanitary and safety standards and complying with national regulatory requirements.
e. Efficient distribution system, providing adequate incentive for distributors and retailers to opt for the product.
f. Targeted promotion in the appropriate media stressing on the health attributes of fruit juice.
g. The adoption of a competitive pricing policy for its products which should also communicate the appropriate image for the product.

3.2.9 Project Milestones

Project schedule is proposed as follows. Construction period is estimated as three months, and “Order of equipment and installation”, “recruitment of staff and training” and “trial production” are assumed to carry out in the construction period.

Table 3.2-18 Project Schedule

Activity	Commencement and duration of activities (in months)											
	1	2	3	4	5	6	7	8	9	10	11	12
Securing Investors funding												
Securing of land												
Building of factory												
Order of Equipment and Installation												
Recruitment of staff and Training												
Trial Production												
Commencement of Production												

3.2.10 Marketing Strategies

The main strength for this project would be the health attributes of its products and its cost effective but attractive packaging material. The thrust of the marketing strategy will be built on the use of small scale state-of-the-art equipment for the production of premium quality juice to outclass the products on the market at a more affordable price. The project plans to adopt attractive sachet packaging which will be easier and more cost effective to handle than the glass bottles used for the carbonated and other fruit juices or the Tetra Packs.

An efficient distribution system will be developed relying on forging personal relationships/contacts with existing and potential wholesalers and retailers. The project would also thrive on the support and clout of the District and/or Municipal assembly in penetrating through existing distribution channels and in winning the patronage of major governmental institutions such as schools.

The company will use local media especially the local community radio stations to highlight the advantages of natural fruit juices over carbonated drinks.

(1) Product and Packaging Strategy

In the short term, the company would concentrate on producing pure fruit Juice (pineapple and/or orange) in attractive and handy sachet. In the medium term, it would also supply to institutions such as schools, hotels/restaurants, hospitals etc in gallons and barrels.

In the long term, the Project will venture into producing fruit juice concentrates for other participants in the industry and for the export market.

(2) Distribution Strategy

In the short term, the project would sell mainly (75%) to retailers including schools canteens, shops, supermarkets, filling station stores, convenience stores, workers' canteens and through recruited hawkers. The remaining 25% would be through main distributors (or wholesalers) in major market centers of cities. The competitive margin for distributors (more than 13% of final sales price to consumers) is expected to encourage more distributors to agree to sell the products.

In the medium term, the proposed company would rely on the clout and goodwill of the District and/or Municipal assembly to supply the products in gallons directly to government institutions including schools, hospitals and other departments and agencies. The project would also develop linkages with local hotels, restaurants and other such hospitality facilities.

(3) Pricing Strategy

Due to its entrant status, the product's entry ex-factory prices have been fixed at ¢2,500 (=$0.27) for retailers and ¢2,100 (=$0.23) for distributors or wholesalers. Consumer price, therefore, is expected around ¢3,000 (=$0.32). This price is low enough to make it competitive and high enough as not to be regarded as one of those 'color and sugar drinks'. The pricing is strategic for the product to gain a unique recognition on the market as the first ever 100% pure juice in a sachet.

(4) Sales Target

With aggressive marketing and effective distribution system in place, the project is optimistic of achieving the following sales forecast.

Table 3.2-19 Summary of Sales Forecast (for Five Years)

(Unit =$)

Channel of Distribution	Year 1	Year 2	Year 3	Year 4	Year 5
Retailers	38,610	154,440	205,920	205,920	257,400
Wholesalers	12,870	51,480	68,640	68,640	85,800
Total Sales	**51,480**	**205,920**	**274,560**	**274,560**	**343,200**

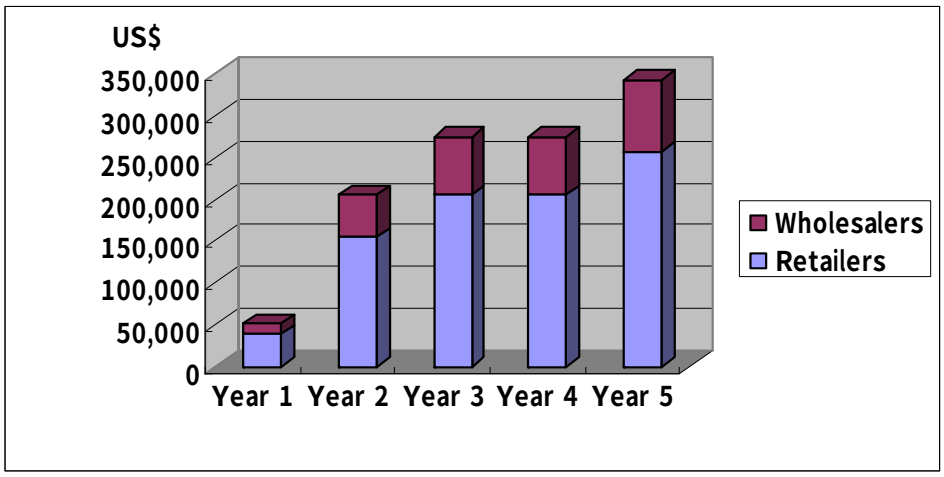


Figure 3.2-6 Summary of Sales Forecast (for Five Years)

3.2.11 Summary of the Trial Program

Major achievements and results are summarized as follows.

- Implementation of Local material survey (25 associations, 99 farmers in 5 districts) (4th to 5th field survey)
- Implementation of demand survey for pure fruits juice (82 distributors, 34 restaurants & hotels, 22 schools) (4th to 5th field survey)
- Setting the product specification and production capacity (4th to 5th field survey)
- Determining production facilities and the factory layout (5th field survey)
- Calculation of costs of construction and operation (5th to 6th field survey)
- Execution of Financial feasibility study (6th field survey)

3.3 Ex-post Evaluation of the Trial Program in the Central Region

3.3.1 Verification of the implementation status and conditions

(1) Verification of implementation results

Inputs have been made generally according to the plan, without a significant problem. In particular, input of the study team in the sixth field survey was reinforced (i.e., addition of team members) to allow the feasibility study to be completed according to the original schedule. Thus, outputs have also been produced according to the plan.

The project purpose was set for promotion of investment in the citrus fruit processing industry by publishing the feasibility study report. As the program was materialized, it was able to attract DA's attention and several potential investors expressed interest. Nevertheless, it takes some more time to attract investment actually. It is therefore very difficult to expect investment decisions during the program period.

The overall goal is to reduce risk relating to new investment. In this respect, the feasibility study has helped reduce investment risk to some degree. To reduce the risk further and attract investors, more vigorous initiatives, such as promotional activities and investment incentives, seem to be called for.

(2) Verification of the implementation process

Program activities have been carried out mostly as scheduled. They were roughly conducted in the following sequence. The program was devoted to the feasibility study and

the Ghanaian counterpart had some expertise and experience. Technology transfer (transfer of knowledge and expertise) was thus conducted in the areas of marketing and raw materials as feasibility study was conducted in close communication and consultation with UCC.

The counterpart has involved in the program with fairly high levels of commitment and understanding. It has actively participated in the program activities, including the provision of relevant information and support for information gathering. Also, DA has experienced the rise in interest in the course of program implementation, although it has not made actual participation.

Program activities have been conducted smoothly without any significant obstacle, except for minor troubles relating to some delays in availability of necessary information.

3.3.2 Five evaluation criteria

(1) Relevance

Relevance of the program is considered to be high from the following viewpoints. The trial program was designed on the basis of participatory type program analysis and its content was approved by related parties at the seminar held prior to the start of the program, where majority of participants agreed with the content presented in the questionnaire.

In the Central Region, cultivation of citrus fruits is a key industry. It faces problems due to sharp price declines during the peak season and the difficulty in expanding the market. Thus, construction of processing plants is very important for producers to establish a reliable customer base, whereas new investment is difficult to attract and existing plants have various difficulties. Under these circumstances, active investment promotion by specifying related risks meets the needs of the target group.

The Ghanaian government has policy to foster and promote local industries that create employment opportunities from the viewpoint of poverty reduction. In this connection, MOTI/PSD/PSI implements District Industrial Programme (DIP) focusing on industrial promotion at district level, which contains a scheme similar to the trial program. However, because the feasibility study conducted under DIP failed to provide information required for investment decision, together with problems relating to the scale of investment, DIP was not attractive enough for investors. On the other hand, the program intends to provide detailed

information for potential investors for the purpose of minimizing investment risks, which agrees with MOTI/PSD/PSI's policy direction.

Japan's ODA policy for Ghana sets priority to "revitalization of rural areas," "fostering of industries leveraging potential" and "improvement of the public administration system." The program is highly relevant in that it aims to revitalize local communities and foster industries using agricultural resources.

Our analysis identified "the shortage of processing plants" as a core issue and the following four causes: SMEs do not have adequate (processing) technology; they do not have information required for business startup; entrepreneurs do not have financial access to raise funds required for initial investment;" and "SMEs are exposed to competitive pressure from imports." The feasibility study primarily addresses the second cause by providing sufficient information, while indirectly dealing with the other three problems by examining adequate technology, funding, and target market. In this sense, the trial program is considered to be an appropriate measure to address the issues effectively.

The primary target group for the program consists of potential investors, fruit producers, and DA. From 13 districts in the Central Region, 5 districts were selected according to the following criteria: 1) an area where orange or pineapple is produced; 2) an area where there is no juice processing plant; and 3) an area where DA aggressively attracts a juice processing plant. In particular, Cape Coast, Assin North, and Ajumako were selected as being suitable for the orange juice plant, and Mfanshiwan and K-E-E-A for the pineapple juice plant. These districts are known for large fruit production that exceeds demand, and selection of producers and DA in these areas as the direct target group is considered to be appropriate. As for potential investors, which are not many in the Central Region, Greater Accra was also included as there were 34 juice processing plants (mostly producing pineapple juice). Expanding the target for potential investors from Central to Greater Accra has added public value to the program.

The study team members have rich experience in juice production projects, which works effectively for implementation of the program.

(2) Effectiveness

From the following reasons, this program is considered to be highly effective.

- The project purpose is highly likely achieved.

- Outputs include the provision of information relating to raw material supply and market, and adequate technology and equipment available in the local area, and the financial plan.
- Production equipment that is local available or field proven in Ghana was selected, regardless of country of origin.
- As the project plan was developed and revealed, stakeholders expressed increasing interest. In particular, DA/MA expressed a high level of commitment.
- Other extraneous conditions include power outage and the rise in fuel price, as the former increases the program cost due to the necessity for purchase of power generation equipment and the latter leads to a higher operation cost. They may have an adverse effect on investment decision.
- Impeding factors at present are roughly classified into the following: 1) production of raw material; 2) quality of raw material; and 3) inflow of foreign products. First of all, Mediterranean fruit fly becomes pervasive in the orange producing area. Quality problems are two-fold. Firstly, skin of orange produced in Ghana is thicker than in other countries, decreasing juice yield by 10%. Secondly, the sugar level of orange declines in the rainy season. The increase in foreign products makes many people feel skeptic about sales of locally produced juice.

(3) Efficiency

For the following reasons, efficiency of this program is very high.

- The results have been produced mostly as planned, and the activities that led to the results seem to have been carried out effectively.
- Due to inflation, costs for the feasibility study had to be adjusted upward.
- Major portions of the survey cost were spent for raw material and market surveys, because they constituted important information which would form the basis of feasibility study and was not obtained in previous feasibility studies.
- Originally, the study team planned to entrust compilation of feasibility study to Cape Coast University. For cost saving purpose, however, the plan was abandoned and the feasibility study was compiled by the study team and the local coordinator.
- Also, machinery design and cost estimation was entrusted to GRATIS on a fee basis. As the study team learned that more accurate information could be obtained from private companies with free of charge, however, cost estimation was switched to them.

(4) Impact

Upon completion of the program, it was not known if the overall goal would be achieved as effect of the program, because actual investment as a result of program implementation did not necessarily mean significant reduction of overall investment risks or inducement of other investment projects. To accomplish the overall goal, continuous investment promotion policies and programs of the Ghanaian government (both central and local) are essential. The trial program does not automatically increase investment.

Once the overall goal is achieved, it will serve as a model for promotion of local/rural industries and will create positive impacts on the country's development planning as a whole.

While the overall goal is not substantially deviated from the project purpose, if the Ghanaian government believes that a successful case naturally spreads to other districts, it may end up as a single success. To ensure the accomplishment of the overall goal, the government needs to create and maintain a mechanism to promote dissemination of a success story to the rest of the country.

The indirect effect realized at this stage is that effectiveness of industry-academics cooperation has clearly been recognized. To maintain the cooperative relationship on a sustainable basis, however, a relationship of mutual trust must be established between the two parties. Meanwhile, construction of a new juice processing plant will likely create demand for improvement of fruit quality, which will prompt farms to make additional efforts, together with the need for technology transfer.

(5) Sustainability

The intended effect of the program after completion of the present project is to induce new investment projects in the Central Region by using the methodology adopted for the trial program. A major impeding factor is the lack of organizational capacity to promote investment at district level. For this purpose, it is important to reinforce the organization and resources. In this connection, GIPC, the investment organization, is stepping up efforts to induce investment in rural areas. This is expected to help build up institutional and organizational capacity to promote investment at local level.

In the feasibility study process, the Ghanaian counterpart has weakness in selection and design of adequate equipment. In particular, capacity shortage seems apparent at district

level. To address the situation, the program proposes minimum-required equipment in terms of economy, which is applicable to other regions.

In social context, it is important to raise awareness of farmers who supply juice. The program was designed under the assumption that farmers make full participation and their intent was confirmed in advance by means of questionnaire survey and workshop. Nevertheless, there is a risk that raw materials are not supplied in accordance with the contract, which will adversely affect the project's feasibility and subsequent investment decisions and projects.

This program alone cannot increase fruit-related investment projects in the Central Region significantly, for the following reasons: 1) the lack of experience by local government; 2) insufficient organizational capacity to promote investment in rural regions; and 3) the shortage of business infrastructure in comparison to the capital region. This study proposes action plans to support continuous investment activities, which can be used as reference.

3.3.3 Conclusion, recommendations, and lessons learned

(1) Conclusion

- This program has been implemented as planned and has achieved its purpose to some degree.
- There has been no significant problem in the implementation process and the program is considered to be highly relevant. Reactions in local communities and Greater Accra suggest that new investment will likely be made to construct juice processing plants.
- Effectiveness is assured in that a new juice plant will bring direct benefits to farmers.
- Potential problems lie in the areas of impact and sustainability, which may make the program short-lived. To ensure the accomplishment of the overall goal, the government needs to make investment promotion efforts on the basis of knowledge and experience learned from the program.

(2) Recommendations

- A viable plant model that can be started with relatively small funds (locally raised) should be promoted.

- Presentation meetings should be held not only in the target area but also in areas where there are a large number of potential investors and entrepreneurs to promote startup.
- Organizational capacity should be built up to promote investment at district and regional levels.

(3) Lessons learned

- Although the program has been completed according to the schedule, actual investment will take some more time, possibly in the long process.
- New investment is essential in development of local industries, but support for existing industries can be easily focused because issues are clearly identified.
- It takes considerable time and effort to obtain valid information. Information access should therefore be incorporated into a permanent mechanism to promote investment and industry development.
- Notably, it was very difficult to obtain information on machinery and equipment required for factory operation, as well as packaging materials. A few potential investors who want to start the juice plant are facing similar problems, suggesting the need for publicizing supplier information under the control of a responsible government organization (such as GIPC), covering a broad range of industries including juice processing.

4. The Trial Program for the Shea Butter Industry in the Northern Region

4. The Trial Program for the Shea Butter Industry in the Northern Region

4.1 Establishment of the Trial Program

4.1.1 Problem Analysis and Formulation of the Draft Master Plan

(1) Core Problem and direct causes

At the workshop conducted on 3 June 2006, the core problems and their causes were identified. They were compiled into a problem tree shown in Fig.4.1-1.

Core Problem: It is difficult to increase sales

The direct causes identified were classified into the following factors.

1) Processors do not have enough business management technique.
2) It is difficult to access buyers' information.
3) Shea nuts are not available in large quantities.
4) Shea butter quality is poor.
5) Product development is poor.

(2) Formulation of the draft master plan

Based on the problem tree, the Team formulated a draft master plan (Fig.4.1-2).

The primary objective of this draft master plan is to augment sales. Shea butter is an important income source for the target group (mainly women), who spends some portions of their income for purchase of necessities and school suppliers. Thus, for the target group who does not have other stable income source, the increase in shea butter sales leads to the improvement of their standard of living. In the questionnaire survey, sales price and the securing of customers are cited as problems common to the target groups. Thus, the increase in sales is an area of strong interest for them.

To achieve the objective, the following five strategies were established.

Strategy 1: Upgrading business management skill
Strategy 2: Sharing market information
Strategy 3: Increase availability of nuts
Strategy 4: Shea butter quality improvement
Strategy 5: Product development initiative

Under this strategy, fifteen programs are proposed based on problem analysis and SWOT analysis (Table 4.1-1). A higher percentage of this target group receives support from Development Partners and NGOs than other target groups. The trial program selected focuses on the ease of linkage with other support organizations as far as possible.

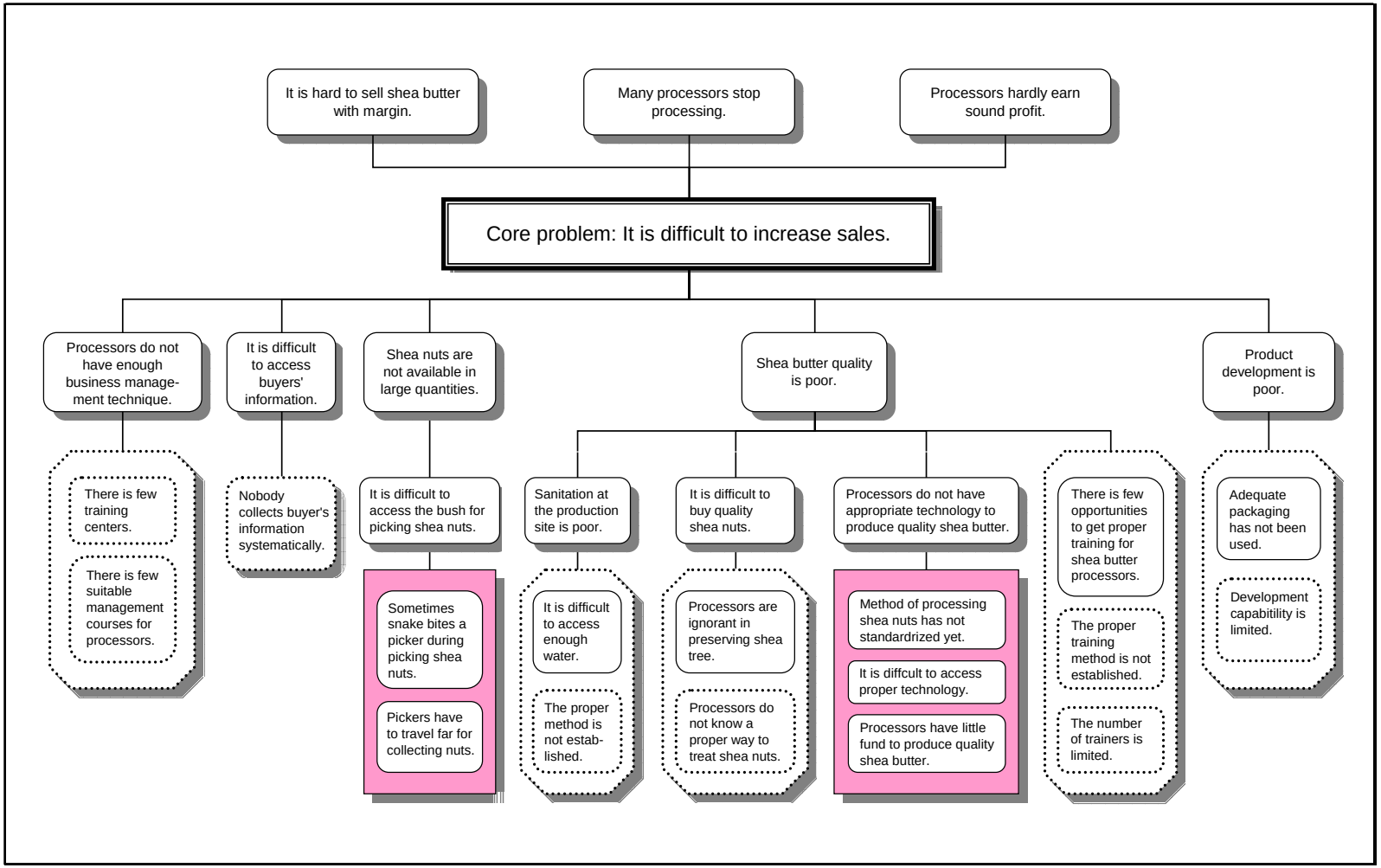


Figure 4.1-1 Problem Tree of the Shea Butter Processing in the Northern Region

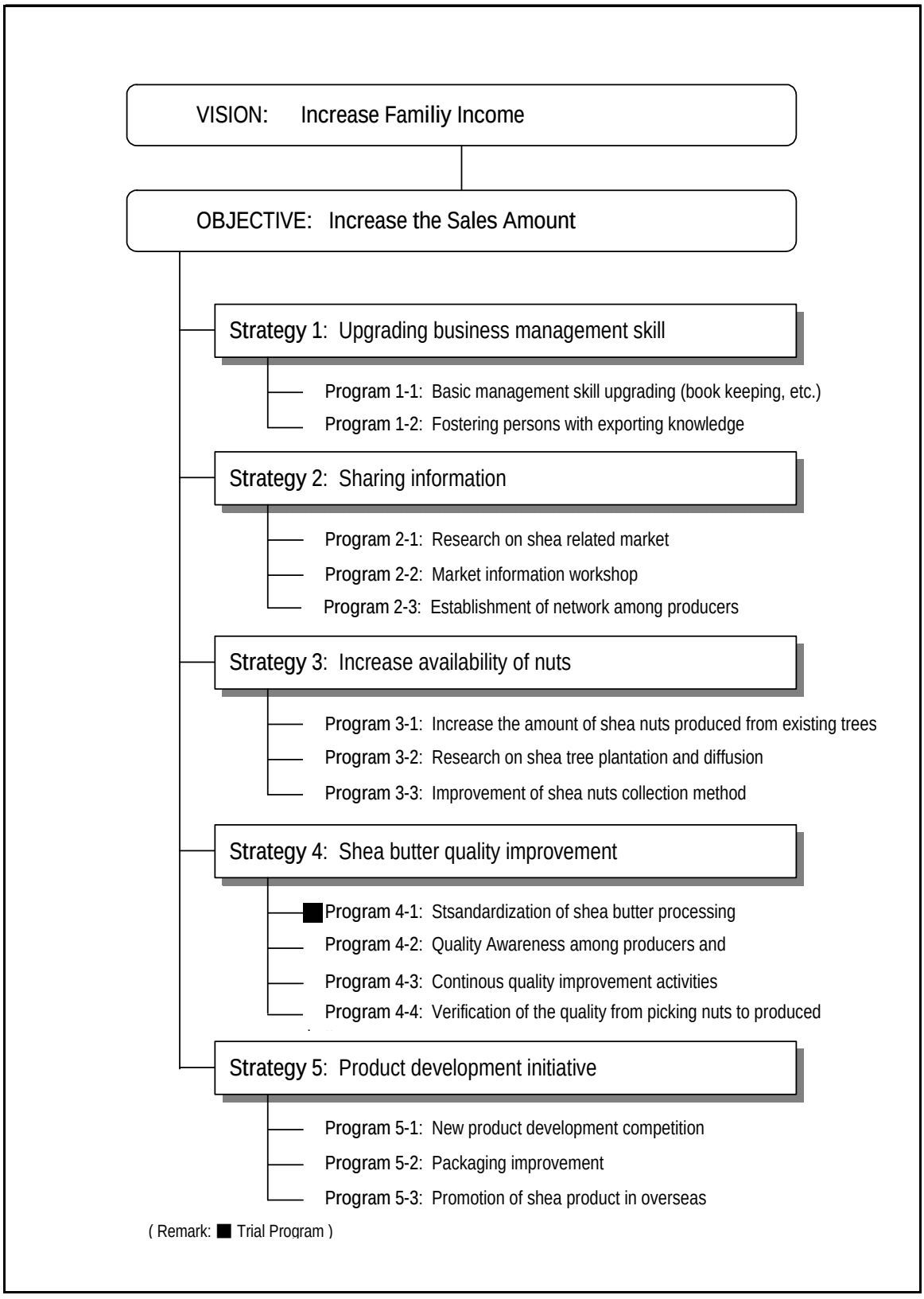


Figure 4.1-2 Framework of Draft Master Plan for the Shea Butter Industry in the Northern Region

Table 4.1-1 SWOT Analysis: the Shea Butter Processing in the Northern Region

	Market	Production / technology	Raw material	Human resource	Development capability	Business environment
STRENGTHS	• Stable demand of shea butter as eligible oil in northern Ghana.	• Flexibility of conventional production	• Northern Ghana belongs to shea nuts belt	• Abundant work force.		• Foreign Donors and NGOs can assist shea butter processing.
WEAKNESSES	• Usage of shea butter is limited in other regions. • Stagnated domestic sale of shea butter.	• Unstable product quality • Lack of technical knowledge.	• Shea tree plantation is difficult. • Unstable harvest • Risky and hard work of harvesting.	• A little chances of training. • Lack of skill and knowledge of shea butter processing	• Lack of development capability. • A few companies produce shea butter related products.	• Lack of funds for mechanization and sales promotion.
OPPORTUNITIES	• Possibility of expanding domestic and foreign market by improvement of package. • Growing interests in developed countries.	• Improvement of manufacturing method and quality control increase quality and quantity.	• Room to increase cultivation of shea nuts (only half of available fruits are collected)		• Research efforts in University/research institute	• Promotion of central and local government for shea butter development.
THREATS	• Demand of local made shea butter grows at a sluggish pace. • Competition against other shea butter producing countries may become intense.	• Improvement is difficult due to adhering to conventional method.	• Sudden depletion of shea nuts	• Work of women's groups can be replaced by cheap and mechanized manufacturing.	• Existing research institute shift the study focus to other products.	

4.1.2 Selection and Outline of the Trial Program

Program name: Standardization of shea butter processing

(1) Reason for selection

At the workshop (problem analysis) in June, the quality issue was raised by many participants. In particular, "poor quality of shea butter" was pointed out as a major cause for poor sales. Then, causes for poor quality were cited, including "lack of appropriate technology" and "lack of training." In fact, the Team confirmed from vendors in the local markets that shea butter of good quality was sold well. Meanwhile, manufacturers are not much aware of product quality. There are cases of mixing water or additive to increase product volume, demanding buyers' confidence. Also, there are problems relating to hygienic control.

As shea butter is made in each community, if quality improvement leads to sales growth and then price rise, it will create positive impacts on beneficiaries. The need for quality improvement was also confirmed by buyers and experts.

As a quality standard for shea butter products was already introduced, the Team chose to **establish a process standard in compliance with it with view to securing sustainability.** However, as it became apparent that the program's time constraint would make it very difficult, it was decided to select a best practice for production of shea butter with quality levels demanded by the market and disseminate it to each community. Also, it is planned to promote dissemination as joint effort with NGOs and other development partners.

(2) Outline of Trial Program

1) Expected Output

a) The qualities required by each market are clarified.
b) The standard operation (codes of practice) to produce the required quality shea butter is found.
c) The dissemination system of codes of practice and quality management method is prepared.

2) Activities

1-1 Select a surveyor for marketing survey and set the content of survey.

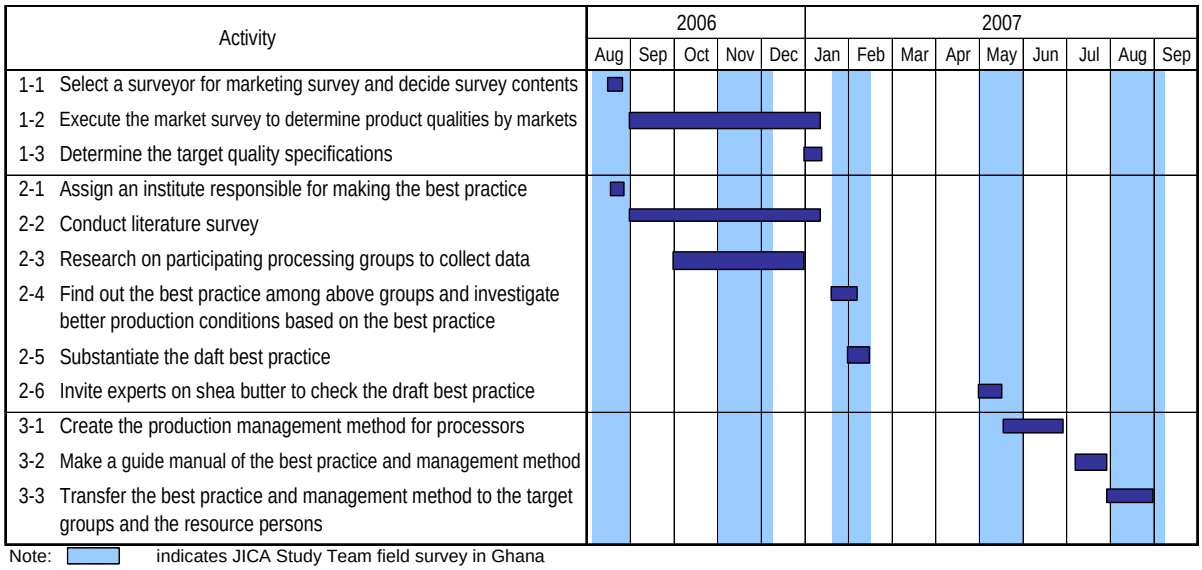
1-2 Execute the market survey to determine product quality required by the market.
1-3 Determine the target quality specification.

2-1 Assign an institute responsible for making codes of practice.
2-2 Conduct literature survey on shea butter production process, quality management and quality improvement methods.
2-3 Investigate shea butter processing groups to collect data of each process and quality.
2-4 Find out the best way to produce shea butter based on the best practice among processing groups.
2-5 Implement verification test for the draft codes of practice with processors to see if the product meets the expected quality. If necessary, revise the codes of practice.
2-6 Invite shea butter experts to examine the draft codes of practice

3-1 Create the production management method for processors to follow the code of practice
3-2 Produce manuals of codes of practice and management method
3-3 Transfer codes of practice and quality management method to resource persons

See Table 4.1-2 for details.

3) Implementation Schedule



Note: indicates JICA Study Team field survey in Ghana
As of Nov. 2006.

Table 4.1-2 Project Design Matrix – Northern Shea Butter Industry

Name of trial program : Standardization of Shea butter processing
Target group : processing groups
Implementation Area : The Northern Region
Implementation period : August 2006～September 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Increase the sales amount	• Sales expansion	• Total sales volume	
Project Purpose Standard process is promoted in the region	• Code of practice is used widely. • Improvement of shea butte quality in the region.	• Inquiry • Test samples	1. Shea butter market does not change dramatically.
Outputs			
1 Clarify the quality required in the market	• Specification required by buyers • Items concerned by consumers	• Specifications and items in the report	1. Shea butter business does not change dramatically.
2 Find out the code of practice to produce the required standard product	• The code of practice • Quality management method	• The Code of practice • Management method	
3 Disseminate code of practice and quality management method	• Method of dissemination • Number of resource person participate	• Manuals • Participant list	
Activities (1)-1 Select a surveyor for marketing survey and decide the content (1)-2 Execute the market survey to determine product qualities by markets (1)-3 Determine the target quality specifications (2)-1 Assign an institute responsible for making code of practice (2)-2 Research on participating processing groups to identify process and quality (2)-3 Find out the best practice among above groups and investigate better production conditions based on best practice (2)-4 Test the daft production condition with processing groups to prove the daft code of practice (2)-5 Invite experts on shea butter to check the draft code of practice (3)-1 Find out the production management method to follow the code of practice (3)-2 Make a guide manual of code of practice and management method (3)-3 Transfer code of practice and management method to resource persons	**Inputs** JICA Study team • Japanese experts • Operating expense - Employment costs of Ghanaian staff - Transportation and accommodation costs - Expenses of training, meetings, workshops - Expenses of training materials Ghanaian counterparts • Counter personnel • Office space, office equipment and furniture • Operating expense - administrative and management costs -		1. The government does not change the policy for the garment industry. **Pre-conditions** 1. Quality of shea butter can be controlled by process

4.2 Standardization of the Shea Butter Processing

4.2.1 General Introduction

(1) Ecology and Distribution

The main product of shea trees is shea butter (karité) which is extracted from dry shea kernels.

Timber and poles made from the wood are termite resistant. The young leaves of shea trees are also used as forage for feeding of sheep and goats. Protected trees tend to produce higher yields and larger fruits than trees in the wild (unpublished results). In the past, the gum produced from the bark of the tree was used in mending musical drums.

In Ghana, shea trees are found mainly in the Upper East, Upper West and Northern Regions (8°-11°N). Small populations are also found in the Brong-Ahafo, Ashanti, Eastern and the Volta Regions in the south.

The tree is perennial and deciduous. It occurs mainly on dry open slopes. It is especially important in areas with less than 1,000 mm rain/year that are not suitable for growing oil palms have all described the growth and yield of shea trees. Mature tree heights vary considerably, with some trees attaining heights of over 14 m. and girths of over 175 cm.

(2) Taxonomy and Nomenclature

The Shea tree is one of the many tropical trees growing naturally only in Africa. Its present status as an international trade commodity predates the colonial era when early Europeans took interest in the tree and its products.

Two subspecies are recognized, *Vitellaria paradoxa var. paradoxa* and *Vitellaria paradoxa var. nilotica. Subsp. paradoxa* occurs in a wide latitudinal belt between 5° and 15°N from Senegal to the Central African Republic. *Subsp. nilotica* is found in Sudan, Uganda, Eastern Ethiopia and in the west of the Democratic Republic of Congo, formally Zaire. The species is rarely found outside its natural distribution range, but it has been introduced to Honduras where it is known as tango. The two subspecies differ in altitudinal range. *Subsp. nilotica* occurs at higher altitudes (650-1,600 m) than *subsp. paradoxa* which is mainly found at 100-600 m altitude, occasionally up to 1,300 m. Mean annual rainfall in the area of distribution is 600-1,400 mm and with 3-7 dry months (less than 50 mm rain). *Subsp.*

paradoxa is generally more drought resistant than *nilotica*. Both subspecies grow on a wide range of soil types.

Shea trees belong to the Family**:** Sapotaceae and known in the English Language as the shea butter tree and in French as karite. The name shea tree is however preferred in this review. The local names of the shea tree in the Northern region are Tanga in Dagbanli and Mampruli, and Aklubi in Gonja.

(3) Structure of the tree

The size of the mature shea tree varies from 7 to 25 m. In cultivated fields the height is typically 15-20 m. The bole is short, 3-4 m, sometimes up to 8 m with diameter less than 1 m and with thick bark that protects old trees from bush fires; slash is reddish, with white latex. Most of the leaves are borne in terminal whorls, 20-30 together. The leaves are simple, 10-25 cm long and with wavy margins. The flower is hermaphrodite in clusters, 10-40 together, cream-yellowish and fragrant.

(4) Flowering and fruiting habit

The flowers are pollinated by bees. In the Sahel, flowering occurs from December to March, when the tree is almost leafless, and the fruits mature from April to September. The phonological events are timed with the changes of seasons. Leaf fall, flushing, flowering and fruiting are noted principally as dry season events. Fruit maturity is associated with the change from dry to wet season and normally coincides with the first rains. Fruit production typically begins when the trees are 15 years old and may continue for 300 years.

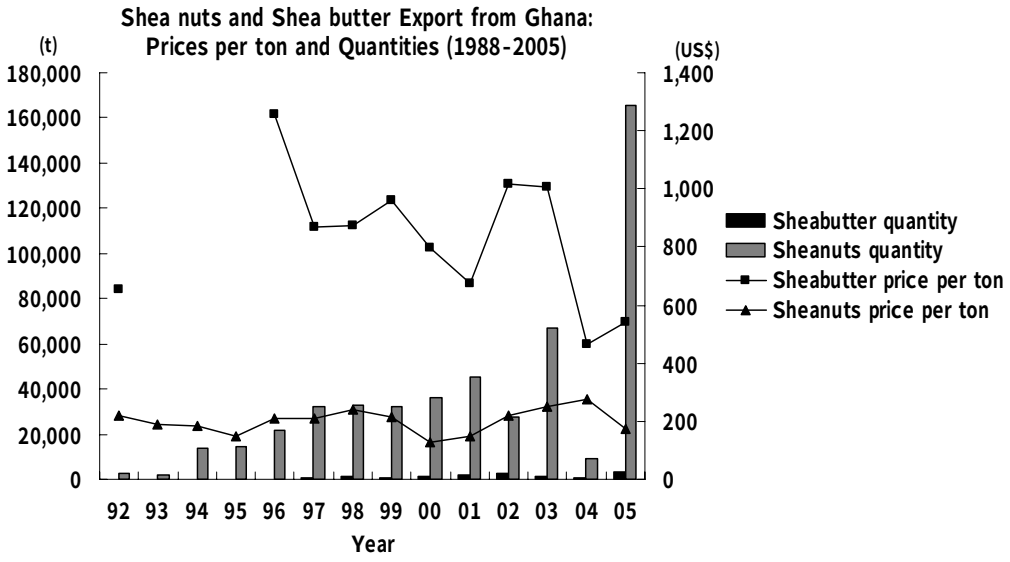
Figure 4.2-1 Shea Flowers

Figure 4.2-2 Shea Fruits

4.2.2 Market Survey

(1) Shea butter Trade

To process shea nuts (raw material) into shea butter (higher value and end-products) is obviously one of the most straight forward means of adding value to any commodity. Figure 4.2-3 shows that he price of shea nuts are relatively stable for 14 years from 1988-2005. It falls into the range of US$147 in 2001 as minimum to US$277 in 2004 as maximum, which supports the argument above that the price of shea nuts has been standardized by the industry. Contrarily, the average price per ton of shea butter is US$541, which is about three times as much as that of shea nuts (US$175) in 2005. The price fluctuations observed from year to year indicates that there is no standard price for shea butter. In fact, the value of the butter depends on the type of market on which it is sold - the diverse price settings for shea butter are taken place in each year among different traders at the different times of year.



Source: Ghana Export Promotion Council (provided in December 2006)
Note: The data on shea butter quantities in 1993-1995 are unavailable.

Figure 4.2-3 Price of Shea Nuts and Shea Butter Exported from Ghana (1988-2005)

Compared with shea nuts, the export quantity of shea butter is insignificant. However, shea butter has become a valued ingredient for the finest natural cosmetics in recent decades. The consumption of shea butter by cosmetic and pharmaceutical industries is estimated to be 2,000 to 8,000 tons of shea butter each year (Masters et al, 2004[1]). These industries form a

[1] E.T. Masters, J.A. Yidana and P.N. Lovett (2004): Reinforcing sound management through trade: shea tree products in Africa. *Unasylva* 219, Vol. 55

relatively small but fast-growing and potentially high-value niche market for shea nuts and shea butter. Especially small-medium scale natural cosmetic industry is looking for higher quality of shea butter processed in traditional method.

In the absence of information on how much more shea butter buyer are willing to pay for the improved quality, it is difficult to predict how producers' investment of time, effort and funds to improve processing will pay off during any given year; rather, it may not be realistic to expect that shea nuts and shea butter of high quality will necessarily fetch a good market price for producers (Masters et al. 2004). However, the ability to create high quality shea butter gives a bargaining power to rural women. If they are able to produce grade 1 (one) shea butter, there will be less chance to be exploited by traders who would otherwise offer low price due to the ordinary quality of butter. Currently, there is only a single price setting for any quality of shea butter traded by bulkers and wholesalers. However, the international cosmetic industry through exporters often looks for certain quality of shea butter (e.g. FFA value, moisture content etc.). If, by forming a cooperative, rural women are able to produce grade 1 shea butter that satisfies any quality requirements, they could be placed in a better position to negotiate with exporters.

From next section, this study analyzes the value chain of shea nuts and butter with different stakeholders in Ghana, focusing on the price determinations and impacts of shea marketing for rural women. The optimal marketing channel to benefit rural women is also identified. The third section discusses the constraints and strategies for women's cooperatives in current shea butter processing and marketing.

(2) Shea nuts and shea butter markets in Ghana – rural women's involvement

The shea butter value chain consists of 4 stages: shea nuts collection, shea nuts marketing, shea butter processing and shea butter marketing (Figure 4.2-4). It involves various actors at each stage. The optimal channel for rural women to maximize the profit is identified with bold arrows: nuts collected by individual women are collectively processed by cooperatives at locally established processing centers, and the butter is sold directly to exporters without involvement of bulkers and wholesalers. In recent years, many cooperatives have been formed throughout northern Ghana through various organizations including NGOs and ODA agencies. The collective production by cooperatives may be able to meet relatively high volume requested by international buyers through exporters within short period. By forming cooperatives, rural women are able to access export market and also gain bargaining power in the market transaction with buyers.

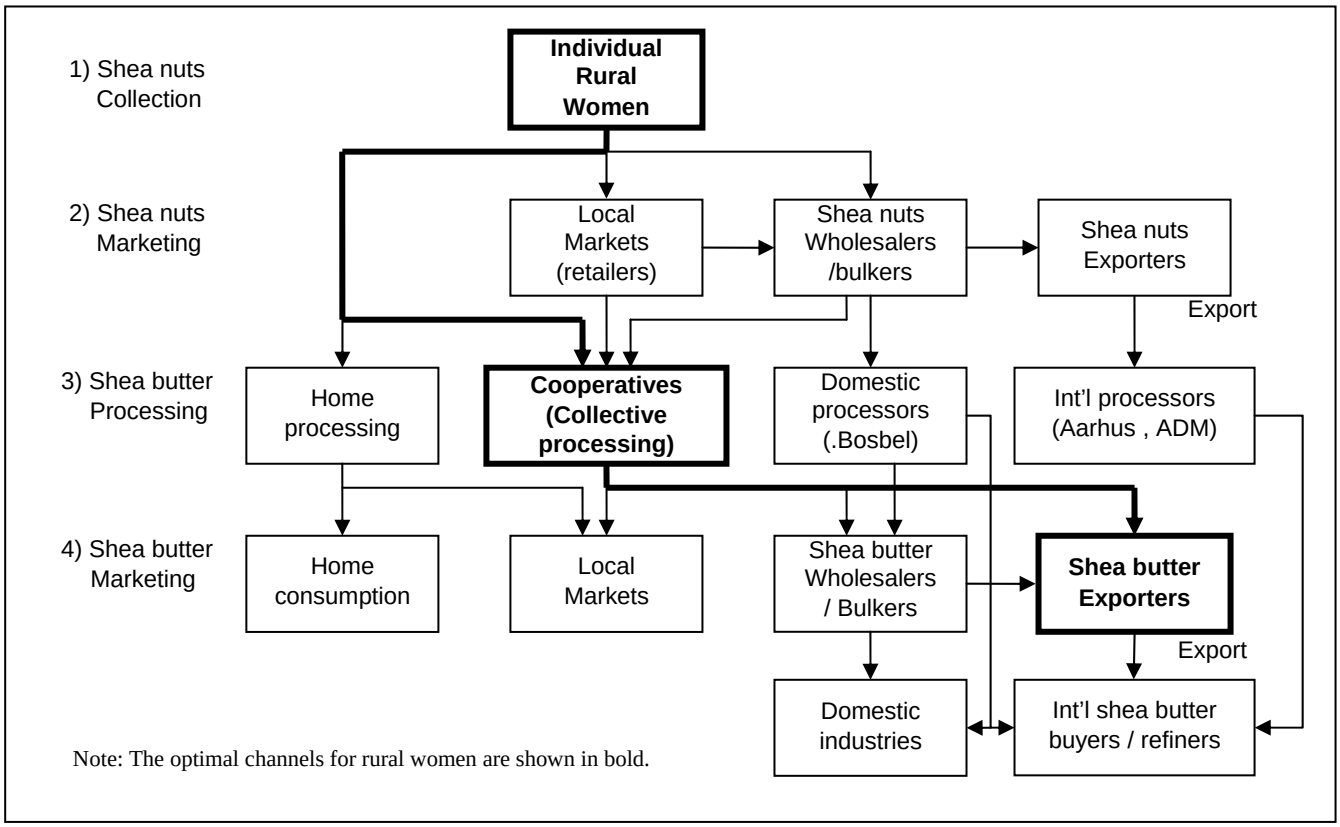


Figure 4.2-4 Shea Nuts and Shea Butter Marketing Value Chain

1) Stage 1: Shea nuts collection

The shea nuts are collected by individual women in rural communities of Northern Ghana from May to August with a peak from June to July. The degree of intensiveness in nuts collection depends on the price of nuts during the picking season. In 2007, the price of shea nuts sold at farm gate started from 4,000 cedis per bowl[2] in May, compared with 2,000 cedis per bowl in May 2006. The price has reached 10,000 cedis per bowl in mid-August 2007, which already exceeded the highest price of shea nuts at farm gate at the end of last season around February to March 2007. In 2007, the low productivity of shea nuts throughout the region has caused the higher price of nuts. When the shea nuts price is high, everybody rushes to pick up shea nuts even to the bushes located far away from the settlement area. In such a condition like this year, unpicked shea nuts are rarely left on farm. Some women and children climb on the tree to shake branches so that more shea

[2] The bowl used to measure shea nuts can contain 2.2kg of nuts. However, one bowl of nuts actually weights around 2.6 kg by using one arm to hold the edge of bowl to gather more nuts, which is the common practice to measure the nuts locally.

nuts are fallen on the ground to be picked up. However, most of the women are aware that the unnaturally dropped nuts are immature and thus do not make good butter.

In the study conducted in three rural villages of populated area in the Northern Region,[3] the average amount of shea nuts collected by randomly selected forty-five married women between the ages of 20 to 65 years old was about 35 bowls (about 90kg or 1 bag) per woman in 2006. All forty-five respondents answered that they have engaged in nuts collection in 2006; however some women such as elderly women with disability of picking nuts and women who have just delivered a baby usually do not engage in shea nuts collection. The maximum shea nuts collected was 80 bowls. In remote areas, large amount of shea nuts are not collected in the bush and some argue for potential exploitation of those shea nuts to be on the market. However, it is unrealistic to argue that those shea nuts in the bush far away from settlement area can be actually collected, if the labor requirement and traveling cost are taken into account for the cost of shea nuts collection.

2) Stage 2: Shea nuts marketing

Among the total number of shea nuts collected, rural women make a decision on how many bowls of shea nuts to sell or to process into butter. The shea nuts may be sold to retailers at local market or wholesalers[4] who come to collect it at farm gate. In the studied villages, thirteen women out of forty-five sold most of the harvested nuts without processing into butter, having kept some nuts for shea butter for home consumption. Among women engaged in nuts sales, some sold one bowl at 5,000 cedis the beginning of active purchasing season, and others waited until the off-season to sell one bowl at 10,000 cedis per bowl at highest later in 2006-2007 season. Two women in studied villages did not sell any of harvested shea nuts but processed all into shea butter and sold. In general, most of women wish to wait to sell shea nuts until around December when the price of shea nuts becomes high. However, they are in need of financial resources during the cropping period so that some women are not able to wait. Some community such as Tali-Botinli has a women's group that collects some amount shea nuts from members and sell collectively when shea nuts price becomes high. The income is saved in the bank and used for crediting among members.

[3] The study was conducted in Jakpahi Bagon, Wayamba-Tuunayili, and Kpachi in Tolon-Kumbungu District, Northern Region. It is homogeneous Dagomba village with population size of 307 in 25 households.

[4] Those local "trading" women / men could be somebody within the village. They purchase the nuts earlier of the season when shea nuts are still cheap, and sell it when the price becomes high in dry season. Sometimes, they purchase shea butter in the North and send it to southern market center such as Techiman and Kumasi where shea butter is more expensive.

The great amount of shea nuts assembled through wholesaler and bulkers from individual women and retailers at local market are sold to local processors and exporters at their demand. The multi-national oil and fats manufacturers such as Aarhus Oliefabrik (Denmark) and Karlshamns (Sweden) are the dominant buyers. Since year 2007, Archer Daniels Midland Company (ADM) has entered the shea nuts market in Ghana as one of the biggest buyers.

The low price of shea nuts during the picking season is due to the moisture content (16% to 25%) of nuts. Such nuts easily become moldy and therefore they require further drying before they can be properly stored. For this reason, only small-scale buyers who have the time and resources to re-dry the nuts are the active buyers during the picking season. They purchase the quantities of nuts varying from 10 to 50 bags (1000 kg to 5000 kg). These retail buyers later sell the dried nuts to bulkers in the Market Centers. According to the study conducted by UDS, in 2006-2007 season, Prices during the shea nuts picking season varied from 70,000 per bag of 100-120 kg (about 700 cedis per Kg to 1,000 cedis per kg), while by March to April, the prices of shea nuts in the local market reached 300,000 cedis per bag (averaging about 3,000 cedis per kg). During the active shea nuts buying period, nuts are well dried with moisture content of 8 % to 10 %. Local prices are set by dialogue between local exporters and local bulkers in the market centers. The final price reached per kg is usually dependent on the following factors:

1. Forecasts on shea tree yields in shea producing countries
2. World demand for shea nuts as reflected by buying contracts awarded to exporters
3. Level and capacity of in-country processing into shea butter
4. Pre-financing offered to local bulkers by exporters
5. Access to credit by local bulkers

Price quotations provided by some of shea nuts processing cooperatives (JICA targeted groups) at the beginning of shea nuts purchasing season and off-season show a steep increase: 1,200 per kg in October and 3,500 per kg from March and onwards.

3) Stage 3: Shea butter processing

Individual women process certain amount of shea nuts into butter for home consumption (average bowls processed for home consumption was about 5 bowls in studied villages, which makes about 4 kg of shea butter). In collective shea butter processing by

cooperatives, shea nuts are usually gathered by members. However, when more nuts are required to fulfill the order, nuts are purchased from retailers and wholesalers. Domestic processors such as Bosbel in Tamale and multi-nationals such as Loders Crocklaan (Holland) also engage in shea butter processing locally. However, the most of the nuts are processed mainly in Europe by the method of solvent extraction and separated it into a vegetable fat fraction to serve international food industry.

4) Stage 4: Shea butter marketing

The price variation of shea butter is minimal, compared to that of shea nuts; however, the price of shea butter varies at different type of markets. The shea butter processed by individual women is supplied to local markets to be sold for individual local women as vegetable oil and skincare product. On the other hand, the shea butter processed by cooperatives and domestic processors supply to export market and some to domestic manufacturers of cosmetic industry.

Between local market and export market, the significant price differences are observed. According to survey conducted in three rural villages[5] of the Northern Region, one calabash of shea butter is sold around 150,000 cedis to 250,000 cedis. Since the quantity of one calabash of shea butter varies around 20 kg. The amount of shea butter made out of 20 bowls (calculated to be 52kg by applying 2.6 kg/bowl) of nuts by individual women is sold at local market around 150,000 to 250,000, depending on the season and market. Applying 30 percent of extraction rate[6], 52 kg of nuts processes 15.6 kg of shea butter, which indicates that prices of shea butter per kg are 9,615 to 15,385 cedis at local market. The price of shea butter set among bulkers in Tamale was around 8,000/kg in 2006, which is a lot less than the supplying price to local market by individual women. In export market, the price of shea butter varies from less than US$1 per kg of ordinary shea butter up to US$3 per kg of “organic” shea butter, depending on the contract between exporters and importers in terms of volume and quality. For corporate social responsibility, some international cosmetic companies purchase shea butter at higher price of more than US$1.5 per kg, and they wish to make a direct purchasing contract with local producers. In addition, more importers in cosmetic industries are becoming quality conscious. In these days, those importers often set the quality criteria of butter that they want to buy, for example, grade A or less than 10% of FFA. For these order, shea butter is examined at the port of Tema by

[5] The villages are: Jakpahi Bagon, Kpachi and Wayamba-Tuunayili in southern part of Tolon-Kumbungu District

[6] Traditional extraction using kneading method yields about 30 to 35 percent of butter by dry weight, while expeller methods that include the use of solvent yields up to 45 percent (Masters et al, 2004).

SGS at shipment. The certified shea butter by international crediting organization such as SGS is normally preferred than that by Ghana Standards Board.

In sum, the different shea butter prices set between local markets and export market as well as within export market indicate the diversification of products and distribution channels in different types of market by different actors. It also proves that the local shea butter markets have not been affected by the price setting of export market yet.

(3) Impact of shea nuts and butter marketing in rural economy

Without joining a cooperative, the majority of rural women do not have access to for export market. For those women, the maximization of benefit in shea marketing may be achieved by collecting more shea nuts, selling the shea nuts in off-season, as well as processing of shea nuts into butter.

In shea nuts picking season, unmarried women without access to shea trees move to one of their family's living in remote village for shea nuts picking only during the harvesting season. Young women in populated area[7] are sometimes called by their female family members living in remote villages for shea nuts picking as well. In these remote areas where shea nuts trees are abundant, one active woman can collect more than 100 bowls of nuts. If these nuts are sold at 10,000 per bowl in off-season, 1 million cedis of income may be generated, while the income will be only 300,000 cedis if sold during picking season at 3,000 per bowl. However, in those years when the price of shea nuts is not so high, many shea nuts are left on the ground unpicked. Processing shea butter is another way to add more value to shea marketing. If 100 bowls of shea nuts (260kg, given 2.6 kg per bowl of nuts) are processed into 78 kg of shea butter at 30% extraction rate, the revenue of 780,000 to 1.17 million cedis (at 10,000 to 15,000 cedis per kg of shea butter) may be generated. However, the average quantity processed by women in targeted villages was only about 25 bowls per women. The maximum quantity obtained by one of the women was 50 bowls.

The study conducted in three targeted village revealed that income generated from shea marketing consists of about 50 percent of total income generated by rural women. The average income generated by shea nuts and shea butter sales was about 400,000 cedis in 2006, while that generated by other source of income, mostly by groundnuts production and some by rice

[7] The southern part of Tolon-Kumbungu District in Northern Region as well as around Bawku in Upper East Region is very populated. The shea trees are relatively scarce and the demand in shea nuts collection is high.

pal-boiling business was also about 400,000 cedis. The price of shea nuts were low in 2006-2007 season compared with 2007-2008 (however, the price of season 2006-2007 is said to be normal condition for shea nuts market). Since the study was conducted in populated villages, more shea nuts collection is possible in remote villages and thus more incomes may be generated from shea nuts and shea butter. Another factor to be noted is that in 2006, the income generated by groundnuts production was low because of drought effect: the yield from one acre of groundnuts production is reported to be less than half of normal year. Considering these facts above, the income generated from shea nuts and shea butter is expected to be less than 50 % of total income for rural women – however, it still consists of big portion of total income. The impact of shea marketing has significant impact for women in rural area of northern Ghana.

(4) Constraints and strategies for cooperatives in shea butter marketing

Numbers of associations and cooperatives have been formed for shea butter processing and sales activities for past decade in northern Ghana. Often linked with local and international NGOs, they gains the opportunity for accessing financial resources to be equipped such as storage facility, crushers, grinding mills, roasters etc. at their initial stage of activity. There are still numbers of rural communities that wish to set up processing center but have the financial difficulties to access resources for initial investment. On the other hand, already equipped cooperatives is facing the difficulty on “how to access” to export market.

One of the most important criteria for successful shea butter cooperatives is to have the ability to produce high quality of shea butter that can meet any quality requirement by importers. In fact, the production of grade A shea butter is a difficult task for many cooperatives. Nonetheless, women’s cooperatives that can constantly produce grade A shea butter exist. Having able to produce grade A shea butter, these cooperatives receives the steady orders by international buyers through different exporters.

According to the exporting company in the box story, the most important thing for cooperative is the attitude to learn the quality which market wants. When the group members are reluctant to learn or fail to follow the detailed correct processing methods at each stage of production, it is not possible to produce high quality of shea butter. However, the ability to produce grade A shea butter gives these cooperatives a strong bargaining power with any exporters. When the exporter receives an order from importer, he discusses with cooperatives about the production cost and the price. Since the production cost varies with

volume of order and the time of the year, the negotiation must be made at each order from the producer's perspective.

The strategies for cooperatives to succeed in shea butter marketing are:

1. To obtain the production facility through investment or leasing to show the production capacity,
2. To have an attitude to learn what market wants,
3. To have a leader with marketing and management ability,
4. To have mutual support among members, and
5. To make steady and trustful relationship with buyers.

4.2.3 Target Groups' Survey

(1) Organization of groups

The target groups of TP have similar organizational structures. Each group is led by an elected executive of 5 to 9 members. The information on each of the target groups is in Table 4.2-1 below.

Table 4.2-1 Names of Target Groups Interviewed

	Name of village	Name of group	Current Number of Members	Number of members at start	Year formed	Number who pick shea nuts
1	Choggu (CHO)	Simili dinvela Women's Shea butter processing Group	33	10	2003	5
2	Jakarayili	Tiyumtaba Women's Shea butter processing Group	40	40	2006	0
3	Jisonayili (JISO)	Tungteiya Women's Shea butter processing Group	32	32	1999	32
4	Kakpa-a-yili	Suglo kon-bo Women's Shea butter processing Group	32	17	2005	0
5	Kalariga (KAL)	Tungteiya Women's Shea butter processing Group	34	34	2006	0
6	Kasalgu (KAS)	Tungteiya Women's Shea butter processing Group	33	7	2003	33
7	Sagnarigu (SAG) (to be replaced by Cheyohi Proc. Group(Che))	Suglo mboribuni Women's Shea butter processi ng Group	90	30	1999	3
8	Shishegu (SHI)	Suglo mboribuni Women's Shea butter processing Group	35	35	2006	0
9	Tuutingli (TUT)	Suglo kon-bo Women's Shea butter processing Group	26	12	2005	0
10	Zuo (Zuo)	Suglo kon-bo Women's Shea butter processing Group	48	48	2006	48
			403			121

*Abbreviations under name of village are used for data sorting in Figure 4.2-10.

(2) Budget for operations among target groups

Shea nuts prices at this time are about 120,000 cedis per bag of 100 Kg. The group is therefore able to stockpile at least 167 bags of shea nuts (about 16,700 tons) per season. Budget of purchasing shea nuts is used in producing butter when there is an order for shea butter from a buyer.

Individual women also purchase shea nuts with their own capital. Quantities purchased are usually small, between 5 and 10 bags per woman. These quantities last only for one or two months. The women then have to purchase small quantities of shea nuts often 2 bags 160 kg to 200 Kg) on market days for processing. Price increases later in the season (from March to June) therefore affect women processors negatively by reducing their net profits, since prices offered by shea butter buyers usually remain relatively more stable.

Adaquaye (2004) estimates shea exports from Africa at an annual maximum of 0.15 million ton of dry kernel with a current market value of approximately US$30 million at prices around US$200/mt free-on-board (f.o.b.) at West African ports. Other estimates in the literature suggest that over 75% of all shea collected in SSA is consumed within Africa (by Dr. Peter Lovett in November, 2004). The export price of nuts ranges from US$150 – US$250 per metric tonne.

(3) Sources of shea nuts for local processors

Investigation on the source of shea nuts used in shea butter production by the target groups and 30 other non target groups shows that there are three main ways that women acquire shea nuts for processing of shea butter (stock management)

1. Nuts picked by self
2. Nuts bought and stocked by self
3. Nuts bought and stocked by group
4. Sources of shea nuts for purchase

1) Nuts picked by self

About 30 % of the individual women constituting the target groups indicated that in addition to shea butter processing, they also pick shea nuts. A higher proportion (about 89 %) among non target groups said they pick shea nuts. This difference is due to the fact that all the target groups are located in the Tamale Metropolis and therefore are far away from shea tree populations where shea nuts are picked. Many of the non target groups are however located in rural areas where high shea tree populations exist. Quantities picked by individuals vary from about 2 bags (160 Kg) to 15 bags (1500 Kg).

2) Nuts bought and stocked by self

For 90 % of the time, all the individual members of all the shea butter processing groups interviewed depend on nuts acquired by the individual processor. These stocks are also usually only small quantities of 5 to 10 bags (500 Kg to 1000 Kg). These are also usually exhausted by the end of March and the women have to rely on purchasing nuts at prevailing prices to produce shea butter. This reduces their profit margins.

3) Nuts bought and stocked by group

Only two groups, Tungteiya at Jisonayili and Suglo mboribuni at Sagnarigu indicated that they stockpile shea nuts owned by the groups. These shea nuts are usually purchased with funds provided as support by a non governmental organisation (Northern Ghana Community Action Fund "NOGCAF" for Tungteiya and the United Nations Children's Fund "UNICEF" for Suglo mboribuni). Such group owned shea nuts are used in processing shea butter when there is a specific order for shea butter. The profit from sale of the butter is shared among the members of the group.

4) Sources of shea nuts for purchase

Shea nuts are marketed locally at various levels. During the period from June to August each year, ripe shea nuts drop and pile up under shea trees. These are collected and processed into dry shea kernel. The primary source of shea nuts for purchase is therefore the shea nuts pickers. All the 10 target groups have pickers from whom they regularly buy shea nuts. The pickers are rural women who collect the shea shea nuts primarily as a source of revenue to support their livelihoods. They belong to farm families whose food stocks are exhausted by the shea nuts picking season. These women therefore primarily pick shea nuts as a source of revenue to purchase foodstuff for their families. The largest market for shea nuts and shea butter marketing is the Ababu market in Tamale.

(4) Facilities (layout of work place, allocation of machines)

Inspection of shea butter processing work places showed that the women processors work under various types of environment. The most organised workplaces are the shea butter processing centres established by the groups. Only two of the target groups have processing centres: Tungteiya at Jisonayili and Suglo mboribuni at Sagnarigu. The typical layout of the centres is as shown in Figure 4.2-6. A typical processing centre consists of the following:

Figure 4.2-5
Processing Centre for Tehisuma Women's Processing Group, Tamale

Figure 4.2-6 Crusher

Figure 4.2-7 Metal Drum Roaster

Figure 4.2-8 Weighing Scale

1) A large concrete yard used for drying shea nuts after cleaning or freshly purchased shea nuts that require further drying.
2) A shed under which processing activities take place: particularly sorting, roasting, and kneading.
3) Separate Storage rooms for shea nuts and shea butter
4) Milling room for groups that have their own grinding mill
5) Rest room for break periods

Equipment installed at the processing centres typically consists of the following: crusher (see Figure 4.2-7), roaster (see Figure 4.2-8), weighing scale (see Figure 4.2-9).

4.2.4 Factors Affecting Shea Kernel Quality

Although all women in the Northern region use the same basic method for processing shea fruits into dry shea kernel, the quality of the shea kernel produced vary due to the following factors:

(1) Ripeness of the fruit.

Only ripe shea fruits produce good shea kernels. However, strong winds may cause unripe fruits to drop. The kernels of such fruits after removing the pulp are still white in colour and can be identified. Such unripe fruits should be separated and discarded. Harvesting by shaking the tree for the fruits to drop also leads to dropping of unripe fruits and should be avoided.

(2) Delays in picking the fruits from the trees.

When ripe fruits remain under the trees for longer than three days, they begin to germinate. This leads to breakdown of chemicals and formation of free fatty acids which lowers the value of the shea nuts and shea butter produced from them. Ripe fruits should therefore be picked from the trees within two days of dropping, depulped and boiled. Boiling prevents germination and the boiled nuts are dried to prevent fungal attack which also causes formation of free fatty acids (FFA). Some communities in the Northern Region require that certain traditional rites be performed before women can begin to pick shea nuts. The time to perform these rites is determined by the leadership of the community. This usually delays the picking of shea fruits that drop early in the season and result in their germination before picking. Communities that require such rites should be encouraged to perform them before the commencement of the shea nuts picking season

(3) Period of accumulation of the fresh fruits before boiling

When ripe shea fruits are heaped for more than three days, some of the fruits begin to germinate. Breakdown of chemicals in the germinating fruit lead to the formation of high levels of free fatty acids that lower the value of the kernels. Fresh fruits should be processed as soon as Accumulation of the fresh fruits should be limited to three days.

(4) Duration of boiling

All women in the Northern Region boil their shea fruits in locally made pots. Boiling is stopped when the fruits turn colour to dark brown. This can be achieved within 45 minutes. However, some women leave the fruits immersed in water for long periods after boiling, particularly when the women are engaged in other household tasks or farm work. The long exposure of the fruits to water makes the kernels in the fruits too wet and prolongs the period and intensity of drying. The delay in drying causes fungal attacks that lower the quality of the shea kernels. Boiling of shea fruits should be limited to 45 minutes from start of boiling.

(5) Access to facilities for drying

The shea fruit picking season spreads over the beginning to the middle of the raining season. Shea kernel samples obtained at the beginning of the picking season (May to June) are well dried with moisture content of about 8 %. The kernels are clean and shea butter prepared from hem is of good quality with low values of FFA, moisture and impurities. The high quality of kernel during this period is attributable to the abundance of sunshine that permits rapid and efficient drying of the shea nuts after boiling and the shea kernel after cracking and cleaning. All pickers produce good quality shea kernel during this period.

Shea kernel samples collected in July have moisture content of 10% to 12 % with high proportions of black kernel (60% to 80 %) and in isolated cases of continuous rainfall all the kernel of a batch of kernels produced may be 100 %. Such kernels contain high FFA levels (over 6 %). The low quality of kernel during this period is the low intensity of sunshine due to frequent cloud cover and rains. This hampers drying and the nuts and later kernel may remain wet even after 10 days of drying. The delay in drying causes fungal attack which subsequently turns the kernels black and lead to the accumulation of high levels of FFA. All kernel produced under such circumstances are generally of poor quality. During this period however, women who have access to extra room space spread their shea kernel on cemented floor in a room warmed by open fire made from firewood or charcoal. In this way, they are able to produce good quality kernel, confirming that rapid drying is essential for producing good quality shea kernel.

(6) Post-harvest handling and Storage of Shea kernel

Shea kernels produced by Pickers are handled in three main ways as follows:

- Sold immediately to local buyers
- Stored by the Picker

- Used to prepare shea butter by the Picker.

Pickers confronted with immediate need to purchase food for the family sell their kernel as soon as they are dry enough to be sold. At this stage, the moisture content of the kernel is about 10 %. The kernel may be sold to local agents who pre-finance some pickers at very low prices, about 30 % of the maximum kernel price for the year or carried to local markets and sold to small local traders under the same conditions of low prices. The small traders may later sell their kernel at higher prices to bulk buyers in the urban centres. Shea butter processing women's groups who have sufficient funds also purchase shea kernel at this period and store for later use. The local agents, small traders and bulkers accumulate the kernel and store them under various conditions of available room space until the shea kernel buying season opens in September each year. At this time, the various middle level traders, agents and bulkers sell the stored kernel to Exporting Companies at bargain prices.

The movement of shea kernel from the Pickers through the various buyers exposes them to deterioration. Owing to the variable moisture content of the kernel, limitations in storage space and labour costs, the kernel remain in the jute sacks once stored until they are sold. Kernel stored early in the season are usually attacked by mold and become brown or black by the time they are ready for sale to exporters. This condition of the kernel is however is of little importance to exporters whose priority is in large volumes at low prices and not kernel quality. Kernel processors abroad seem to have technologies that can produce good shea butter from poor quality kernel. Local Shea butter buyers on the other hand, test shea butter for quality before they purchase and shea butter quality is determined by the quality of shea kernel used. The quality of shea kernel should therefore be of primary concern to in-country small-scale processors. However, owing to lack of knowledge among local small-scale shea butter processing groups about the criteria used in determining shea butter quality, perceptions of kernel quality among local processors has minimized the concern they should have about the shea kernel they use for shea butter extraction.

4.2.5 Improving Shea Nuts and Shea Butter Processing in the Northern Region

(1) Shea nuts are picked one fruit at a time by individual women at early dawn due to competition for the fruits on bushlands. The fruits on farmlands are owned by the women of the household and are picked more leisurely. In all cases however, the fruits are heaped for one to 20 days before boiling to stop the fruits from germination and to loosen the shell for easy removal. Heaping the fruits beyond three (3) days leads to germinations of the early collections.

(2) Solution: Create awareness among women of the adverse effects of germination and limit heaping period to three days or less.

(3) The conditions under which shea fruits are handled vary but the methods of primary processing are the same in all communities. The critical stages that adversely affect quality are as follows:

- Variable duration of Boiling time: this is caused by pressure of competing work schedules and lack of awareness of the effect of over boiling such as high water content within the shea fruit and deactivation of antioxidants. This increases the drying time and leads to accelerated mould attack and rancidity of the kernel produced. Inadequate boiling makes removal of the kernel difficult.

Solution: Train women on the chemical and physical effects of over-boiling and limit the boiling time to 45 minutes or as soon as the nuts change colour to dark brown.

- Hygiene and loses to animals: Heaping of shea fruits and boiling them in open spaces lead to contamination with inert materials and consumption of the fruits by animals. Drying of the fruits on the bare floor after boiling also causes contamination.

Solution: Handling and drying of fruits after boiling should be done in an enclosed environment and on mats

- Boiling of fruits with the pulp on can increase the sugar content in nuts and encourage the growth of mould. Use of solar dryers can reduce drying time and increase quality of kernel produced. Drying in enclosed environment can exclude animals.

Solution: Encourage all women pickers to depulp shea fruits before boiling. Train women on improved fruit depulping methods. Improve access of women pickers to solar dryers or mechanical dryers to limit the period of drying to 3 days or less. Introduce moisture testing equipment and set dry moisture content to 9 %.

- Cracking of shea fruits on bare floor: This increases contamination of kernel with dust and other inert materials.

Solution: Encourage women to dry kernel on mats or in solar dryers

- Storage of shea kernel: the best storage material is new jute sack stacked on raised wooden platform

Solution: Provide community-based central storage facility with service charges.

Appropriate interventions for Shea kernel processing into shea butter

- Variable quality of shea kernel: Ensure that only Grade 1 Quality of shea kernel is used for shea butter processing.

Solution: Train shea butter processors on good quality characteristics of shea kernel, buy shea kernel directly from trained Picker Co-operatives

- Long processing cycle: Encourage the use of labour saving technologies by enhancing access to them (Crushers, roasters, grinding mills, improved boilers and mechanized filtration)

- Poor product presentation: Packaging of shea butter in cardboard cartons lined with polythene sheet protects the butter from sunlight, inert contaminants and keeps uniform temperature within the package. It also enables labeling for product identification

Solution: Train Processors on product presentation and labeling

- Poor record keeping: This makes product traceability difficult.

Solution: Train Processors (and Pickers) on record keeping, introduce non-formal education for processors (and Pickers)

- Poor Access to market: Linking Pickers and Processors will enhance market access and increase profit margins for women

(4) Comprehensive solution

Instead of piecemeal solution by tackling individual problems, an approach based on picking and processing centres equipped with quality-ensuring infrastructure and equipment based on a service charging system with provide consistent and competence-based solution to the various problems to low quality. It will also encourage individual enterprise in a group guarantee system for access to credit

4.2.6 Verification for the Best Practice

About 1kg samples of shea butter were taken from the target groups and analysed for quality parameters as specified in the draft standards for unrefined shea butter developed by the Ghana Standards Board. The parameters measured were: Free fatty Acid (FFA) as % Oleic acid), Peroxide Value (mEq/kg), Moisture (%), Unsaponifiable Matter (%), Impurities (%) (insoluble Pet. Ether) and Colour and Melting Point. The data collected were used to establish the current quality status of shea butter produced by small-scale processors to serve as a baseline for tracking improvements.

(1) Effects of age and source of shea kernel on shea butter Quality

The FFA content of nuts from the current season ranged between 0.23% (for CHE; Sample ID 82 in Table 4.2-7) and 0.42% (for Wulugu; Sample ID 85). The mean FFA content for all the nuts from the current season was 0.3275%. For the old nuts FFA content was between 0.817% (for Gurugu 2; Sample ID 40) and 3.666% (for KAS 2; Sample ID 26), with the mean FFA for all the samples being 1.8135%. Old nuts had statistically higher FFA content (P=0.05) than the nuts from the current season.

(2) Effects of Crushing and roasting

The final sizes of pieces present in a mass of crushed nuts are very variable, from about 4mm pieces to less than 2mm. All these sizes are present in all crushed nuts respective of the method used. The difference is in proportions of the different size ranges present in a particular sample. The sizes of pieces affect their response to roasting. A high proportion of the small size range easily becomes over roasted, attaining the black colour of chard material. This is said to impart a smoke-smell on the butter produced. However, most important factor affecting that causes over roasting does not rest on the size range of the pieces, but rather on the skill of the person carrying out the roasting. The most important factor that can reduce the

over roasting is training of women on roasting by experienced shea butter processing members of the groups.

Roasting of nuts resulted in a FFA content ranging between 0.833% (for SAG 3; Sample ID 3) and 3.666% (for KAS 2; Sample ID 26). The mean FFA content for all the roasted samples analyzed was 2.21%. The non-roasted samples had FFA content ranging between 0.817% (for Gurugu 2; Sample ID 40) and 3.666% (for Burkina nuts; Sample ID 48). The mean FFA content for all the non-roasted samples was 2.21% (See Figure 4.2-9).

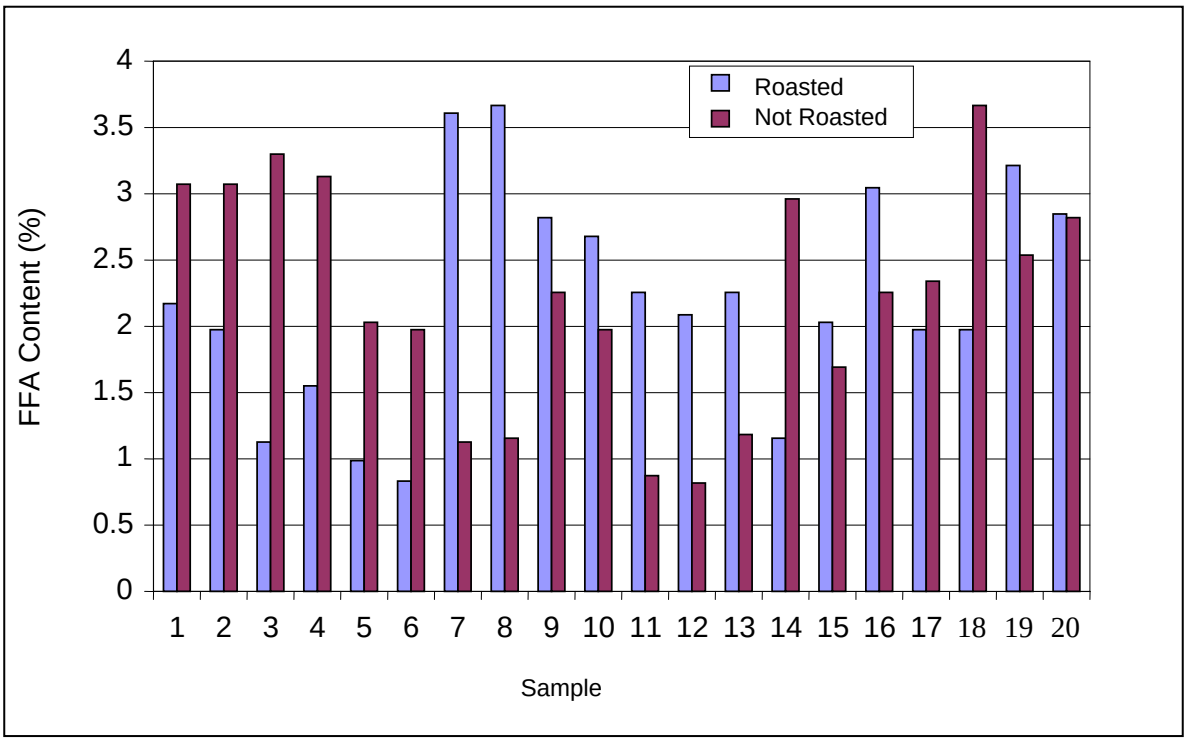


Figure 4.2-9 Effects of Roasting on FFA Content of Shea Butter

(3) Differences between target and non-target groups and the effects of milling

Milling by hand on stone pestles is now an out mode practices. The method is not used by any of the target groups or non target groups interviewed across the Northern region. All the Processing groups interviewed live in communities where grinding mills can be found. Some of the individual members of the groups however prefer the manual method of crushing the nuts because it is cheaper, requiring only the time and labour of the processor and assistants. The target groups where the manual crushing method is still used by some members include Kasalgu and Zuo. There are no crushers or grinding mills in these villages. Members who wish to use grinding mills are however able to do so by trekking to nearby villages with

grinding mills. Processors in Kasalgu use mills at Shishegu, about 5 Km away whilst processors at Zuo use grinding mills at Gbabshie, about 4 Km away. There were no significant differences in quality factors between the target and non target groups

(4) Effects of kneading and boiling.

This is a group activity whether done by hand or by machine. Using the manual method, about 3 to 10 women work at a time, each stirring amount 5 Kg of the milled mass in a pan. All the separated crude butter belonging to one member is combined in a pot and boiled together. The individual women kneading do not present any significant source of variation as the point of rise of butter is indicated by a distinct color change in the mass being kneaded, a cream white end-point. Also, this point is determined by judgement of the experienced processors present at the time of processing.

The kneading stage however presents differences among groups that use different sources of water: Pipe borne, wells, boreholes and dams. Variation in quality of these sources of water and the effect on mineral composition of the butter produced is still under investigation.

Boiling of the crude butter is done in iron pots among all the groups. The end point of boiling is determined by the processors perception of when all the water present in the butter has been boiled off. This point is tested by throwing a small quantity of the butter being boiled in the open fire. If a flare is caused by the oil, boiling is brought to a stop. This point is also preceded by a change in colour of the surface of the boiling mixture.

The boiling stage presents a significant source of variation. If boiling is stopped before all the water is boiled off, the moisture content of the butter is high (2 % or more). However, the moisture content of 38 samples from the target groups that were analysed contained less than 1% moisture.

The FFA content for samples with first boiling ranged between 0.874% (for Gurugu 1; Sample ID 39) and 3.609 (for KAS 1; Sample ID 25), whiles for the samples with a second boiling it ranged between 0.817% (for Gurugu 2; Sample ID 40) and 3.666% (for KAS 2; Sample ID 26). The respective means of FFA content for first boiling and second boiling are 2.228% and 2.124%. The samples from the first boiling had significantly higher (P= 0.0085) FFA content than those treated to a second boiling.

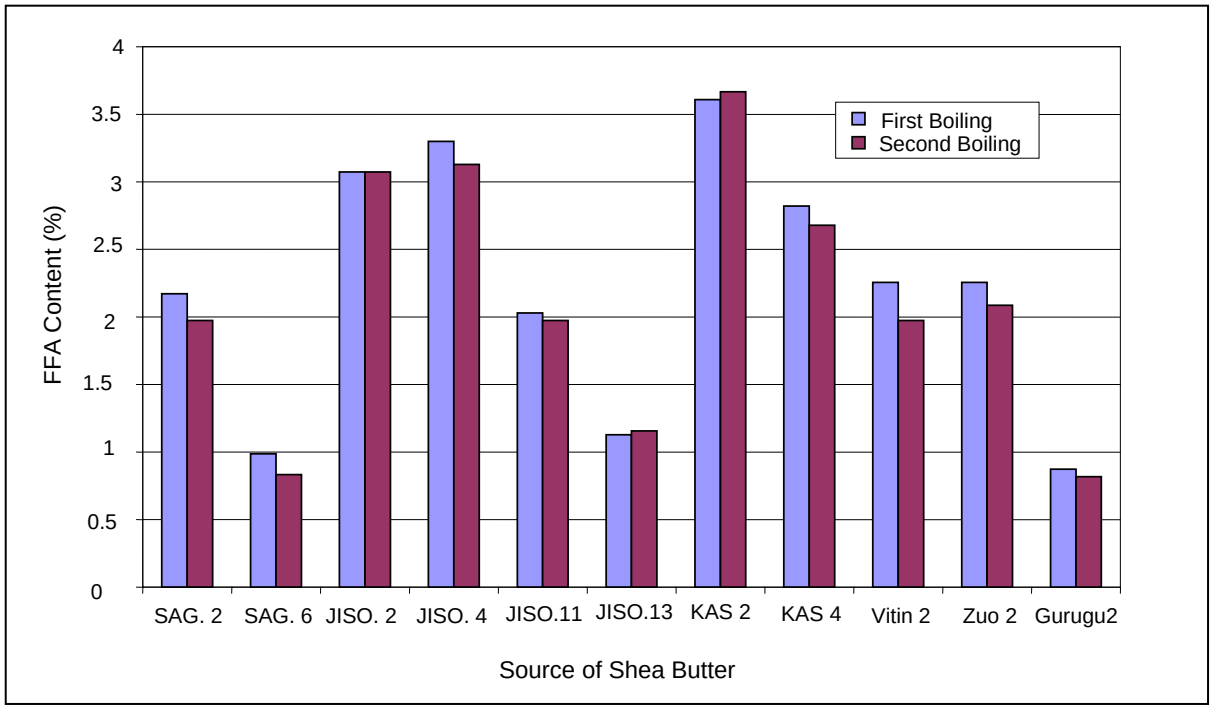


Figure 4.2-10 Interactive Effects of Source of Kernel and Boiling on FFA Content of Shea Butter

(5) Effects of Filtration, Cooling and Packaging

After the water in the boiling mixture is completely boiled off, the remaining clear oil is removed from the fire. The clear top part of the oil is decanted into a calabash or pan made up of plastic or metal. The clean portion is decanted off until only the residue of cake pieces are left at the bottom of the pot used in boiling. The decanted oil is further filtered through a water filter to remove any remaining physical impurities. The oil is then intermittently stirred gently until it coagulates. The continuous stirring produces a smooth texture. Rapid cooling without stirring produces crystals that imparts a rough texture to the oil and reduces its attractiveness to buyers.

(6) Effects of adding local additives

"Yolga" (local plant) versus "No Yolga"

The FFA content in samples without "Yolga" was between 1.128% (for JISO 12; Sample ID 22) and 3.299% (for JISO 3; Sample ID 23). FFA content of the samples treated with "Yolga" ranged between 1.170% (for JISO 24; Sample ID 75) and 3.073% (for JISO 1 and JISO 2; Sample ID 11 and 12). The mean FFA content for all the samples without "Yolga" was 2.119% whiles the corresponding figure for the samples with "Yolga was 2.234%. These means, however, were not statistically different (P=0.424).

(7) Other Characteristics of shea butter in the Northern Region

The results show that Peroxide Value (mEq/kg), Moisture content, Unsaponifiable Matter, Insoluble Impurities, Colour and Melting Point are within the standards set for Grade 1 butter in both the Ghana standards and Africa Standard for shea butter. Originally, the melting point was set at 45 degrees Celsius. Owing to preliminary results presented to the technical committee on shea butter standards in July 2007, the range of melting point for shea butter from Ghana was extended to cover 30 degrees Celsius. The Unsaponifiable matter was also found to be lower than in butter from other parts of West Africa and thereby shows that stearin levels are higher as is required by the international shea butter market.

Analysis for heavy metals content was difficult to carry out as a result of delays in responses as to the existence of the capacity for such an analysis in Ghanaian Laboratories. The Ghana Standards Board has recently indicated that it has the capacity to analyse for heavy metals and samples are being collected for the analysis.

4.2.7 Training of Target Groups and Resource Persons in the Best Practice

(1) Objectives

The training workshop was organized with the following objectives:

1) To test the effectiveness of training manuals developed on best practices for shea kernel and shea butter processing by small-scale processors
2) To train a core team in best practices on shea kernel and shea butter processing as part of strategy for dissemination of best practice
3) To Fine-tune training manuals as training materials based on comments received from participants in training

(2) Training contents

A combined total of sixty women shea kernel and shea butter processing women were selected for training. These consisted of the following:

- Two Africa 2000 shea butter processing groups : 20 participants
- Ten target shea butter Processing groups of TP : 30 participants
- Five shea kernel processing groups : 10 participants

(3) Proceedings of training

The training emphasized the practices that will improve the quality of shea kernel and shea butter produced by small-scale processing methods. The draft code of practice was followed in the presentation of the training.

1) Shea kernel processing

Important points of learning presented were:

i. Avoid use of germinated shea fruits.

This requires the adoption of the following:

- Collect fruits within 3 days of dropping from the tree
- Sort collected fruits to remove all germinating fruits
- Depulp and boil all fresh fruits immediately

ii. Avoid soaking of fruits during boiling by:

- Timing of boiling within 45 minutes
- Drain off water immediately after boiling
- Use improved equipment to make draining of water easy

iii. Prevent fungal attack on kernel by:

- Drying the nuts soon after boiling
- Avoid rewetting once the drying process has started
- Use heated room or solar drier to enhance drying within 3 days

iv. Avoid breaking of shea kernel during cracking

v. Store dried kernels in jute sacks on wooden pallets to avoid re-wetting

2) Training on shea butter processing

The code of practice and recommendations in the draft training manual were followed. Participants were informed on the importance of the following practices in achieving quality:

- use of quality nuts
- avoidance of over-roasting
- avoidance of contamination
- how to maintain vitamin content
- need for filtering the butter

need for packaging, labeling and storage in clean well-ventilated store room

Figure 4.2-11 Training in Class

Figure 4.2-12 Training on Site with the Pictorial Manual

4.2.8 Conclusion

It was very successful to implement the site surveys, the demonstration, the training and the manuals. As for the site surveys including the demonstration, the result was very good on the data. This result must be continuously sustained to secure the quality by women's group. And it was disappointed that a few participant only could be trained thorough the practical training. But through this training, we believe that the participants will help other shea butter processors.

At last, as our most important output, Proposed Codes of Practice for Shea (*Vitellaria paradoxa* (Cf Gaertner) Kernel and Shea Butter production in Northern Ghana of Ghana by use of small-scale processing methods appears at Appendix 6.

4.2.9 Summary of the Trial Program

Major achievements and results are summarized as follows

Survey on current shea butter processing method (42 women's groups) (4th field survey)

- Analysis of 84 shea butter samples (5th field survey)
- Survey on picking shea nuts and preservation (6th field survey)
- Formulation of the draft code of practice from picking raw materials to processing shea butter (6th to 7th field survey)
- Making the video manual and the pictorial manual (7th field survey)
- Training to disseminate the code of practice (2 times total 50 women from 24 groups) (7th field survey)
- Analysis and verification of shea butter quality processed on the code of practice (7th field survey)

4.3 Ex-post Evaluation of the Trial Program in the Northern Region

4.3.1 Verification of the Implementation Status and Conditions

(1) Verification of implementation results

Inputs by the study team have been made according to the plan. On the other hand, inputs by the counterpart were led by coordinators and UDS, which served as contractor. Originally, participation of MOTI/PSD/PSI and NBSSI was expected, but their participation was fairly limited.

The project purpose, "to promote work standardization," has been accomplished well for the target group, as training based on work standardization was conducted as part of the trial

program. It was also confirmed that the overall goal – improvement of shea butter quality in the entire region – can be achieved by using the pictorial manuals, video programs, and work standards that were produced as a result of the trial program.

(2) Verification of the implementation process

The implementation schedule has been generally complied with, except for some delays in submission of deliverables.

As for the measurement of effectiveness, there were problems relating to the establishment of butter quality demanded by buyers, which was made on the basis of market study, and confirmation of the work standards by experts. First of all, the market study primarily covered producers and did not extend to the actual market trend, especially buyers. Also, research and study relating to specific quality indicators was not sufficient. The target quality standard was established on the basis of the results of interviews with related parties, which revealed that butter quality demanded by buyers was more or less the same as the quality standard based on GSB's criteria. Secondly, the program could not conduct expert review of the developed work standard, despite the original plan, because there were few experts in the field of shea butter and no place for information exchange in the expert community. Later, it was agreed that the work standard would be reviewed by GSB as an outside organization. However, the review was not carried out during the trial program and the verification results have not been reflected in the manuals and other outputs.

The counterpart organizations (MOTI/PSD/PSI and NBSSI) were not actively participated in program activities because they did not allocate the budget to support full-fledged activities of local offices and could not share recognition of key issues due to the lack of knowledge on shea butter and standardization. On the other hand, they extended cooperation in administrative work, such as preparation of invitation letters for workshops and communication with the mass media.

The target group faced difficulty in understanding the program's purpose and content in the initial stage partly due to a low rate of literacy, but the level of understanding improved significantly as a result of frequent visits and participation in four workshops. In addition, communication was difficult because many people in North spoke the regional language only and it was difficult to obtain understanding on technical matters. It was generally overcome by using the pictorial manuals and video programs.

4.3.2 Five Evaluation Criteria

(1) Relevance

For the following reasons, the program is considered to be highly relevant.

Shea butter processing is a key industry in the Northern Region and is an important source of income for farmers, in particular women. However, ensuring stable quality is difficult because the production process is dominated by manual work. Also, the producer groups led by women generally lack knowledge relating to modern production and rely on traditional techniques and experience. The produced shea butter is largely supplied to the local market and the producer groups want to explore new markets, especially foreign buyers who make volume purchase, but they do not know of quality and other requirements demanded in new markets. Thus, improvement of product quality to meet international market standards under the trial program meets the needs of producers.

The Ghanaian government has policy to develop local industries that create employment opportunities from the viewpoint of poverty reduction. While it is difficult to create a sizable number of jobs through the improvement of shea butter quality alone, it will lead to larger export opportunity and higher income of producers.

At the workshop for issue analysis, majority of opinions agreed on the view that “poor quality of shea butter makes its sales growth difficult.” Meanwhile, the relationship between the production method and quality has rarely been studied. The study team judged that the establishment and enforcement of an appropriate work standard would help improve quality and achieve stability of quality. And the trial program is considered as an effective measure to address the major issue.

Target women’s groups were selected from those in or near Tamale City to maximize service coverage. Selected groups included those that actively participated in the workshops. Detailed information on candidate groups was obtained by visiting them and was used for the final selection process involving the counterpart. Outside the target groups, the trial program assumes dissemination of its results to groups supported by local NGOs, which are expected to adopt the quality improvement method and practice.

(2) Effectiveness

A key deliverable of the program was the work standard. Pictorial manuals and videos were used as a tool to communicate it to target groups effectively. These deliverables were produced according to the plan and their effectiveness was confirmed from actual quality improvement of shea butter that was produced by target groups according to the work standard. Nevertheless, all the groups could not produce butter according to the standard due to weather and other factors, thus unable to achieve the target quality standard. Also, not all quality items in the standard were rated as highest grade, suggesting there is still a room for research and improvement.

(3) Efficiency

As the picking period was around six months after the start of the trial program, any delay in the production process could be adjusted during the program implementation period. Nevertheless, production of pictorial manuals and videos took longer time than expected.

UDS was a qualified contractor but it was difficult to be involved in the project because instructors and assistants were engaged in program activities and their participation was limited due to class schedule. As a result, resource input was often delayed and took longer time than expected.

In addition, the program was the first of this kind for the Ghanaian government and the contract was unable to allocate time adequately, causing some delays. An alternative method was limited as UDS was only one organization capable of implementing the program. The program cost mainly consisted of labor, inspection, production of teaching materials, and actual training. Cost reduction efforts were made, including the reduction of items to be inspected. It was difficult to reduce the cost further without affecting the program's effectiveness.

(4) Impact

To achieve the overall goal, "to improve quality of shea butter produced in the Northern Region," a key factor is that the work standard is disseminated and adopted throughout the region. While UNDP will promote the program results in some areas, the Ghanaian government is expected to be responsible for the rest of the region. Once the work standard is widely adopted by producer groups, product quality will surely improve above the current level. Meanwhile, information obtained from buyers during the field survey indicates that

there is shea butter demand but quality is a major obstacle to actual purchase. Thus, when producers realize that quality improvement leads to sales expansion, the work standard is widely adopted, although problems will remain as to how producers can access to buyers and assure quality.

(5) Sustainability

The work standard developed as result of the trial program is treated as GSB's draft work standard. When it is adopted as the formal work standard, its consistency is maintained under the leadership of public organizations. In addition, the work standard and training manuals will be used for UNDP's projects, and they are expected to become pervasive to some extent. A major problem is the lack of specific support measures for shea butter producers by the Ghanaian government. This means that there is no formal mechanism to disseminate the work standard throughout the industry.

The most important factor for continuing the program on a sustainable basis is the change in the mindset of women groups, in particular the development of leadership to take initiative if dissemination and adoption of the work standard is to become industry-wide activities. Leadership by an outside organization cannot assure sustainability. At present, organization of shea butter producers is being promoted under NGO's support, and it is expected to serve as opportunity to promote further development as self-help efforts of producer groups.

4.3.3 Conclusion, Recommendations and Lessons Learned

(1) Conclusion

- The trial program has been implemented according to the plan and has achieved its intended purpose.
- There was no significant problem in the implementation process. The program is considered to be highly relevant.
- Some activities have been often delayed to affect quality of standard work. Also, additional research and study is required in the future.
- In addition to outside support, self-help efforts of producer (women) groups and local communities are called for.

(2) Recommendations

- The Ghanaian government should provide training and field guidance for dissemination of the work standard throughout the region.
- A shea butter research center should be established in Tamale for long-term research.
- Researchers on shea nuts and butter should be increased.

(3) Lessons learned

- Although the program has completed according to the schedule, the study schedule did not match the shea butter industry that is highly seasonal.
- The trial program involved a lot of office work in relation to extensive research and study as well as confirmation of deliverables. In addition to shea butter experts, administrative staff capable of handling such work should have been secured.

Appendix: Proposed Codes of Practice for Shea (*Vitellaria Paradoxa* (Cf Gaertner) Kernel and Shea Butter Production in Northern Ghana by Use of Small-scale Processing Methods

Introduction and background

This proposed code of practice describes the best procedures and methods for small-scale shea kernel and shea butter production in the Northern Ghana of Ghana which when used ensures the production of high quality shea kernel and shea butter. The description includes best practices in shea fruit picking, primary processing of shea fruits into shea kernel and small-scale shea butter production in the Northern Ghana of Ghana. Best practice methods for shea kernel and shea butter packaging, labeling and storage and transportation are also described.

This code of practice has been developed following a comprehensive survey of the shea kernel and shea butter production methods in Northern Ghana as part of a Pilot Programme on the promotion of local industries in Ghana conducted by the Japan International Co-operation Agency (JICA) from September 2006 to August 2007 in collaboration with UNICO International Corporation of Japan, University for Development Studies in Tamale, Ghana, and the Ministry of Trade and industry of Ghana. The Pilot Programme aimed at intervention Studies conducted in this study included a comprehensive literature survey on shea kernel and shea butter production methods in Ghana. It also included market study on shea kernel and shea butter, survey of kernel and shea butter processing groups in Northern Ghana and Laboratory testing of shea kernel and shea butter samples produced by small-scale producers in Northern Ghana. Best practices recommended here are based on the results of the JICA Pilot Programme in Northern Ghana.

A.1 Definitions

Shea fruit: Matured fertilized seed of shea fruit with floral parts

Shea nut : shell + kernel

Shea kernel: dry seed of shea fruit

Shea butter: The vegetable oil extracted from the shea kernel without any changes to the nature of the oil

Depulping: removal of the outer cover of the fresh ripe fruit of the shea tree

Conditioning: the gradual stirring and cooling of shea butter to form a smooth solidified texture without changing the odour, colour or chemical composition of the butter

A.2 Small- scale Production of Shea Kernel in Northern Ghana of Ghana

A.2.1 Shea fruit picking

Shea fruits for processing into kernel should not be harvested from the trees directly. The fruits fall under the trees when ripe. Ripe fruits have soft pulp and brown shell which can be seen only after removing the pulp (depulping). The shell of an immature fruit is white in color. The ripe fruits should be picked individually from under the tree. The ripe fruits germinate if they are not boiled within three days after falling from the trees. Shea kernels and shea butter produced from germinated fruits have low quality and low price.

A.2.2 Depulping and boiling of shea fruits

The pulp of the ripe shea fruits contains high amounts of sugar that encourage the growth of fungi if not removed before boiling the fruit. The process of removing the pulp from the fruits is called depulping. The fungi cause breakdown of chemicals in the kernels that lowers the quality of shea butter produced from them. The pulp should therefore be removed (depulping) from shea fruits before boiling them. Depulping should be done by covering heaps of the ripe fruits and rubbing off the pulp by hand or treading on the heaps. The depulped fruits should then be washed in clean water to remove the sand before boiling.

A.2.3 Boiling

Boiling the depulped fruits should be done by filling a still drum fitted with a pipe for draining the hot water after the nuts become deep brown or boiling for 45 minutes. The boiling container should be filled with fresh shea nuts to two-thirds of its capacity. Sufficient water should be added to the pot to submerge all the shea nuts in the pot. The source of heat should be gas, wood or charcoal. Using gas is faster and ensures uniform boiling. The boiled shea nuts should then be placed into a basket or perforated metal drum to drain off the remaining water on the wet boiled shea nuts. The purpose of boiling shea fruits is to avoid germination. It also makes extraction of shea butter from the kernels by small-scale methods easier, yields more butter from the kernels and produces hard fat that contains that has high demand by shea butter buyers. . However, prolonged boiling of the fruits destroys good natural compounds that keep

the shea kernels in good condition after they have become dry. Therefore drain off water from the nuts as soon as boiling is stopped.

A.2.4 Drying the shea nuts after boiling

The boiled shea fruits should be spread lightly on a cemented or concrete floor in a in the sun to dry. Where there is sufficient sunshine the shea nuts are thoroughly dry within three days, are easy to crack and the kernels obtained from them are of good quality. When the sky is cloudy and the intensity of sunshine is low or when there is frequent rainfall, the shea nuts can be dried within three days by using solar dryers or a heated well-ventilated room. This can be done by using solar dryers or by spreading the shea nuts in a heated well-ventilated room to ensure that the shea nuts are thoroughly dry within three days. The shea nuts are well-dried when they produce rattle noisily when shaken. The moisture content of the kernels in them is 8% of the weight of the kernels. At this point, the kernels are completely detached from the walls of the shells containing them.

A.2.5 Cracking the dry shea nuts

The purpose of cracking the dried shea nuts is to separate the kernels from the shells containing them. Cracking is easy when the nuts are thoroughly dry. Cracking should be done by filling a mortar up to one-third of its capacity and pounding lightly with a pestle. When the mortar is filled more than one third of its capacity, many shells remain unbroken and separation of the kernel is difficult. Smaller pieces of the shell should be removed by winnowing on a windy day. Larger pieces of shells are removed by hand-picking the kernels from the shell pieces. Winnowing and separation of the kernel should be done on a concrete or cemented floor to avoid contamination with soil and other impurities.

A.2.6 Drying of cleaned shea kernel

The cleaned kernel is still damp with moisture content of about 1.6 or 16 % of the weight of the kernel. The kernels should be dried until they rattle noisily when a handful of them are shaken in the palms or until moisture content of content of 0.01 or 1% of kernel weight. Drying should be done by spreading the dry kernel thinly on mats placed on cemented floor, concrete floor or on raised platforms in the sun. Drying of kernels must be done in an area protected from animals, poultry and strong winds to avoid contamination with animal droppings, contact with the bare grounds, sands, soil seeds of other plants and materials containing chemicals. Where there is sufficient sunshine the kernels are thoroughly dry within three days, and are of good quality. When the sky is cloudy and the intensity of sunshine is low or when there is frequent rainfall, a source of heat to dry the kernels within three days must be provided. This can be done

by using solar dryers or by spreading the shea nuts in a heated well-ventilated room to ensure that the kernels are thoroughly dry within three days. When the kernels are thoroughly dry, all broken pieces of kernel and foreign matter should be removed. Broken pieces of kernel are easily infected with fungi that will spread to the whole kernels if they are not removed before storage. The dry whole shea kernels should be packed in clean jute sacks, for storage or sale. Whole dry kernels free from fungal infection attract better market prices and produce high quality shea butter.

A.2.7 Storage of shea kernel

Jute sacks filled with dry shea kernel for storage should be labelled with labelled with clear type. The jute sacks should be placed on wooden pallets raised at least 30 centimetres above the floor of the storage room to avoid the kernels becoming damp from moisture from the floor or spilled water. Storage of dry kernel in open baskets and other open containers should be avoided as this leads to re-wetting of the dry kernels and encourages fungal attacks

A.2.8 Transportation of shea kernel

Shea kernel should be transported only after they have become truly dry at 8% of moisture content. When wet or damp shea kernels are transported, they become coated with dust and other impurities that cannot be washed away. Dry shea kernel should be protected from dust, rain and other materials during transport. Haulage trucks transporting large quantities of shea kernel should be loaded only with dry shea kernel to avoid contamination with other materials

A.3 Small- scale Production of Shea Butter in Northern Ghana

A.3.1 Sorting and washing of kernel

Shea kernel obtained from local sources may contain contaminants of other materials such as dust, seeds of other plants and kernels infected with fungi. Therefore all kernels for shea butter production should sorted to remove broken kernel, infected kernels, and other foreign matter. The whole kernels should then be washed with clean water free from pesticide and other contaminants. Washing of the kernels removes the dust particles and moistens the kernel to moisture content of 0.16 (16 %) for efficient crushing with a crushing machine.

A.3.2 Crushing the kernels into small pieces

Whole shea kernels are crushed in order to reduce their size for uniform roasting. The crushing machine available locally crushes the kernels to suitable sizes and saves time. It is also driven by electric power and therefore contamination with fuel is avoided. The machine is

also specifically reserved for shea kernelled crushing and therefore contamination with other materials is avoided. The roasted shea kernel pieces should be cooled to room temperature about 30 degrees Celsius before milling.

A.3.3 Roasting

The crushed shea kernel pieces should be roasted using the drum roaster. The drum should be filled to two-third of its capacity. Roasting should stop when the pieces attain a deep brown colour. Avoid burning the pieces as this makes shea butter produced from them black.

A.3.4 Milling

The cooled roasted pieces should be milled using an electric powered generator to avoid contamination with residues of fuel. A grinding mill specifically reserved for shea butter milling is preferable as this avoids contamination with other milled materials in public mills. The milled paste is hot and should be cooled to about 34 degrees before kneading.

A.3.5 Kneading

The cooled milled paste should be kept at about 34 degrees Celsius by adding water and mixing thoroughly. Kneading should proceed at the same temperature by continuously adding warm water to the mixture while kneading. The extracted crude butter appears as a creamy mass floating on top of the mixture being kneaded. This creamy crude butter should be washed once before boiling. Repeated washing of the crude butter leads to loss of vitamins that make shea butter of high value in the export market. Repeated washing should be avoided

A.3.6 Boiling

The crude cream should be place into a boiling pot up to two thirds of the capacity of the pot. The boiling mixture appears brown and opaque at when boiling starts initially. As boiling proceeds, particles gather at the centre of the surface of the boiling mixture. These should be removed frequently. Boiling should stop as soon as the mixture becomes clear and all the water contained in the boiling oil is vaporized or when the bubbles disappear completely. This is indicated by throwing a small quantity of the boiling oil into the open fire. A silent flare of flames shows that all water has vaporized. The clear yellow oil should be decanted and allowed to cool to about 40 degrees Celsius before filtering through a filter cloth to remove all remaining visible impurities. The filtered oil should be placed in a clean cool room for conditioning.

A.3.7 Conditioning and packaging

Conditioning should be done by stirring the cooling oil with a clean stirring stick. When all the oil becomes semi-solid upon cooling to room temperature, the semi-solid oil should be weighed into cardboard boxes lined with white polythene sheets. The unit weight of 25 kg per box is preferable as the boxes are easy to handle and easy to count. The butter is allowed to solidify, taking the shape of the cardboard box. The box should be sealed using adhesive tape and labelled.

A.3.8 Labeling

Labelling should be done using clear fonts.