

RURAL WOMEN'S PERCEPTIONS OF THE DIFFUSION OF
TECHNOLOGICAL INNOVATIONS THAT INCREASE QUALITY
SHEA BUTTER PRODUCTION IN MALI

by

Assa Kante

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Chair

Dr. Martin Frick

Approved for the Division of Agricultural Education/Agricultural Operations Technology

Dr. Robert Gough

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April 2007

VITA

Assa KANTE was born in Kita, Mali on May 2, 1957. She is the daughter of Samba KANTE and Mariam CISSE. She graduated from IPR/IFRA Katibougou, Mali in 1981 and earned a Bachelor of Science in Agriculture. In 1987, she completed her first Master's degree in Food Science and Technology at Texas A&M University, and in 2007 she completed her second Master's degree requirements for Agricultural Education from Montana State University.

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ABSTRACT

An ethnographic case study was conducted in three villages in Mali (West Africa) to determine the perceptions of woman producers of shea butter toward the introduction of new technologies to save labor input in processing and improving quality of shea butter. During the in-depth interviews conducted, most of the participants said they would be grateful for the technologies, but are facing economic and external market information constraints. A few of the participants still believe that manual churning provides good quality even though it is labor intensive. Participants prefer using visual aids in farmer-to-farmer training because they believe this will be more effective and the knowledge gained will be sustainable.

CHAPTER ONE

INTRODUCTION

In a material sense, Africa may never “catch up” with Europe or North America or Japan. However, it should be possible for Africa to ensure for its peoples a real improvement in their lives and a greater harmony between their physical resources, cultural traditions, natural environment, and material expectations. Africa needs to be “allowed” to develop in her own way and not be “told” what to do and then be given the chance to do what it can with what it possesses (Calderisi, 2006). Despite its poverty, Africa has enormous resources at its disposal to build a better life. Human determination can indeed triumph, and women will play an important role in the process. Calderisi, 2006 reported a conversation he had with an African,

“My mother never set foot in a school” he said, “but when I was ten years old, she decided to learn to read by asking us - her children—questions. She was the pillar of the support for her five sons. Two became doctors-one in the humanities and the other in medicine. Three of us became engineers.”

In Mali, rural women have the primary responsibility of maintaining family health and providing educational opportunities for their children. Revenue from individual small business activities conducted by women is essential to food security in Mali. It is also critical for women whose access to labor and secure land tenure are volatile. In recent years, increased emphasis on cash crop production such as cotton redirected labor and resources away from subsistence agriculture (Ward, Ballif-Spanvill, Fuhriman, Solomon, and Widdison-Jones 2004). The World Bank estimates 78 percent of economically active women in Mali are engaged in agricultural activities (Ward et al., 2004). Consequently,

women are challenged as much as men by recent changes (like drought, less fertile soils, low rainfall) resulting in diminished agricultural yields (Ward et al., 2004).

Shea butter is economically important to Malian rural women, because they can support the diverse financial needs of their families through the additional income generated from shea butter production. Over two million women in 13 African countries produce shea butter for cash and consumption (Botang, 1992). Shea butter is a high-value export to European countries and the United States, where it is considered a luxury product. It is often used as a substitute for cocoa butter in the chocolate and confectionary industries because it is sweet and oily (Food and Agricultural Organization, 1991). It is also used in the cosmetic industry for its high cleansing power (Food and Agricultural Organization, 1991). Because of the inefficiency of the production process however, profits are not being realized by rural women of Mali, or by women in the other 12 countries where shea trees grow.

Culturally, shea nut processing is the domain of women. After collecting the nuts, women must clean, de-shell, and roast the nuts, before grinding them into a paste, and then kneading the paste to separate the solids and oils. The entire shea butter production process currently involves 14 individual steps. Traditional shea butter production methods are physically demanding and inefficient, and the end product also lacks quality. For example, kneading by hand requires an average of three hours (University of St Thomas, 2005). In order to help African women improve both the quality of the product and the efficiency of shea butter production, a fair-trade, non-profit organization, *Shea Yeleen International*, was founded in 2004 by Wright (R. Wright, personal

communication, March 2004). This organization, in collaboration with faculty and students at the University of St. Thomas (UST) in St. Paul, Minnesota, designed a mixer to knead shea paste, thereby reducing the physical labor and time required to separate the shea butter solids from the oils. This project team is also linked to professors at Montana State University (MSU) and with scientists in Mali at Institut d'Economie Rurale (IER) (Dunkel, 2004). The main objective of this partnership is quality improvement of shea butter while reducing the time and labor utilized in the production process. Ultimately, the goal of this project is to improve women's lives in Mali by providing them with access to new and culturally appropriate technology, which will in turn expand their economic opportunities.

UST and MSU have also partnered with IER and the University of Bamako, Institute of Agriculture to launch the Mali Agribusiness Entrepreneurial Incubator Center (Dunkel and Montagne, 2004). One of the responsibilities of the Center will be to develop a model for rural groups to collaborate in order to disseminate their innovations. The effective distribution of this technology has the potential to alleviate poverty in Mali by increasing the income among marginalized segments of the population, namely women. Toward that means, it was necessary to determine the extent to which Malian women involved in agriculture, and particularly shea butter production, were willing and able to adopt technological innovations and diffuse them throughout their society. The findings of this research could be exploited as baseline information and be used in future development of diffusion and adoption plans for technological innovations.

Significance of the Study

There is a vast potential export market for shea butter. It is used to formulate a cocoa butter substitute and can replace it in food products without any noticeable difference. It is also used in margarine and other fatty spreads industries (Fleury, 1981). The demands from European and Japanese food industries for this lower-priced product had never been met and Sahelian countries were increasingly interested in industrializing the production of the butter (Fleury, 1981)

Despite the potential of shea butter as a good source of fat and export earnings, the traditional method of processing provides a poor-quality product with a low fat yield of about 15 percent (Fleury, 1981). This limits its utilization both locally and internationally. To improve the yield and quality, it is therefore necessary to develop improved methods for processing shea butter (Olajide, Ade Omowaye, and Otunola, 2000). Without standard operating procedures or guidelines, the process is difficult to replicate. In Mali, several studies and many discussions have revealed the same results (Laboratoire de Technologie Alimentaire, personal communication, 2004). To effectively improve production of shea butter, the Food Technology Laboratory (LTA) at Institut d'Economie Rurale (IER), which is the main government-funded research institute in Mali, has reviewed the traditional processing of shea nuts (LTA, 2004) and developed improved processing techniques. These techniques have been put in an appropriate training program for adult learning with an instructional poster series on quality management (Kante, 2004).

Also, Lija, Sanders, Durham, and Groote (1996) suggest women should be provided with more extension services, inputs or land to increase their income, and that technological change supports their empowerment. Getting a new idea adopted, even when it has obvious advantages, is often difficult. Generally, many innovations require a lengthy period before the innovation becomes available and is widely adopted. Often this frustration has resulted in research results remaining unused and remaining on research center "shelves" (Riesenberg and Gor, 1989).

Therefore, there is an urgent need to study factors affecting the adoption rate of technological innovations and develop outreach strategies for efficient shea butter production processing methods in Mali. The present study's aim is to collect information in order to develop a diffusion and adoption plan to introduce these techniques. The ultimate goal will be to overcome some of the main production and processing constraints such as high labor requirements, low extraction yield, and poor quality.

Research Problem

Can technology adoption related to shea butter production be influenced by identifiable constraints, whether actual or perceived?

Statement of Purpose

The purpose of this research project was to ascertain shea butter producers' perceptions toward technologies that improve the efficiency of shea butter production.

The specific objectives of this study were to:

1. Identify social, situational, institutional, and dispositional barriers to the adoption of new technologies in shea butter processing;
2. Identify the information channels used by the target audience that influence their ability to receive information on new and innovative production processing practices;
3. Identify the preferences for receiving training on new or innovative practices associated with producing and marketing shea butter from harvest to retail markets; and
4. Collect and organize baseline information that could be used in future development of diffusion and adoption plans for technological innovations.

Limitations

One of the limitations of this study was the geographical distance involved in data collection. The data collection phase required a trip by the researcher to Mali to interview shea butter producers and users. Although the researcher was a native Malian, rural populations may be reticent to respond to questions from individuals they do not personally know. Furthermore, the data could be potentially biased if they did not fully and honestly participate.

Mali is a large country, covering an area of 1,241,238 square kilometres. It has a population of 11.22 million people. Yet, the study was geographically limited to women residing in three rural locations: Zantieboucou, where a well-organized women's shea

butter cooperative existed; Doila, which had a women's association producing shea butter for surrounding local markets; and Dio where the manually operated mixer (built by the University of Saint Thomas) had been tested.

Assumptions

The following assumptions existed for this study:

1. In Mali, rural women play a vital role in family economics.
2. Rural Malian women have preferences and constraints concerning new innovations.
3. The cultural, social, and economic conditions of rural Malian women should be considered when developing extension diffusion plans.
4. Extension agents have the knowledge and expertise to identify, assess, and help solve problems surrounding agriculture and environmental issues in Mali.
5. The quality of shea butter can be improved and higher quality shea butter products can bring a higher export price.

Definition of Terms

The following specific terms were used in this study:

- (1) Adoption: a decision to make full use of an innovation as the best course of action available (Rogers, 1983).
- (2) Commune: geographical grouping of certain number of villages.

- (3) Diffusion: “The process by which an innovation is communicated through certain channels over the time among members of a social system. It is a special type of communication in that the messages are conceived with new ideas” (Rogers, 1983).
- (4) Institutional barrier: an obstacle that impedes individual access to activities or education (e.g., lack of offerings when participants can attend; little information (public notice) on diffusion activities; content desired—not available).
- (5) Dispositional barrier: personal perception obstacle that inhibits an individual’s self-improvement (e.g., lack of knowledge on what to study and the positive result of the diffusion process; lack of confidence in one’s ability; adult views self as too old to engage in education). This definition was based on the explanation of personal variables given by Lionberger and Gwin in 1991 as follows: “People vary greatly in their native abilities. What they are and ultimately become results from a combination of inherited characteristics and learned experiences.”
- (6) Perception: Personal inclination to disregard some things about a message, emphasize others and put meanings together in one’s own way. Predisposition of individuals, which affect behavior (Lionberger and Gwin, 1991).
- (7) Quality: distinctive attribute or relative nature or kind or character of a thing (Abate, 1997).

- (8) Technological Innovation: Rogers (1983) explained new ideas as technological innovations. He used the words “innovation” and “technology” as synonyms. A *technology* is a design for instrumental action that reduces the uncertainty of the cause-effect relationships involved in achieving a desired outcome. A technology has two components: (1) a *hardware* aspect, consisting of the tool that embodies the technology as a material or physical object; and (2) a *software* aspect, consisting of the information base for the tool (instructions and other information aspects of this tool that allow us to use it to extend human capabilities in solving certain problems).
- (9) Situational barrier: an obstacle, which impedes progress, based on certain circumstances (e.g., cost; not enough time; no child care; no transportation). This definition was based on the following concept of situational variables: conditions in which a person’s natural or man-made environment varies over time and from place to place (Lionberger and Gwin, 1991).

CHAPTER TWO

LITERATURE REVIEW

The review of literature consisted of three major sections and several subsections. The first section provided descriptive information on the shea tree and shea butter, as well as shea butter properties, processing methods and product quality. This included the scientific names of the “Shea Tree” along with its growth characteristics and the practical aspects of shea butter. The second section was an overview of adoption and diffusion methods with a specific focus on extension, information channels and preferences for training. The final section highlighted the barriers encountered with the introduction of laborsaving technologies for shea butter production, and discussed the benefits of these labor saving technologies to the users in Mali.

Description of the Shea Tree and Shea Butter

The shea tree is an indigenous tree growing in the southern part of the African Sahel zone, which extends across 16 countries from Gambia in the west to Sudan in the east (Hammond, Anstee, Donkor, Wumbediow, 1997). Two binomial names were used in the literature to refer to the shea tree. The first, named for the Scottish explorer Mungo Park was *Butyrosperm parkii* L. (*butyrum* = 'butter' and *spermum* = 'seed'). The second was *Vitellaria paradoxa* L. (*vittelus* = 'egg yolk'). Throughout this document, *Vitellaria paradoxa* L. will be used.

Trees, *Vitellaria paradoxa*, often reached 20 meters tall and 1 meter in diameter at adult chest height. The species are primarily insect-pollinated, with trees flowering and fruiting from December to May. Fruits ripen at the onset of the rainy season, usually in July. The species are barochlore, or gravity dependent, but humans, monkeys, rodents and some birds also disperse viable seeds. As with most tree species, regardless of family, flowering and fruiting ability are correlated strongly with tree size. Shea trees take an average of 20 years to mature and produce fruit. The trees are relatively long-lived, with ranges in the literature from 135 years to over 200 years. *Vitellaria paradoxa* had two subspecies (ssp *paradoxa* and ssp *nilotica*) the latter also called “*Vitellaria nilotica*” (Hall, Aebisher, Tomlinson, Osei-Amaning, Hindle, 1996).

According to Maranz and Wiesman (2003), trait values, such as fruit size and shape, pulp sweetness, and kernel fat content were significantly influenced by temperature and rainfall. Shea trees in the wetter Guinean zone had significantly larger and heavier seeds and significantly more pulp. Populations in the hotter and drier Sahelian zone had a significantly larger seed length-to-diameter ratio and significantly higher kernel fat content. In west central Mali (Sirakorola), fat content was moderate, with very low pulp sweetness and higher stearic acid content.

Shea fruits have been collected annually on family farmlands. The fleshy edible pulp of the fruit is removed to expose the nuts that are then parboiled and sun dried. The nuts are lightly crushed with a mortar and pestle to remove the outer shell and expose the oil bearing kernels. The kernels are then stored in bags to accumulate a sufficiently large batch for processing. The fruits and nuts are shown in Figure 1.



Figure1: Shea Fruits, Nuts, and Kernels

Shea kernels have substantial economic importance to some African countries as they consisted of 55 percent oil in weight (Casten and Synder, 1985). In general, the kernel fat content of *Vitellaria* is 20-50 percent. Fat content from 20-30 can be considered poor, whereas values in the mid 30's are intermediate and values above 40 percent are good. Value above 50 percent are rare and represent elite individual trees (Maranz and Wiesman , 2003). Shea butter is principally composed of five fatty acids: palmitic, stearic, oleic, linoleic and arachidic. In an extensive study of 42 shea populations in eleven African countries, Maranz and Wiesman , (2003) found stearic and oleic acids together accounted for 85 to 90% of the fatty acid in most samples. Maranz and Wiesman , (2003) also reported that the melting point of stearic acid was 69.9°C, while that of oleic was 16.3°C, and that the high stearic acid content of shea butter was responsible for the consistency that made this butter distinctive, while the relative

percentage of oleic acid influenced how soft or hard the shea butter is. Ugandan's shea tree populations in East Africa produced consistently high oleic acid butter (51.2-62.5 percent) that is liquid at warm ambient temperatures. West African shea butter (Senegal to Nigeria) was much more variable than Ugandan shea butter, with an oleic acid content ranging from 37.1-54.7 percent (Maranz and Wiesman , 2003).

The kernels are processed to obtain shea oil, which when solidified, formed a solid, fatty, butter-like substance called 'shea butter' (Figure 2)



Figure 2 Shea Butter

Shea Butter Properties, Processing Methods and Product Quality

Through literature reviews and studies in rural areas, the LTA (2004) compiled information into a concise document called “Techniques Améliorées de Production du

Beurre de Karité”, which can be translated into English as “Improved shea butter processing techniques.”

Properties of Shea Butter

For centuries, shea butter has been produced in Mali as food and as a product that has medicinal properties. Because of its wide use, shea butter has become a target product for continued improvement both in quality and in yield.

The high allantoin content in the shea butter renders it useful as a base for many pharmaceutical preparations to treat inflammations, rashes on children, and other skin ailments, and for cosmetics to prevent drying of the skin (Fleury, 1981). The population in Mali utilizes shea butter for the treatment of colds and injuries (LTA, 2004). In the cosmetics area, shea butter is an essential resource because it was the main skin cleaning and care product for men and women in rural areas of West Africa. In Africa, shea butter is also used as essential food oil (Kelly, Bouvet, Picard, 2004; Sanou, Kambou, Teklehaimanot, Dembelé, Yossi, Sina, Djingdia, and Bouvet, 2005).

Characteristics of Shea Butter

Terpend (1982) reported that shea butter contained stearic acid and oleic acid (45.5 percent and 42.2 percent, respectively). The high levels of stearic acid allowed shea butter to be resistant to oxidation. This was one of the major reasons for the preference in using shea butter for producing cosmetics. The level of oleic acid reduced the melting point of shea butter, also making it more suitable for use in cosmetics. The melting point of shea butter was close to the temperature of the human body, and therefore absorbed by

the skin effectively. (Terpend, 1982) However, the presence of unsaponifiables (non-triglyceride hydrocarbons, e.g., sterols) in natural shea butter created a barrier for its use in food and the soap industry. This did not affect its desired use in cosmetics (Terpend, 1982).

Shea Butter Processing

Traditional processing of shea nuts has been used by women in Africa, especially in Mali, for generations and is passed from mother to daughter. The traditional method is time and energy consuming and produced a lower quality product. Through a thorough study, the following activities have been documented in the processing of shea butter in Mali (LTA, 2004):

1. Collection of the fruits and pretreatment of the nuts:
 2. Shea trees are not cultivated. Therefore, the first activity is to collect the shea fruit in the forest or in areas neighboring the village.
 3. Store the fruit.
 4. Remove the pulp from the fruits and wash the nuts.
 5. Cook the nuts in order to inactivate the lipases and microorganisms.
 6. Dry the cooked nuts.
 7. Store the dried nuts in jute bags or baskets.
- Extraction technique:
 1. Dehull the nuts.
 2. Grind the dehulled nuts.
 3. Extract the butter.

4. Churn (kneading and stirring).
5. Package and label.
6. Preserve.

Shea butter product quality: Keith (2001) explained quality as follows:

“Quality referred to meeting stakeholders’ expectations. Quality was achieved when stakeholders received what they expected and desired. Quality was not about using the latest, the most sophisticated, or the costliest techniques; it is only about doing that which is expected by the stakeholders. Quality is about relevance to and meeting the needs of stakeholders. It depends, in both cases, on whether the stakeholders are satisfied or not. Since quality is a measurement of the degree to which the expectations of particular stakeholders are met, then one must not make the mistake of assuming that creating an expensive product will necessarily create the perception that the goal of higher quality is met.”

Thus, stakeholders have established several measures of shea butter quality.

Within the traditional African shea butter market, kernel fat percentage was probably the most important nut characteristic, as high fat content greatly increased the return on the same amount of extraction labor. Regional preferences likely exist for butter consistency at least in Africa. In Mali and Burkina Faso, a harder butter seemed to be preferred while in Uganda not enough difference existed in shea butter to create choices (Maranz and Wiesman , 2003).

In the chocolate industry, shea butter owed its importance to its similarity to cocoa butter. Cocoa butter is solid at ambient temperature, but exhibits a characteristic steep melting curve as it approaches human body temperature. This property causes chocolate to melt quickly in the mouth while releasing sweetness and chocolate flavor (Maranz and Wiesman , 2003).

According to LTA (2004), international quality criteria for shea butter are: 1) Acidity less than 1 percent; 2) moisture content less than 0.05 percent; 3) impurities less than 0.01 percent; 4) unsaponifiables approximately 7 percent.

LTA (2004) also identified several factors that can affect shea butter quality:

1. Level of maturity of the fruits;
2. Conditions under which the collection of the fruits was done;
3. Storage conditions of the fruits after collection;
4. Fatty acid content in the endosperm;
5. Extraction technique;
6. Conditioning technique; and
7. Preservation conditions of the butter.

In order to address these factors affecting quality, LTA (2004) also determined that quality control should be conducted at the following levels:

1. Control of the raw materials (fruits, nuts, endosperm);
2. Control of pretreatment operations (collection, cooking, drying, and preservation)
3. Control of the processing operations (extraction, conditioning); and
4. Control of the quality of the butter (physico-chemical, organoleptic such as color, flavor, taste, texture).

Adoption and Diffusion Through Extension

There was no universally accepted definition of extension. Black (2000) reported that a common meaning for the term was that, "...extension involves the conscious use of communication, and information to help people form sound opinions and make good decisions" (p. 493). Black stated that extension involved "the use of communication and adult education processes to help people and communities identify potential improvements to their practices, and provides them with the skills and resources to effect these improvements" (p. 493). Marsh and Pannell (1998), as cited by Black defined agricultural extension broadly to include: "public and private sector activities relating to technology transfer, education, attitude change, human resource development and dissemination and collection of information" (p. 493).

Progress in agriculture was achieved through extension workers who transferred the results of scientific research to farmers (Macadam, 2000). Extension involved communication between extension personnel and communities to provide skills and resources to help people make good decisions about resource management. Despite the efforts of extension personnel and researchers, the technologies that were developed take some time to reach the targeted populations. It is therefore important to understand outreach strategies and individuals' perceptions towards innovations, in order to solve barriers to technology transfer in rural areas. Various extension models have been used around the world, including linear "top-down" transfer of technology; participatory "bottom-up" approaches; one-to-one advice or information exchange; and formal or

structured education and training. However, no single model or strategy was likely to be sufficient by its own (Black, 2000).

The aim for introducing new technologies in rural settings has been to have populations apply them as their own practices. Factors that seem to affect the motivation of farmers to use new practices were functions of a dynamic network of institutional, situational, and personal factors. These factors were in a constant state of interaction (M. Frick, personal communication, February, 2006). Specific variables that affected the motivation of farmers to use new technologies included age, level of education, attitudes toward technologies, mechanical skills, and availability of labor.

The survival of agriculture was dependent on the survival of rural communities. Extension personnel needed to acknowledge the active role of women in farming as well as assist them in adopting practices to help meet the needs of these women (Vanclay, 2004). The role of women had been essential in situations where there was a clearly defined division of labor. In the course of globalization, there had been significant changes, with a greater demand on off-farm income to support the farm and an increasing diversity for on-farm activities. Rural women in Africa were the main family support needed to take advantage of the new opportunities available to them (Vanclay, 2004).

Research results had to follow a precise path to provide an effective system for development, together, they can provide an effective system for development, delivery and application of new technology (Lionberger and Gwin, 1991).

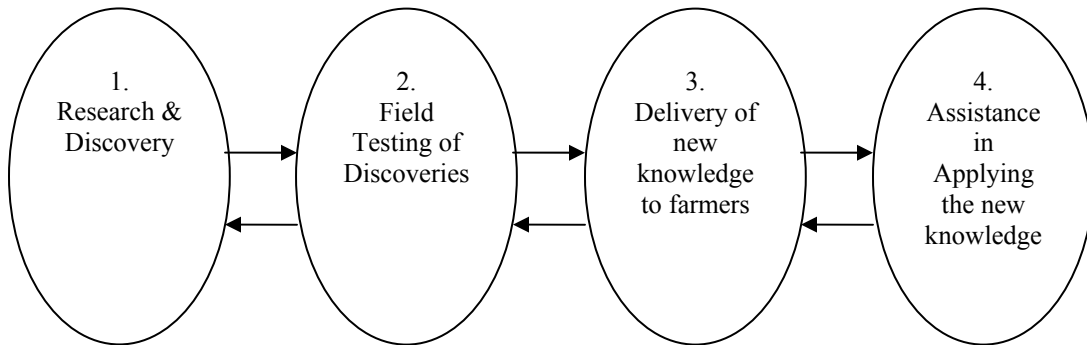


Figure 3. The New Way: Form a Special Organization to do the Necessary Task

Moreover, Lionberger and Gwin (1991) questioned, “When people are deciding whether or not to accept an innovation or make a change, what makes a difference? What influences them to change or not” (page 5). Lionberger and Gwin (1991), stated that,

“In order to answer these questions one had to address several factors that operate in combinations and sequences over a period of time. The reason was that it varied from person to person and community to community. These variables included the characteristics of individuals; their situations, support system, resources, and social environment; the kind of educational strategies they were exposed to; how they were treated by outsiders who try to influence their behavior; and the value they placed on change” (page 5).

Adoption and Diffusion of Innovations

There is an extensive literature history on adoption and diffusion of innovations. Lindner (1987) classified the literature into studies principally concerned with adopter characteristics (adoption studies) and those principally concerned with innovation characteristics (diffusion studies), with each category having both cross-sectional and temporal studies. While the literature had expanded considerably in the intervening years, as reviewed by Feder and Umali (1993), the essential dichotomy described by Lindner (1987) still remains. However, analyses in these areas included an increasingly

sophisticated set of mathematical and econometric techniques. Lindner (1987) described the contradictory results typically associated with adoption studies, and pointed to methodological problems associated with many studies.

Marsh, Pannell, and Lindner (2000) noted: “Diffusion has been modeled to account for changing equilibrium populations, changing technologies, changing rates of adoption, special differences, and the rate of abandonment” (p. 571).

Macadam (1997) traced the historical development of alternative extension paradigms in Austria and identified an emerging appreciation of the need to enhance extension clients’ capacities to make informed and critical decisions. He calls this paradigm a learning paradigm with an emphasis on empowering clients, and contrasts it with the linear, teaching approach inherent in the technology transfer model. Macadam (2000) indicated the traditionally accepted belief that progress in agriculture was achieved through extension workers transferring the results of the scientific research to farmers was too simplistic. The notion of farmers as passive knowledge receivers had been discredited. However, according to Macadam (1997), to make this switch in practice was a complex and challenging endeavor. The case study hypothesis Macadam (1997) presented in *Oil Palm Industry Corporation of Papua New Guinea* (OPIC) indicated,

“The organizational development process underway was transforming OPIC from a directive, technology-transfer oriented organization focused on persuading its small-holder farmer clients to reach preset production targets it sets, to a collegial learning organization with a community development orientation, focused on facilitating clients’ capacity to grasp the opportunities provided by participation in this oil palm industry” (p. 585).

Macadam (1997) emphasized in this case study that,

“Experiential learning was construed as a purposeful combination of experiencing, finding out, making sense, and taking action, and that the extent to which this process was understood by learners determines their ability to consciously guide the process” (p. 587).

Despite criticisms of the linear technology transfer model, there was still a need to provide access to reliable scientific information, just as there was a need to promote the active participation of farmers in research and development processes. One-to-one trade of information and guidance, whether from farmer to farmer or from professional counselor to farmer (or vice versa), will continue to be important (Black, 2000). Raising levels of formal education and training among farmers will also be important. New information technologies will facilitate some forms of education, training and information switch, but they will need to be appendaged by other extension strategies (Black).

Farmers’ decisions concerning applications of new management practices were a function of a dynamic network of institutional, situational, and personal factors. These factors were in constant state of interaction, combining in unique ways to direct the decision-making process of individuals considering alternative courses of action (Lionberger and Gwin(1991).

Lionberger and Gwin, (1991) stated:

“In agriculture, technical information, supplies, credit, attitude changes, and changes in present farming methods have to come between awareness and use of an innovation. You have to examine all the variables in a local situation and make as many of those variables as possible helpful or at least not an obstacle to adoption. We can influence change... But don’t expect to achieve instant agricultural development with a magic gadget.” (p. 15).

Inaizumi, Singh, Sanginga, Manyong, Adesina, and Tarawali (1999) examined the adoption and impact of dry-season dual-purpose cowpea in semiarid Nigeria. They concluded that, when a technology is appropriate, it stimulates an endogenous process of autodiffusion, through a dynamic farmer to farmer horizontal spread of planting materials. Rapid adoption of agriculture technologies by resource-poor farmers would require farmers increased participation in the technology development and evaluation process in order to ensure that the technology would be appropriate for their needs.

Based on twenty years of research and personal reflection, Vanclay (2004) developed key social principles relevant to the promotion of natural resource management issues in agriculture and concluded that farming was a cultural activity. Farm management practices were not solely technical but were physical manifestations of cultural expression, which were loaded with social meanings and significance. Vanclay said, “Farmers wanted practical advice, but that advice should be based on a social understanding.

Information Channels/ Training Preferences

The focus of past research on innovative farming practices centered on “why”, but not “how” operators adopt those practices. On that basis, Lionberger and Gwin (1991) stated:

“But, when it was discovered that adoption is really the result of a sequence of influences operating through time and that the process could be divided into stages...they asked them how they became aware of the new practices, where they got additional information about them, what was most influential in helping them decide to accept the information (the evaluation stage), and where they got the information needed to put the ideas to use.

It was found that the sources mentioned were quite different from those given when farmers were only asked why they adopted the new practices. At the adoption stage, they were at a loss to give any answers. Their own experiences or that of other farmers was more important than outside information sources at that stage” (page 49).

Many new agricultural technologies were left idle in research centers because of poor communication linkages between researchers, agricultural educators, and non-operator farm landowners. The identification of effective channels in the dissemination of useful agricultural information on new and/or innovative farming practices tended to hasten the flow of information between researchers and farmers and non-operator farm landowners (Malton, Cantrell, King, and Benoit-Catin, 1984).

In order to strengthen communication channels between researchers, agricultural educators, farmers, and non-operator farm landowners, a good understanding of factors that influenced the adoption of sustainable farming practices was necessary. When seeking information needed to make sound management decisions, a distinction should be made between personal, situational, intervening, and behavioral variables. And how these variables interacted to influence subpopulations of farmers and non-operator farm landowners regarding the use of agricultural land.

Riesenberg and Gor, (1989) studied in Idaho the influence of a wide range of information sources on available new and innovative farming practices including field trips, guest speakers, groups discussions, workshops, on-farm demonstrations, audio-visual materials, printed matter, and interactive telecommunications. They concluded that when the methods of receiving agricultural information were classified as interpersonal and mass media methods, farmers preferred interpersonal methods of receiving

information. They defined interpersonal sources of information as those involving face-to-face exchange between individuals, and mass media as those enabling one to one or few individuals to reach audience of many. Machine-assisted interpersonal communication is a third category.

Riesenberg and Gor, (1989) reported in the same study that younger farmers (20 to 35 years) tended to prefer computer-assisted instruction, home study, and publications more than the old farmers (66 years and older). Farmers farming larger acreages tend to prefer publications as a method of receiving information on new or innovative farming practices more than farmers with acreages less than 250 acres. Farmers with college of agriculture experience tend to prefer publications, computer assisted instruction, and home study more than farmers without college of agriculture experience. They concluded that, "Extension practitioners and planners who design or disseminate agriculture information should recognize the apparent patterns in preferences based on age, educational status, and farm size towards methods of receiving information on new or innovative farming practices. Such recognition is warranted by the fact that variations do occur, and the more the relations between these subsets of independent variables and farmers preferences are identified, the more successful the dissemination process will be" (p. 11).

Labor-saving Technologies for Agriculture and for Shea Butter Processing
and Women's Perception for Change

Labor-Saving Initiatives

Several initiatives were conducted to save labor and time in shea butter processing. The amount of shea butter produced by women depended on the local abundance and productivity of shea trees, the speed and efficiency of the production methods, and the time devoted to other economic activities. Fleury in 1981 stated,

“The development of a new technology for producing shea butter will probably have an enormous impact on women's lives. If they willingly submitted to the hard labor involved, it was because it was a source of personal income. What can they expect if the technology brought shea butter production into the realm of the man's work?”

In agriculture and livestock keeping, the low cost production of ox-drawn plows and burrows, hand-operated cultivators, planters and winnowers etc., all can save women time and energy. Other ways in which women's time can be saved is by building water catchments tanks. If used in rural areas, they can save time involved in carrying water from great distances (Otieno, 2001).

In most of West Africa, shea nut collection, pretreatment, and butter preparation were traditionally women's tasks. In Mali, 200,000 to 250,000 women were involved in shea collection and processing (Centre d'Echange et Promotion des Artisans en Zones à Equiper (CPAZE), 1988; Division du Machinisme Agricole (DMA), 1988).

During the 1960s, French industrialists introduced special presses for extracting the butter that yielded 35 to 40 percent of butter. Despite their relative simplicity, a lack of maintenance brought about the rapid deterioration of the machines. They were also too

costly for the villagers. Because of their high volume requirement, the machines required that large quantities of nuts be massed together for processing. This was not acceptable to the population who prefer family or village scale shea butter production (Fleury, 1981).

Before the 1980s, private firms indicated their intent to launch industrial production, but feared shortages of shea nuts. In well-watered areas shea trees will produce nuts every year, but the long waiting period before shea trees begin to fruit discouraged all plans to establish plantations. Shea butter remains dependent on the uncertain rains of the Sahel, thus causing great fluctuations in fruit yield (Fleury, 1981).

At some level between large-scale commercial butter extraction for export and traditional extraction for local consumption, many people were attempting to introduce an efficient and simple extraction method that would enable villages to satisfy both local and external demand (Fleury, 1981).

During the 1980s, there was a renewed attention to shea processing technologies with assistance from organizations like Gesellschaft für Technische Zusammenarbeit (GTZ) and Centre d'Echange et Promotion des Artisans en Zones à Equiper (CEPAZE). The GTZ and CEPAZE programs emphasized ownership and operation of the equipment by groups of village women. These organizations helped to develop a scaled-down manually-operated-dry press, a wet process in animal traction, and motorized versions to help reduce labor intensity for the women and to help increase shea butter production.

Initially, decisions for participation to test the technologies were based on politics and family ties. Although generally the GTZ technology was accepted, in a few cases however, women were reluctant (Hyman, 1991). Hyman reported that according to Lash

(1988), the main reasons for the reluctance were a) that the process did not correspond to the traditional steps of shea butter production; b) that higher labor intensity was required, or c) lower shea butter yields resulted. Additionally, Lash (1988) noted that women were interested in the processing devices like the grinder and motor for the press; the solar driers in one system were however not popular because of inconvenience and maintenance requirements. Populations were also reluctant to adopt the animal driven machines because of technical and cultural acceptability (Bielenberg, 1986; Didier, 1986). Women were sometimes reluctant to use the centrifuge because of the lower extraction rate and preferred to resume the traditional process after the grinding. Unlike the grinder, the centrifuge could only be operated with a full batch of shea paste because the oil was separated by volume displacement. Some women did have enough paste to fill a batch and resisted mixing their paste with someone else's because of oil content quality differences of the shea kernels and the care in pretreatment and storage (Hyman, 1991). Some women were reluctant to use the centrifuge to avoid being perceived as lazy for spending money to avoid work that their peers did by hand. The social stigma was problematic for a service-processing unit, particularly when the shea harvest was small and therefore, the workload and potential revenues were low (Hyman, 1991). In some cases the laborsaving technologies were effectively used, but in other cases they were not accepted for economic and non-economic reasons (Hyman, 1991).

“The experience with shea butter processing equipment illustrates some common lessons in the introduction of new technologies like (a) providing training for proper operation, (b) establishing a sustainable system for maintenance and replacement parts, (c) criteria to help ensure an equitable distribution of costs and benefits, and (d) incorporating the preferences of users in the design.” (Hyman, 1991, 1265-1266).

Coordination of the technologies between stakeholders could resolve issues such as access to spare parts; a more regular supply of shea nuts; effective promotion, training, and monitoring; ownership/management patterns; and credit for shea processing enterprises (Hyman, 1991).

External technical assistance from developed countries was key to upgrading traditional rural technologies. Understanding the local context was necessary for successful application of the diffusion and adoption process. In-depth interaction was essential at all stages, from designing and testing through dissemination. A strategy for disseminating technology must be based on a clear identification of the target beneficiaries and their resources and constraints (Hyman, Stifetel, Moreau, and Nichols 1988).

The “Multifunctional Platform” project for poverty alleviation aimed at improving the living conditions of populations in four areas in Mali and targeted particularly poor women through the introduction of mechanical and electrical energy source in the form of multifunctional platform. This helped to strengthen the economy through the direct and induced effects made possible by the platform notably thanks to time and energy gains that it provided, and the increase in income that were derived from it. Project activities were geared to the needs of various beneficiaries who, through a participatory approach, took the initiative in identifying their needs, in choosing the equipment to be installed and in financially contributing in the purchase and the full maintenance and running costs of these equipments. The “Multifunctional Platform” was

used for milling and husking of cereals, crushing of shea nuts, battery charging, lighting, and water pumping (Diagana, 2001).

User Benefits from Labor Saving Technologies

The time and energy spent by women for gathering wood to roast the shea nuts could be spent in activities that would improve food production. Therefore, the supply of fuel wood and technologies to reduce the amount of wood needed concerns not only women, but also the whole village community and nation whose agricultural productivity has declined due to environmental degradation such as loss of forests and other firewood production areas (Otieno, 2001).

The main benefit of upgraded technologies for shea butter production was that reducing the amount of labor involved allowed women to conduct other income generating activities. In rural Malian societies, women had few opportunities for individual wage employment due to socio-cultural barriers. Since shea nut processing was seasonal and women earned income in other ways, the returns from shea processing alone might not reflect the opportunity cost of labor time over a year (Hyman, 1991).

Diagana (2001) conducted an impact study of the “Multifunctional Platform” on the living conditions of women. He translated the impact of the platform in terms of individual or collective opportunities for direct or indirect beneficiaries. These opportunities were economic, financial and socio-political. He summarized the impacts as follows: alleviation of domestic tasks and less difficult nature of work; increased production and productivity of work; diversification of activities; improvement of

income; free time; improvement of school performance of girls; improvement of the quality of life; improvement of health; job creation; acquisition of technical skills; acquisition of financial resources for women's associations; participation of women in the public life of the village. Men's attitudes, opinions and expectations were also noted: men have been closely associated with the establishment of platforms mainly the response to the demand, participation in the capital costs in the form of grants or credits, and identification of the site of the platform. There was a particular interest of men for the installation of modules such as welding post, the alternator for battery charging, and public lighting. Men agreed that women had individually acquired a certain financial autonomy with the establishment of the platform. However, because these individual resources generated from extra-family activities were relatively autonomous with regard to the family budget they directly manage as family chiefs, they perceived less their importance although an important part of these incomes was reinvested in the family. On the other hand, the financial impact of the platform through the direct resources generated by its activities was well perceived because of the existing bridges between the women's associations and village councils. Frequently the village councils appealed to women's associations for credit and for funding other activities.

Summary of the Literature Review

The shea tree is an indigenous tree grown in the African Sahel zone. The fruits of the tree give "shea butter" which, for rural Sahelian rural women is a vital source of food, medicine, and revenue. Because shea butter is also used in the cosmetics and chocolate

industries in Europe and North America, it provides hope to rural women for the revival of their economics if international quality requirements are met and processing labor reduced. The literature reviewed showed several factors affecting quality of shea butter including fruit ripeness, processing and storage techniques of shea nuts and butter. There is a need for adoption and diffusion of innovative technologies developed to improve quality and to reduce labor intensity in the processing. Some extension specialists strongly supported the appearance of widespread paradigm shift in the extension and development literature of the 1980s. The old paradigm, which saw extension as a conduit for new ideas, was criticized because it tried to impose scientific products, and ignored positive and negative impacts of technological change, and ignored indigenous technical knowledge; ignored the socio-political and cultural context of agriculture. Several scientists and extension practitioners showed that for successful dissemination, proper communication must exist among researchers, extensions practitioners and farmers as well as social, situational, and personal variables should be considered.

Shea butter production is a women's affair. Therefore, women's perceptions and constraints must be considered in developing innovative technologies to help them alleviate problems in processing and marketing. Scientists and technicians working in this area have offered insights which included: training for proper operation; establishing sustainable maintenance and replacement parts; development of criteria to ensure equitable distribution of costs and benefits; and incorporation of users' preferences in equipment design. The literature review also showed that reducing time and energy spent

by women would allow them to conduct other income-generating activities, to gain new knowledge, to educate their children.

CHAPTER THREE

METHODOLOGY

Following Leedy and Ormrod (2005), this research was developed within parameters of case studies. Based on their terminology, a case study entails an in depth examination of an individual, program or event. Case study techniques can include observations, interviews, documents (e.g., newspaper articles), past records (e.g., previous test scores), and audiovisual materials (e.g., photograph, video tapes, audiotapes). In many instances, the researcher may spend an extended time period of time on site, and interact regularly with the people who are being studied.

In this research a case study was conducted that focused on purposefully selected sites and individuals. Although findings are reported on three different villages, a single case study approach was used to collect data and report results. This is because the case study focused on Malian village women who were involved in Shea butter production and were considering the adoption of new Shea butter production technology. Research was conducted and subsequent findings reported for three different villages because of unique differences in infrastructure, business organization, and production practices at the village level. The study included four aspects of case study, as identified by Cresswell (2005):

1. The setting (where the research took place);
2. The actors or participants (who was observed or interviewed);
3. The events (what the actor was doing);

4. The process (the evolving nature of events undertaken by the actors within the setting).

This chapter is divided into three sections. Respectively, these sections are titled: 1) “location of the study, description of participants and sampling process”; 2) the data collection instrument; 3) data analysis procedures.

Locations of the Study

The study was conducted in Dio Gare, Zantieboucou and Doila/Mali. Dio is located 45 kilometers west of Bamako, the capital city of Mali. Zantieboucou is located about 200 kilometers south of Bamako and Doila 180 kilometers north of Bamako (see Figure 4). The illiteracy rate among adults in these areas was approximately 80 percent (Oxfam America, 2006). The workforce was largely informal or engaged in subsistence agriculture. The population spoke Bambara, the national and most spoken local language in Mali. For centuries, the population has been producing shea butter in these areas, believing in the force of grouping activities for income generation. Shea butter producers in these areas are members of women’s associations in their village. These three locations have connections to the history of the technological innovations we planned to diffuse. In Dio, Shea Yeleen and UST worked with the women to develop and test the manually operated churning mixer. In Doila, IER conducted a participatory needs assessment to improve shea butter quality where all the steps in the process have been recently mechanized through UNIDO, PROKARITE, and MITOWA initiatives. These initiatives

all coordinated their efforts to support the development and promotion of Mali shea butter for a better economics revival at rural and national levels.



Figure 4: Map of Mali (Source: <http://www.geoatlas.com>)

In each village the researcher was introduced by NGO or government institution workers, either directly to the village residents or to a village chief. The researcher stayed seven days in each village to be acquainted with the populations and to gain their confidence. The researcher presented the objectives to the chief of the village, who directed her to the appropriate participants. Two main activities were conducted:

Sampling and Interviews' Process

The interviews were conducted at two levels: individuals and focus groups. The participants were identified as those who could best add to the understanding of the diffusion/adoption of technological innovations related to shea butter. The chief of the village or the president of the women's association selected participants.

Individuals

Individual interviews were conducted with youth and adult shea producers, and with shea butter users in the village.

Focus Group

The size of the focus group did not exceed 10 people. The key criteria for selecting a focus group was those participants who would work with the new technology.

Instruments

To conform to the guidelines of using human subjects in the research, a consent form was mailed to potential participants (see Appendix A). Participants returned the signed consent form to the researcher prior to becoming involved in the study. A semi-structured interview protocol with a cover letter was used to collect women's reflections on the research topic (see Appendices B and C). Though the protocol served as a guide to the interviews, the questions were often followed by probing remarks which allowed the researcher to get more in-depth information on the perceptions of women on the technological innovations. Participants were encouraged to tell their stories about the

introduction of technological innovations. The guidelines of Gay, Mills, and Airasian (2006) were used for constructing the interview protocol and designing a theoretical framework to understand the perceived experiences and preferred conditions of learning innovations. The entire interviews were audio taped and video recorded (with the consent of the participants), and transcribed. After transcription, the researcher listened to the tapes individually to make corrections within the transcripts when errors were found.

To cross-check information, the researcher also did some observations during the processing and the researcher recorded some observations on the essential aspects of the process. A few artifacts such training documents were also collected on the shea butter process.

Instrument Reliability and Validity

A pilot study was conducted to further define the population and further clarify the questions and a report from the pilot study was discussed for a consolidated interview protocol.

As with most research activities, data collection efforts that use focus groups are frequently concerned with the validity and reliability of the results. First, focus groups are almost never used in research activities where “statistically” validity and reliability are required. Focus groups are rarely randomly selected, their confidentiality is difficult to protect, and the interaction of focus group participants produces “bias” in the data because each participant responds to the observations and input of other members of the

group. Therefore, this form of validity and reliability are important to produce using focus groups (Wielbold, Sudduth, Davis, Shannon, Kitchen, 1998)

Despite these attributes, focus groups excel at producing information with a high degree of “face” validity. This means that the information collected reflected the understanding of a variety of well-informed individuals regarding the questions placed before the group “in their own words.” The researcher therefore obtained a very complete and accurate picture of the situation “as seen by participants.”

Reliability, or ability of other researchers or data collection methods to produce similar results, is rarely possible using focus groups. The interaction of the specific members participating in the focus group, the skill of each group facilitator conducting the focus group, the situational factors that affect comfort, trust and other small group dynamics, cannot be controlled in the fashion in every group for different researchers.

Data Analysis Procedures

Three iterative steps to collect and analyze data were used: reading/memoing from transcripts (see Appendix D); describing what is going on in the setting; and classifying research data. Initially, data analysis involved (1) becoming familiar with the data and identifying potential themes in it; (2) examining the data in depth to provide detailed descriptions of the setting, participants, and activity. This was done in order to provide a narrative picture and develop an understanding of the context in which the study was taking place, as well as meanings, and social relations, and to illuminate the

perspectives of participants; and (3) categorizing and coding pieces of data and grouping them into themes.

Based on the research questions, connections of the findings with related literature were used to give a better understanding of the perceptions of women about the introduction of technological innovations in the shea butter process. Finally, an ethnographic account was written .

CHAPTER FOUR

FINDINGS AND DISCUSSION

A case study report should include the following as suggested by Cresswell (2005); Leedy and Ormrod (2005):

- A detailed description of the facts related to the case: the specific individuals, programs, or events, as well as the setting.
- A description of the data collected. What has been observed, who has been interviewed, what documents have been used, and so on.
- A discussion of the patterns found. Describe any trends, themes, personality characteristics, and so on that the data suggested. At this point, the researcher is going beyond the facts themselves to his or her interpretation of the facts. Each pattern should be supported with sufficient evidence to convince the reader.
- A connection to the larger scheme of things. In what way did the study contribute to the general knowledge about some aspect of human experience? The researcher might compare the case to other, previously reported cases and note similarities and dissimilarities.

In light of the above considerations, the findings and discussion chapter included two main sections:

- The first section presented: description of the setting where the research took place; the participants who were observed or interviewed; the events; and the process.
- The second section presented: the account and the main themes found in the narratives in each village.

Section One: Description of the Setting, Actors, and Shea Butter Process

Setting

The study was conducted in three shea butter production areas. Information was gathered from published documents in each commune. Therefore, the available information varied, respectively.

Dio-Gare. The Commune of Dio-Gare covers 180.3 kilometers, and is bordered to the east by the Rural Commune of Diago, in the north by the Rural Commune Kalifabougou, in the south by the Rural Commune of Dongabougou, and in the west by the Rural Commune of Bassofala. The landscape is mainly hills and valleys. Dio-Gare is crossed by the railroad connecting Bamako, the capital of Mali, to Dakar, the capital of the neighboring country of Senegal. The main ethnic groups are Bambara, Peulh, Soninke, and Dogon. The main spoken language are Bambara and Peulh. Economic activities are primarily agriculture based, the majority of which consist of gardening and raising livestock.

Dioila. Situated 165 km southeast of Bamako, Dioila is 40 km to the south of Fana and 142 km to the west of Segou. Dioila has an area of 2961 square kilometers and a population of 6000 people (local statistics, May 1986). The population density is 17.64 people per square kilometer. Dioila includes 83 villages. The ethnic groups, Bambara and Peulh, practice agriculture and raise livestock and dominate the population. Some Sarakoles, Dioulas, and Mossis ethnic groups also live here and mainly conduct trading and transportation activities.

Zantiebougu. Bordered in the north by the Communes of Dogo and Debelen, the Zantiebougu Commune is also bordered in the south by the Communes of Garalo and Kebila; in the east by the Commune of Koumatou; and in the west by the Commune of Bougouni. The Commune of Zantiebougu is situated 27 km from Bougouni and 187 km from Sikasso. It has an area of 1500 square kilometers. The population is 31,316 people composed of Bambara and Peulh. The main economic activities in Zantiebougu are agriculture, livestock, timber harvesting, and trade.

The Actors or Participants Interviewed

Participants were identified as those who could best add to the understanding of the diffusion/adoption of technological innovations related to shea butter production. The individuals studied were young (approximately 20 years old), adult (approximately 40 years old), and older women (55 years and older). The population speaks Bambara, the national and most spoken local language in Mali. For centuries, the population has been producing shea butter in the same area. Believing in the force of group activities for

income generation, the participants were all members of a women's association in their village. In each village a traditional therapist was also interviewed about the use of shea butter in traditional medicine.

The Events

An interview protocol was used to elicit responses from participants either at focus groups or individual levels. The responses of the participants were recorded on videotape and audiotape. Some observations were done while the participants were processing the shea butter. Quality improvement training documents were also used for triangulation purposes to describe the new process for shea butter production.

The Process of Shea Butter Production: Traditional vs. New Technology

The production of shea butter included two main operations: 1) collection and pretreatment of the nuts; 2) extraction of the butter from the nuts. Each operation involved several processing steps. Shea trees were wild and not yet cultivated. Therefore, the first step of the process was to collect the shea fruits in the forest or in areas neighboring the village. The rest of the operation was conducted at the household level. Traditional and new technologies were used by participants in this study:

Traditional Shea Butter Processing Method.

- Collect the fallen fruit. This could mean a walk of about 10 miles or 15 kilometers. There are not many roads for vehicle travel in the African savannah even if a vehicle is owned.

- Carry the fruit to the processing area. The fruit in the head basket or head pan could weigh 20 and sometimes as much as 40 kilograms (about 40 to 80 pounds).
- Remove the pulp from the seeds by scraping, and store the fruit by burying in the ground until needed.
- Dry the seeds on traditional stove.
- Pound the seeds between stones to remove the husk or shell.
- Dry the fat-rich kernels.
- Reduce the kernel to kernel meal by pounding. This process takes hours and is done outside, sometimes in temperatures of 104 degrees F. (40 degrees C.)
- Roast the kernel meal.
- Mix the kernel meal with warm water; knead and churn to obtain a white foam.
- Boil the foam over a wood fire. A mass of Shea Butter will come together in the pot.
- Remove the oil as it rises. Remove the butter mass when it forms.
- Cool.
- Rinse the butter mass with water.

This process takes hours of female labor, scarce water and scarce firewood.

New Shea Butter Processing Method. During the last 10 years, governmental and non-governmental organizations, both African and international have become interested in the shea butter business. These organizations were interested in shea butter production for the following:

- It is a commercially desirable product;
- It involves women's cooperatives that help to ensure financial and social independence for poor women in poor countries;
- It is a fair trade product with a minimum of middlemen; and
- It uses a natural, renewable product from trees, which do not require treatment with pesticides or water for irrigation.

The many groups that are working to promote and modernize shea butter production have begun to introduce machines and new pretreatment techniques to save time and energy, and also to promote the quality of the final product.

Boiling/Drying the Shea Nuts before Extraction. Boiling, drying, and properly storing the nuts before extraction of the butter have been proposed for better quality management. This process has been tested by participants and consisted of:

- Collecting mature fruits which have fallen down from the tree;
- Removing the pulp of the fruits and wash to get the nuts;
- Boiling and drying the nuts for preservation before the extraction of the butter;
- Dehulling the nuts and grind them into a paste;
- Adding warm and cold water to the paste for churning to obtain whitish foam;
- Washing the foam several times with cleaned water;

- Heating the cleaned foam to separate the oil and the paste residue; and
- Cooling to thicken the shea oil.

Some of the machines were:

- Mills for breaking the outside shell;
- Solar nut kernel dryers;
- Mills for grinding the kernel;
- Mechanical shea butter churns;

Manually Operated Churning Machine Developed by University of Saint Thomas.

The mechanical shea butter churner developed by University of Saint Thomas was composed of:

- Larger pulley on crank;
- Brass bushings placed in crank post;
- Plastic handle added to crank;
- Crank moved to opposite side;
- Tension thread bar incorporated into shaft beam;
- Single piece of metal with slot used for vertical tension bars; and
- Drilled a hole in the post for tensioning bar and added a wing nut and washer;

With limited availability of shop tools in the village, the design of the mixing machine required minimizing the tools necessary for assembly. Wing-nuts were used to reduce the need for special tools in assembling the machine. All other parts were either hand-drilled or hand-tightened further eliminating the need for expensive tools. Screws were used to secure wood fixtures and a screw-driver set was left in the village to ensure

the local Malians would have adequate tools for constructing the machine. Cutting wood, drilling holes and alignment of parts were all done effortlessly by the local Malians. Welding would be completed by the local craftsmen. Working with the craftsman in Mali, it was evident that his capabilities and skills were exceptional for the work required to manufacture the blade assembly. Any failures or problems resulting from daily use of the machine would be easily maintained and fixed in Mali (UST, 2005).



Figure 5. Manually Operated Churning Machine Developed by University of Saint Thomas

Section Two: The Account

The content of the transcripts from the recordings was organized into themes according to the responses to the questions. Outlines were formulated according to participants' main thoughts, ideas, and perceptions regarding each question or group of questions. Based on the outlines, five main themes were identified from each of the three villages: 1) factors that support a new technology, 2) organization of shea butter

processing, 3) barriers for adoption/diffusion, 4) utilization of shea butter, and 5) comparison of shea butter quality from the traditional and new processing methods for its common uses in the village.

Factors that support a new technology included: women's initiative, education for women, shared responsibility for shea trees, information channels, how people welcome innovations, and other current issues in the village.

Narrative Account in Dio Gare Commune

Factors that Support a New Technology.

Women's Initiative. Women are free to introduce any kind of technology related to their income generating activities. Men encourage women to develop their economic situation. In their social system, women were well invested in the decision-making process and they were very independent. Men were not seen as the powerful influential gender in decisions regarding shea butter production. The idea of introducing the shea butter mixer was initiated by UST and not by women, but the women really appreciate and welcome it because it would increase employment in Dio and enhance their economy. All the new initiatives need teamwork and financial support, which the Dio women were missing at that moment. In general, for decision making, men, women, and the elderly were exposed to the issues and they make decisions collectively. The male participant reported:

“When Rahama Wright worked with us at Toubaniso (Peace-Corps volunteers' training center) for the first time, we stated that women were the main decision-makers in Dio. She was amazed. However, when she

came to Dio as a Peace Corps volunteer, she realized it. Women are very independent. If we can find ways to gather women around this activity, this will be well accepted.”

A woman stated, “We can use or introduce new technology without any influence of men on our decision, because shea butter production is not men’s job but women’s business.”

Education for Women. A male respondent stated that the education of women is beneficial for the village, and opportunities have been given to highly educated women to occupy outstanding positions in the government because of women’s capabilities. Additionally, all men and women were involved in organizing training sessions for shea butter processing or training in general. In terms of the participants’ choice for the training setting and styles, participants preferred face-to-face training with visual aids like video or film. One of the participants said, “For adult learners, explaining and presenting an image is more beneficial for learning.” They can complement the explanation of the trainer with the images themselves. Another of the participants stated, “In order to learn, Africans want to see it and do it.” From the point of view of the participants, as long as one stands up, regardless of age, a woman can learn something and do something for herself.

Shared Responsibility for Shea Trees. The respondents stated,

“If you consider the whole process of shea butter production, women can prepare shea butter; however, they cannot take care of the shea trees. Therefore, there is a gap between growing shea trees and making a profit from the butter. If we can have men in the village take care of the shea trees, this will be a good thing. We should share roles between individuals or groups of men to take care of the plots of the shea trees.

Within three to four years this will be a high-quality project with all those involved with the shea butter process, including those who now cut the trees down.”

Shea trees in a particular farmland belonged to family members. Women from the same household could collect shea fruits in the family farmland. The shea trees, which grow in the forest have no private property and were for public use. Some firewood traders in the villages, when short in other wood resources fetched the shea trees and they should be disallowed from cutting the shea tree in order to increase its population in the area.

Information Channels. The main information channel is through the women’s association weekly meeting. The participants reported, “The information is given to the president of the women’s association, who in turn informs all the women in the village through a meeting (topic, date, and place are given in advance).” Another information channel is the chief of the village. In the recent past, an experimental radio station 25-30 km in radius has been tested to diffuse or receive information.

How People Welcome Innovations? Participation of beneficiaries is important and necessary for the success of the project. When a new technology is introduced, few people are willing to approach it until they see its benefit. From earlier experiences, the male participant reported, “Most people want to wait and see how it will work. If the experience doesn’t work, they won’t approach.” He also reported,

“What our decision makers did not understand is that if you would like to bring a big change, you should ask the community concerned by the change. It is important to ask the question of how it will affect everyone involved. Villagers, public services, NGOs, and researchers should all agree on the change. As an

example: in Dio, they installed electricity devices in the villages without consulting everyone in the village. A few days later all the installations were stolen.”

Other Current Issues in the Village. In the past, participants relied on the train stop to sell their shea butter products, fruits, and vegetables to the train passengers. Now, because of political and management changes, the train stop is gone, and the participants no longer have an outlet for their products. One of the participants said, “There is a problem with the train now, we are lost! We never thought that the train would stop one day. Actually, we are not active because of changes in train stops.”

The participants’ main concern today is to have alternative activities besides those related to the train. Their new expectations are in shea butter and the dried mango markets.

Organization of the Shea Butter Producing System. Seven villages in the Dio commune were involved in the mixer testing and adoption. They all produced shea butter and converge toward Dio to sell their products. In some villages, women can collect shea nuts and fill three to four 200-liter tanks. Little by little, they process the shea nuts and sell their final product. The biggest market for shea butter was Kayes, the first region in Mali. Traders came from Kayes and bought the butter.

The shea butter production process is difficult and slow. With the introduction of the mixer, the work can be made easier, quicker, and therefore more productive. During the researcher’s interviews, the participants were planning quality grading (grade 1, 2, and 3). Each grade will be priced based on shea nut quality. One of the participants said,

“We train people to distinguish between the different qualities in shea nuts. Grade 1 is nuts from shea fruits which ripened and fell down with no germination. Germinated kernels give a bitter taste, which can only be suitable for soap making. Comparatively, immature fruits give low butter yield which is suitable for lipsticks only and would not be classified grade 1.”

The other two grades were not mentioned in the interview.

The participants learned that there is a preferred time to churn shea butter. It is not wise to churn shea butter during the hot part of the day. Either churn early in the morning or late in the afternoon. The male participant reported,

“The day of the demonstration of the mixer an old lady came into Dio to grind her nuts. We asked her to sell us her nuts for the demonstration; she accepted and then discovered the mixer. She knew how advantageous the mixer was in terms of time and labor saving. She said that her village would be happy to have this new tool. With our interaction with this lady we also learned something: there is a time to churn shea butter. This day the organizers of the demonstration were late in their agenda, the churning could not be done until after 12 PM when it was really hot, the old lady participant pointed out that churning should be operated during a cooler moment.”

Barriers to Adopting New Technologies. There is a financial constraint for the acquisition of the newly introduced mixer machine. According to the participants, “When you consider the cost of the machine a single woman or group of women cannot presently afford it.”

There was a lack of income generating activity for villagers. It has also been stated that women were not good planners; their concern was their daily food supply. One of the participants stated, “Usually, villagers cannot plan more than six months in advance. They think and plan on a day-to-day basis. Our concern is what we are going to eat today.” This is because the basic human need (food) is in short supply, and villagers are never sure where their next meal is going to come from.

There is a general economic crisis in the village. Their income related activity associated with the train station is no longer available. Women's expectation to revive their economic situation is based on a market for the shea butter.

General use of Shea Butter. According to participants shea butter is used as food oil and for:

- Baby's body ache
- Sore thorax
- Cold and cough
- Fever (put all over the body)
- Stomach ache in association with other plant leaves
- Skin swelling
- Sore throat (swallow a little bit)
- Body cream (in addition to incense)
- Massage
- Soap

Comparison of Shea Butter Quality from the Traditional and New Processing Methods for its Common uses in the Village. A traditional therapist is a person to whom people go to, who has traditional knowledge which has been handed down each generation, from mother to daughter or father to son. The traditional therapist did not find any difference between the two technologies in terms of efficiency to heal the diseases, but the housewives using the shea butter for cooking or cosmetics did find differences.

Before the introduction of the machine, traditional therapists in the village used shea butter from the traditional process for the above uses. The therapist interviewed stated,

“New technologies do not make any difference for the common uses of shea butter. Since the introduction of new technologies in shea butter processing, we used shea butter from both technologies. For the use of shea butter in the traditional medicine, there is not any difference between the shea butter from the traditional and the new processing method.”

The new technology, which consist of boiling/drying of the nuts and properly storing them before extraction seemed to improve organoleptics (such as butter color, smell, and consistency). One of the participants who approved the new technology because it reduced the steps in the production process, she said:

“There is a difference between the precooked dried nuts (new processing methods) and the traditional process. The butter from the traditional process has some off-odors and flavors. In the traditional drying method with firewood, the nuts get a smoky smell, which is not as valued. In the boiling system there is no off-smell. After boiling, you don’t need further grilling, but you have to dry the nuts for at least 5 days. After drying the boiled nuts, you can directly mill which then will get the same the type of paste as you do with the traditional stove.”

Narrative Account in Doila Village

Factors that Support a New Technology.

Women’s Initiative. Culturally, women were respected and their decisions and needs were given priority by administrators. From the point of view of the participants, women played an important role in their society. One of the participants said, “We even asked for some hectares of land to grow shea trees; this has been accepted by the representative of the government (the mayor).”

Education for Women. The participants relied on their ability to master any innovations, and to them, age did not play a role in who was trained and who was not.

The participants said,

“What our generation is learning about shea butter is more than what our mothers and the generation before learned. We will have the responsibility to transmit our knowledge to the next generation, and they can learn more than what we pass on them. At the busiest time (rainy season), while the youngest are in the field, older people (65-70 years old) can help at home in activities such as removing the pulp, washing, and boiling the nuts after collection. At nighttime, the youngest can continue the pretreatment. Everybody deserves knowledge regardless of their age.”

These women have a preference for farmer-to-farmer transmission of information with visual aids. The program coordinator of the new project (funded by the United Nations for Industrial Development Organization) stated,

“If the village women gain skills, they will be motivated to train others and these skills will remain forever. Information will be transmitted from generation to generation. We also need visual aids like books. This type of training setting is more sustainable for them because project training stops with the end of the training session. Women continue the transmission to others in their targeted villages. Training is usually organized and funded by supporting services.”

Shared Responsibility for Shea Trees. Women were planning to cultivate shea trees to increase productivity. This may require the help of men for planting and taking care of the shea trees before they bear fruits.

Information Channels. Over the last ten years in many areas, women have been organized into an association. Generally, associations met locally or their representatives participated to meetings in Bamako at the Headquarter of National Women Association Coordination (Coordination des Associations et ONG Feminines: CAFO) or the Ministry

in charge of Women/Children/Family Promotion (Ministere de la Promotion de la Femme, de l'Enfant et de la Famille), and this is how they got most of their information.

One of the participants said,

“The program coordinator of the new project is a very active woman and well informed; she is the one who gives us much information, and organizes meetings with all the women associations in Doila. During these meetings, information collected from the National Women Coordination is dispatched to us.”

How do People Welcome Innovations? The participants affirmed that, “Access to knowledge was not easy for us, because we did not know it existed and where to get it. We got access to these new technologies through a project funded by the United Nations for Industrial Development Organization.” The technologies were more than welcome, because they are less arduous and also improve the quality of the product and then the price, even on the local market. The Project coordinator alleged,

“If you apply the new technology, you sell your butter for 350 FCFA* per kilogram versus 150 FCFA per kilogram. The cooperative at the village level sells to the center for 500 FCFA per kilogram. Once in the center, we refine and condition the shea butter in plastic containers and this shea butter sells for 750 FCFA per kilogram. Villagers start to consume the improved shea butter, because it tastes better. This is already an impact.”

*FCFA is the national currency of Mali. One American dollar is equivalent to 516 FCFA in July 2006 (Xe.com Interactive Currency Table, 2007).

Other Current Issues in the Village. The crucial problem is the lack of an external market for shea butter. The aim of the villagers is to meet outside market requirements using their own tools. The Program Manager said,

“We need to sell all our products in order to motivate women to produce more of the quality we require. If we cannot sell, nothing will work. We count on support

services' assistance to find markets for us. Actually, in terms of quality control, we need to be more equipped and have more tools to be able to meet the norms and standards. This is our worry now. We want to be able to analyze moisture content, acidity, etc. If we could directly export our shea butter there would be a significant increase in our profits. If we sell our butter in Mali we lose part of our profit.”

Organization of the Shea Butter Producing System. According to participants, there has been a big change in the shea butter processing. With the event of the project Supporting Women Associations for Shea Butter Development, women in the villages are advised to give up the underground storage of the nuts. One of the participants reported,

“The shea nuts are boiled now as part of a new technology before storage and extraction of the oil. When the new processing method is applied, the shea butter has a better quality (taste, flavor, color) and consequently a better price even at local market for 350 FCFA per kilogram instead of 150 FCFA per kilogram.”

Barriers to Adopting New Technologies. There was a financial constraint for the acquisition of the machines recently introduced to mechanize all the steps involved in shea butter processing. All the participants agreed, “We cannot individually or collectively afford all of these machines.”

General use of Shea Butter. According to participants shea butter was used as food oil and for:

- Food
- Baby's body ache and fever
- Broken bones
- Body cream
- Massage

- Soap
- Source of revenue

Comparison of Shea Butter Quality from the Traditional and New Processing Methods for its Common uses in the Village. The traditional therapist did not find any difference between the two technologies in terms of efficiency to heal the diseases, but they found differences in organoleptic properties like color, smell, and viscosity. Shea butter from the boiling process seemed to have a higher quality. Because the drying on traditional stoves was skipped, the risk of burning was also avoided. Therefore, there was a higher recovery rate.

Narrative Account in Zantiebouyou Village

Factors that Support a New Technology.

Women's Initiative. Participants affirmed, "Regarding shea butter processing we as women make decisions."

Education for Women. All ages contribute to the procedure of shea butter processing. Children (male and female) help their mothers collect and carry the nuts to the house. Even grandmothers help because they give food to babies while the mothers are in the field. To learn better, participants prefer to have books, images, and face-to-face exchanges as training techniques. In terms of training needs, cooperative management was their main concern.

Shared Responsibility for Shea Trees. In terms of shared responsibilities regarding the protection of trees, men and women decided together.

Information Channels. One participant stated, “Information is not easily available, Internet is not accessible, and information sources are not diversified.”

How do People Welcome Innovations? One participant reported, “We always test and adapt new technologies to be lined up with our state of production.”

Other Current Issues in the Village. The main issue the participants were facing was to find an external market to sell their products. One of the participants asserted, “We want to expand our market to the USA, but do not have any contacts, we lack market information.”

Organization of the Shea Butter Producing System. To improve the quality, new technologies have been introduced in shea butter processing, like the grinder; triage (removing germinated, shrunken, and insect damaged kernels); boiling the nuts three days after the collection of the fruits; washing of foam seven times; and to avoid a bad smell, boiling a small amount of water and adding the foam to it during the oil recovery step. It was noted that women preferred the manual churning to the mechanical method, because they get a better result (higher extraction rate and higher quality butter) even though it was time and energy consuming.

The cooperative was producing two grades of shea butter sold at different prices and different places (grade 1 and grade 2). Grade 1 is sold in Canada for 3500 FCFA per

kilogram. Total annual sale is 70 kilograms. Grade 2 is sold in Bamako for 1000 FCFA per kilogram.

Barriers to Adopting New Technologies. Participants believed that the process is time consuming. Nevertheless, the women judge that if one wants money, one has to take time.

The Zamtiebougou village participants did not have easy access to market information (no connection to the Internet). In general, there are not many information sources and there is little sharing of technological knowledge. The president of the cooperative reported, “Our main source of information is Bamako which is 200 kilometers from Zantiebougou.”

In terms of ethnological account, the researcher observed the participants were not the main initiators of the technologies introduced in the shea butter processing, but most of them appreciated the innovations because of time and labor saving rewards. The majority of the participants still preferred the traditional manual churning in the face of the advantages of the machines because they assume that it has a higher extraction rate and higher quality of the end product.

For quality improvement, boiling and drying the nuts before their storage was being practiced in much of the study area. Participants were aware of the benefits of the pretreatment and their main concern was to find an external market and be equipped to meet the international standards.

Boiling also took time, some women spend a long period of time boiling their nuts at night. Drying is the other constraint; sometimes children were asked to watch

them. During the very rainy season (August), stoves were used for drying with low fire (wood, charcoal). To participants, the churning machine would never give the recovery rate and quality butter one produces from the manual churning. But, it saves time and human energy.

General use of Shea Butter. In the past shea butter was used for:

- Food (cooking oil)
- Muscle aches
- Heal the stump of the umbilical cord until it falls off
- Stomach upset in newborns (shea butter and lemon juice in hot water)
- Adults' stomach wounds

Today, in addition, shea butter is used for:

- Revenue
- Body aches
- Fever in newborns

Comparison of Shea Butter Quality from the Traditional and New Processing

Methods for its Common uses in the Village. Traditional therapist participants did not find any difference between the two technologies in efficacy of shea butter in traditional medicine. Women participants found differences between the boiling/drying and the traditional processing in quality criteria:

- Color
- Smell

- Taste
- Consistency
- Organoleptic properties

CHAPTER FIVE

CONCLUSION/IMPLICATIONS/RECOMMENDATIONS

Summary of the Findings

All interviews contributed to satisfying the four main objectives of this research in significant ways as summarized below.

Objective 1: Identify Social, Situational, Institutional, and Dispositional Barriers to the Adoption of New Technologies in Shea Butter Processing

While those factors affecting the decision to adopt a technology varied from person to person and community to community, in the three study areas, any social barrier regarding the adoption of new technologies in shea butter processing was noted. When compared to the past, rural women in these areas were becoming free to decide for themselves which activities they pursued. Certain of these activities formerly were seen only as “women’s affairs”. The study revealed a financial constraint because an individual woman could not afford the labor-saving mechanical device. Another constraint was found regarding the overlapping of field activities in the rainy season, especially regarding boiling and drying the nuts. The boiling/drying of the nuts before extraction presented quality improvement advantages, but boiling either needed to be done late at night or required help from other family members. Women in Zantiebouyou were using a mill to grind the shea nuts after boiling/drying, but preferred the traditional hand-churning because they believe it yielded a higher recovery rate of shea and a whiter

foam. In Dioila, the women's association supported by UNIDO (United Nations for Industrial Development Organization), worked in a facility where most of the operations were mechanized, but individual women still practiced hand operated processing and the boiling/drying pre-treatment process.

Although the boiling/drying process presented some constraints, most of the participants were willing to adopt it because of the higher quality shea butter they produced and the increased revenue they got from the sale. This indicated women were interested in increasing profits, even if the process was relatively longer.

External market information and accessibility were other issues presented by participants. The main goal of this research was to help shea butter producers manage quality and efficiency of the process and better their lives through the sale of the product. This goal could be achieved through external market development. Derks (2005) analyzed the same issue in case study aiming to find ways to facilitate business services for shea producers in Mali. An assessment of the subsector showed that shea producers lacked access to higher value markets and needed quality management services to help meet markets standards. The assessment also showed that subsector intermediaries - exporters of shea butter and shea kernels - were best positioned to provide such services and benefit from increased sales of a better-quality product. By facilitating exporters' capacity to connect with foreign buyers and manage shea butter quality, exporters would invest time and resources working with producers to improve product quality (Derks 2005). Action for Enterprise (AFE), assisted by USAID, facilitated the existing and potential shea exporters/traders. AFE believed that those exporters/traders could serve as

the primary providers of market access and quality control. But, women producers of shea butter interviewed in this case study would prefer to connect directly to external market buyers, thereby shortening the commercialization pathway and increasing profit. They believed those intermediaries did not value their product, regardless of quality.

Objective 2: Identify the Information Channels used by the Target Audience that Influence their Ability to Receive Information on New and Innovative Production Processing Practices

The identification of effective channels in the dissemination of useful agricultural information on new and/or innovative technologies tended to improve the flow of information between farmers and researchers (Malton et al., 1984). For this reason, the participants were asked to describe how they had received information in the past. The responses allowed the researcher to gain understanding of how information circulated throughout communities regarding innovative technologies. Most of the participants received information in weekly meetings, from opinion's leaders or from a radio station at the village level. Some information was also be collected from the Malian women's associations headquarters in Bamako, the capital of Mali (some participants had access to market information through Internet). In general, information sources were not diversified and there was little sharing of technological knowledge. In some of the study area there was an extension agent or some Non Governmental Organizations (NGOs) who also contributed to informing the populations. Regarding the dissemination of information concerning shea processing technologies, most was done by community leaders.

Objective 3: Identify the Preferences for Receiving Training on New or Innovative Practices Associated with Producing and Marketing Shea Butter from Harvest to Retail Markets

Riesenberg and Gor (1989) reported that farmers preferred interpersonal methods of receiving training and also supported position that age was an important factor to be considered in that choice. The present study confirmed the same tendency. Most of the participants preferred face-to-face interaction with visual aids to contextualize their training. They also believed that word-of-mouth, farmer-to-farmer knowledge distribution was more sustainable, and this way of knowledge transmission was highly valued, especially the transmission from one generation to another. Regarding sustainable training, the participants perceived on-site trainers and continuously accessible resources like DVDs and manuals as examples of sustainable knowledge distribution. The on-site trainer had the ability to customize his or her instructions to the local climate and conditions.

Objective 4: Collect and Organize Baseline Information that Could be used in Future Development of Diffusion and Adoption Plans for Technological Innovations

The baseline information the researcher found in this study was:

1. Social barriers were not an issue for adopting new technologies in shea butter processing.
2. Economics was an issue for acquiring mechanical devices.

3. Time, both situational and dispositional, was a barrier, but if profits were insured participants will be committed to adopt the technologies, especially for the boiling/drying.
4. Communication styles and channels were not well established, regular, or effective.
5. Knowledge was valued. Oral culture, where the language was rarely written, predominated. Participants wanted to have a trained person from the village that could train others in the community.

In conclusion, the study revealed that the appropriateness of time and labor saving technologies for women depend on: 1) the relative cost of the technologies; 2) the accessibility of information on new technologies; 3) the arduousness of the work avoided; 4) the economic status of the households' and women's associations; and 5) the productivity of the participants in other economic activities.

A strategy for disseminating any given technology must be based on clear identification of the target beneficiaries and their resources, their preferences, and constraints. The involvement of the beneficiaries in the design process of the technological innovations is essential for their acceptance and adoption.

The study reconfirmed the conclusions of Hyman, et al. (1988), that external technical assistance from developed countries can play a vital catalytic role in upgrading traditional rural technologies. Nevertheless, the top-down technical assistance was not needed. The new technologies had to be requested, and an understanding of the local

context for their application and a strong field presence were important for designing and testing through dissemination.

Implications

The implications of the study traversed different publics and institutions. The study collected the perceptions of participants on two new technologies: the boiling/drying of the nuts prior to extraction and the manually operated churning machine used in shea butter processing. These technologies presented both common and different implications.

Boiling and Drying the Nuts for Quality Management of the Shea Butter

The boiling/drying process was intended to improve the quality of the final product, and; therefore, allowed women to store the nuts longer, because microorganisms and insects were killed and lipase was inactivated. If the nuts were boiled and sun dried, the women were not so likely to let the nuts burn as when they were roasted. The resulting increased quality will lead to more volume and larger markets.

The boiling/drying process, on the other hand, increased the processing time. Shea nuts collected in the rainy season, which was a busy time for rural women, may be a problem. For quality assurance, boiling the nuts within three days after harvesting, (which corresponds to the busy time) was recommended.

Drying might also be a problem due to the absence of sunny days during the rainy season. This may require monitoring and controlling the nuts spread on drying mats in

the house yard to protect from rain. If the women cannot control the drying process, other family members (elders and children in the household) may be involved. Another possibility was access to solar or gas dryers, which will require additional funding.

The Mixer as a Means to Reduce the Labor Requirement in the Churning Process

The development and adoption of mixers will likely create new jobs for those who build them and make them available in the shea butter production areas. The mixer was a labor saving device, and women could use the time saved to conduct other income-generating activities. The extra money earned could be used to improve family diets, provide access to the education of their children or improve the women's own well-being. The cost of the mixer could be a financial problem for individual women; therefore, women needed to be in an association or cooperative. This will require some management training for the members.

Implications for Both Technologies

The increased quality of the shea butter and the reduction of labor intensity will improve the productivity, efficiency, and effectiveness of the process.

An effective outreach of these technologies will require Government, Non Government Organizations (NGO), and community involvement and cooperation. These organizations would be expected to assist with diffusion as well as with setting up micro-finance facilities and training facilities for the use of the new technologies.

Recommendations

Based on issues identified in the case study, the following recommendations were made:

Shea Nut Harvesting and Butter Production

Men should be encouraged to help women care for shea trees and governmental policies should be developed to protect shea trees. Women should be helped to have shea trees plantations and reduce certain constraints related to shea fruits collection such as long distance walk and insecurity of supply. Knowing the long agronomic cycle of the shea species, these actions could benefit future generations.

Training Programs for Mixer use and Quality Management in Shea Butter Processing

Governmental and non-governmental agencies should collaborate to develop an extension-training program. Effective outreach needed several holistic workshops, lobbying, and awareness of all the decision makers.

Further, assistance should be provided to organize women in cooperatives and train the members in cooperative management and marketing. The governmental and non-governmental agencies should also provide essential training to potential community educators in adult teaching methods and shea butter quality management methods. All training programs should use visual-aids like books or posters, with emphasis on interpersonal methods. The focus should be on demonstrations to facilitate a better understanding and uptake of the training on the innovative technologies.

Most of the dissemination of information regarding shea processing technologies, being done by community leaders, and they needed to be empowered for a better flow of information. The efficiency of the channels presented by participants merited further research.

Knowledge was valued. It should be transmitted using visual and oral techniques. Therefore, to improve technologies, outsiders must acknowledge that learning and information distribution is acquired both orally and visually.

Development of Business and Job Opportunities

The researcher recommends training local blacksmiths to construct and market the manually operated churning mixer. Young people should be trained in entrepreneurship to produce and sell the mixer.

Market Development

All the decision makers, those were women producers of shea butter should share the same goal and coordinate their actions for the development and promotion of a Mali shea butter brand.

Women producers should be empowered to have access to external market directly. As AFE did for Malian shea butter exporters/traders, assistance should be given to women to build their skills in market access and communications techniques (e.g. effective use of email and Internet, customer service, brochure development, etc.) as well as cost-benefit analysis. Community Learning and Information Centers' facilities (initiated by USAID in 2002), could be used in some communes to facilitate

communication with external markets. Other alternative communication channels should also be used (personal contacts, participation in international fairs, networking, etc.).

The Malian government and / or NGO's should provide financial assistance in the form of grants or low-interest loans to women's cooperatives in order to enable them to have access to innovative technology.

Future Research

Based on the findings and conclusions of this research, future research should examine the following issues:

- Compare the recovery rate and the quality of the shea from traditional processing means and from new ones (boiling/drying and mechanical churning machines).
- Develop a plan and an evaluation program for the large-scale diffusion of the two technologies (boiling/drying the nuts before extraction, manually operated churning machine).
- Study the efficiency of information channels in the villages.
- Investigate whether a correlation exists between labor intensity, labor-saving technologies and overall health of Malian women who produce shea butter.
- Evaluation of the effectiveness of external markets and cooperative marketing systems as they are developed.

- Because the boiling/drying process presented additional labor and energy constraints, alternative solutions and additional technologies need to be investigated.

Additionally, follow-up studies to this research should be conducted to examine:

- How the increased quality of the shea butter and the reduction of labor intensity will improve the productivity, efficiency, and effectiveness of the process, and how those improvements will impact quality standards as well as supply to international markets.
- How the economy of the Mali will be impacted due to the influx of foreign currency driven by the demand for shea butter at external markets.

The findings of the future research proposed will certainly generate new information on the efficiency of the innovative technologies for a better acceptability and adoption by the users.

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APPENDICES

APPENDIX A

CONSENT FORM

Montana State University, Institut d'Economie Rurale, University of Saint Thomas and Shea Yeleen are willing to conduct a study for the diffusion of technological innovations for labor and quality management in shea butter production. This study is directed toward women producers of shea butter in your village.

This form is provided to have your consent in participating to the study. We insure you that the information you will be given will be anonymous and confidential. The purpose of this study is to describe the perceptions of rural women who harvest and produce shea butter toward technologies that improve the efficiency of shea butter production, the study aims the following objectives.

1. Identify social, situational, institutional, and dispositional barriers to the adoption of new technologies in shea butter processing
2. Identify differences in adopter characteristics as related to preferences for receiving information on new or innovative practices associated with producing and marketing shea butter from harvest to retail markets

The information obtained from this study will be analyzed and a feedback will be given to the village for appropriate decisions to be taken for intensity and quality management in shea butter production.

There are no foreseeable risks to the participants involved. In addition, any participant may withdraw from the study at any time.

Specific information about individual participant will be kept strictly confidential. The results of this study will not reference any specific individual by name. By signing this form you acknowledge that you understand this information and agree to participate cooperatively.

Signature

Date

APPENDIX B

COVER LETTER

March 1st, 2006
Mme NDiaye Assa Kante
Department of Education
Student at Montana State University
Bozeman, MT 59 715

Dear,

The Department of Agricultural Education at Montana State University is interested in identifying your ideas, interests, and perceptions of introducing technological innovations to help you overcome some of the processing constraints in shea butter production and improve the quality of the final product for international markets opportunities.

We would appreciate your collaboration for conducting an interview on the subject.

We realize that your schedule is busy and your time is valuable. However, we hope that the time it will take you to participate to this interview will be helpful for developing an effective and efficient diffusion plan of technological innovations in shea butter production.

Thank you in advance to your participation. If you have questions about the study, you can contact me.

Yours truly.

Assa Kante

APPENDIX C

INTERVIEW PROTOCOL

Project title: Perceptions of Rural Women about the Introduction of Technological Innovations that Increase Quality Shea Butter Production in Mali

Time of interview:

Date:

Place:

Interviewer:

Position of interviewer:

(Briefly describe the project)

UST collaborated with the women's butter in Dio in Mali to design and test a mixer that optimized the mixing process. Mixing time was successfully reduced from several hours to thirty minutes (UST, 2005) while meeting all other engineering and customer design requirements. IER, MSU and UST would like to disseminate their innovations, such as the machine and the quality control methods for shea butter production (Kante, 2004).

The effective distribution of this technology will help reduce processing labor input, help improve the quality of shea butter and increase income among the most marginalized groups in Mali.

Questions:

The following research questions were identified:

1. What are the perceptions of rural women who produce shea butter regarding the training program on “Quality Management” of shea butter production? How did the women respond to the “manually operated mixer for churning” that will improve the efficiency of shea butter production?

2. What knowledge do rural women have on available new technologies in shea butter production?
3. How should training programs intended to introduce new technological innovations related to shea butter production be designed?
 - What was the format of the training provided in the past:
 - How is the need assessment organized?
 - How is the training usually organized and delivered?
 - What activities follow the the training?
 - How do rural women prefer to be trained?
4. What are the barriers to the availability of previous knowledge on quality management and the manually operated mixing machine?

A. Situational:

- What new technologies or ideas have been adopted in your village to make life easier in the past 10 years?
- What new strategies have been adopted to make food production and processing easier or more efficient?
- What has been the cost of the new technologies introduced in your village over the last 10 years?
- How much time do you have for other activities by using these technologies?

* May require follow up questions

B. Social:

- What is social status of women in your village?
- Is it the men or women who decide?
- Do you have the power to make decisions regarding the purchase and adoption of new technologies?
- Do women have the freedom to use the resources generated from the sale of their shea butter? If yes how? If not why?
- How do you share the profit generated from the shea butter sale if you the nuts are collected from your husband's field?
- Age?
- Are there age issues in acquiring new knowledge?
- How old does a woman need to be in order to convince other women?
- Is it important for women to be married to have authority? What is the reason for this?
- What are the status features that affect the respect of women?

C. Institutional:

- What infrastructures exist in the community to provide with you new knowledge or technology that helps you solve problems?
- What type of information do you receive? How do you receive it?
- How often do you get it on diffusion activities?
- How do you acquire the content of the training program for new technology?

- Are you involved in the process of setting up training programs for new technology?
- What responsibility do you have in determining new technology training?
- How would you like to receive information about new technology?
- What mediums would you prefer? Choices

D. Dispositional:

- What knowledge do you have about Shea butter production and processing?
- What specific topics related to Shea butter production do you believe your village coworkers need the most training?
- What is the area of shea butter production in your village that needs to be improved in order to receive more money from the she butter sales?
- What is the level of confidence in your ability in cultivating, harvesting, processing, and selling shea butter?
- Do you think one can be too old to engage in education? Explain.
- What difference do you find between the traditional methods and the new technologies?
- Is there any difference between the new technology and the traditional one in terms of:
 - Labor requirement
 - Easiness

- Economics, If yes How? and why?
- Quality of the end product. If yes what is the difference? (taste, flavor, color, texture, etc.)
- Are you ready to convert your practice for the new technology?

(Thank individual for participating in this interview. Assure her/him of confidentiality of responses and potentials future interviews).

APPENDIX D

COMPLETE INTERVIEW TRANSCRIPT IN DIO STUDY VILLAGE

DIO: INTERVIEW

A woman participant said, for this interview to be helpful to you, it is necessary that a male participant should accompany me. Any female activity with no men is not decent.

- I. What knowledge do rural women have on available new technologies in shea butter production?

Male participant: When a new technology is introduced few people are willing to approach it. Most people want to “wait and see” how it will work. If the experience doesn’t work, they won’t approach.

What our decision makers did not understand is that if you would like to bring a big change you should ask the neighborhood concerned by the change. It is important to ask the question of how it will affect everyone involved? We all should agree on the change. Example: In Dio, they installed electricity devices in the villages without consulting everyone in the village. A few days later all the installations were stolen.

If you do not involve the entire village with your ideas and projects, your project will fail. Your ideas won’t have any follow-up or results. No one in the village will be interested in this project. It takes the entire effort of the village!

- II. How should training programs intended to introduce new technological innovations related to shea butter production be designed?

Male participant said: I can work with anybody regardless of the age and philosophy of that individual. The teacher has to modify his teaching techniques to match the students comprehensive ability.

People do not rush into a new thought or technology. They think those who are doing it “don’t have anything to do” until they benefit from the new skill. If you tell people go get information and knowledge you should also show them what practical benefit they can gain. Presenting the benefit can be a partner to reaching new innovations. An example would be to have support to get more mixers.

The day we had a demonstration of the mixer with the researcher, an old lady came in Dio to grind her nuts. We asked her to sell us her nuts for the demonstration, she accepted and then discovered the mixer. She knows how advantageous the mixer is in terms of time and labor saving. She said her village will be happy to have this new tool. With our interaction with this lady we also learned something: there is a time to churn shea butter. It is wise to not churn butter during the hot part of the day. Either churn early in the morning or late in the afternoon.

What is the level of self-confidence in your ability to learn?

Women participant: We are able to learn.

Do you think one can be too old to engage in education? Explain.

Women Participant: Eyes may be a problem. As long as you stand up, regardless of the age you can learn something and do something for yourself.

How is the training usually organized, delivered?

Women Participant: All men and women are involved.

How would like to be trained?

Women Participant:

- Books
- Film
- Trainer (face-to-face)
- Images alone cannot be understood by everybody in the same way.
- Older people have difficulties to read or understand images or interpret them.
- It is better to have to have someone training you face-to-face and explaining to you clearly
- To summarize, there are two things essential: the trainer and the visual-aids (video, film) are essential
- Example: If there is a new song on TV, 3 days later all the kids know how to sing that song, this means that it is very quick medium for children.
- For adult learners: explain and present an image is more beneficial for learning. They can complete your explanation with the images
- Reading books is not favorable to the villagers.

Follow-up question: Do you have easily access to DVD system for film projection?

A Male participant: We can easily get access to DVD player using the car battery or solar energy. The DVD system is low in cost and can match with our revenue as a group. Farmer-to-farmer training already exists. Example: a loan trainer visited a village and spread the information on obtaining money loans for business. This information was then spread among other women in the area (farmer-to-farmer). For

African to learn, they want to see it and do it. Farmer to farmer training is more convenient for us because in the rainy season we are all busy and we do not have the same type of activities. Training during the rainy session is not convenient. Books can be used any time; children can help us read the books. In group training, we prefer to learn from an image like videos or films.

III. What are the barriers to the availability of previous knowledge on quality management and the manually operated mixing machine?

Situational:

What new things have been adopted in your village to make life easier in the past 10 years?

Woman Participant: There has been no new technology introduced the past 10 years except the churning machine from Saint Thomas University (U.S.A.). The old technologies we have are for cereals, which are for milling cereal, grinding of shea nuts and plowing machines. This is the first time we have received a technology to process shea butter. We have already dispersed equipment such as the cereals mills. The women worked with UST team to develop a shea butter machine by giving their ideas for improvements on already existing shea butter churning processes. The Malian women were able to incorporate their ideas during the testing for improvements with the technicians and engineers.

When you consider the cost of the machine a single woman or group of women cannot presently afford it. For these reasons we think that shea butter activity can be a good one for our population.

What new things have been adopted to make food production and processing easier or better?

Women Participant: The mills reduced the labor requirement in cereal and shea butter processing. We used to pound 10-20 kg of shea nuts by hand; ten women or more would help to process it into paste. This process is fading with the introduction of the mills.

What has been the cost of the new technologies introduced in your village over the last 10 years?

Woman Participant: The new technologies have increased our expenses, because we need to pay for the services to use them (cereal mills; plowing machines, etc.). On the other hand, they reduced the work intensity and load. The time saved is used to conduct other activities.

Can these activities generate income?

Women Participant: Yes, for example while you are watering your garden your children can take the cereal to the mill.

Social:

What is the social status of women in your village and culture?

Women Participant: If you consider the whole process of shea butter production, women can prepare shea butter; however, they cannot take care of the shea trees. Therefore, there is a gap between growing shea trees and making a profit from the butter. Birds and other seed carrying animals drop seeds onto the shea tree's branches. These seeds then plant themselves into the tree. These new plants become grafted onto the limbs of the shea tree and are destructive. "Shea grafting" prevents the tree from getting its potential fructification, thus reducing its productivity. If men can take care of the young trees while older ones are producing fruits, then there could be an increase in fertility of the trees.

Presently men are cutting shea trees for income as firewood for domestic cooking. They cut the shea trees because they are easier to cut in comparison to other species of trees in the area. If we can have men in the village take care of the shea trees, this will be a good thing. We should share roles between individuals or groups of men to take care of plots of shea tree. Within 3-4 years this will be a high-quality project with all those involved with the shea butter process, including those who cut the trees down. The reason men cut the shea tree is because of its high population and the quality of its trunks for building. Also you can spend a whole day trying to cut a single species of tree with little result, while 20 slashes with a knife on a shea tree is enough to cut it down. If men are stimulated with other activities they will have a reason to take care of their precious shea trees instead of removing them.

In "Kati cercle", we have to be proud of ourselves, because we believe that women should be provided with an outstanding position in our society. When Rahama

Wright worked with us at “Toubaniso” for the first time, we stated that women are the main decision-makers in Dio, people were amazed. But, when she came in Dio as a peace corps volunteer, she realized it. Women are very independent. If we could find ways to gather them around this activity, this will be fine. Presently it is difficult, because they are mainly worried about the daily food supply. If there were a paved road we could get access to surrounding markets. We need ways to be able to express our expertise. In Dio, we have talented fabric dyers, soap makers...etc. However, if we don't have partners funding our initiatives, it will be difficult for us to get ahead.

What is social status of women in your village? Is it the men or women who make decisions?

Women Participant: We can use or introduce a new technology without any influence of men on our decision, because shea butter production is not men's job but women's business.

Male Participant: I visited 7 villages in the commune of Dio; men think that if women can get resources to cover their basic needs, this will be a relief for them. Men were pleased to have the churning machine. What we need to do is to gather men and women in each village and tell them the role of each gender group in the shea butter production.

Are there gender issues in terms of acquiring new knowledge or technology?

Male Participant: If women are provided with a higher education, such as University training, they will have the opportunity to share their new skills with a village. They will have the ability and creativity to bring new projects to a village in need. Our

deputy is a woman (representing our “cercle” at the national assembly). Men have not been as successful in bringing new projects to the villages.

Age and decision making:

Male Participant: Young and older people collect the fruits. Women over 65 years old are not involved because they have weakened with age, but in terms of cultural respect they can be informed. For decision making, men, women, and the elderly are exposed to the issues and collectively make decisions. Men are not seen as the powerful influential gender in decisions on shea butter production.

It is the decision of men to introduce new technologies like mills. Then, we organize ourselves to manage these machines.

Do you have the power for decision-making regarding innovations (can you make the decision to buy or adopt new technology)?

Women Participant: All villages are not the same. In Dio most of the population are civil workers and we have different rules from the ones in the villages. In Dio, we have the power to decide for ourselves, but in the surrounding villages no decision could be made without the chief of the village and his committee. The village leaders who are mainly men decide our meetings.

How do you share the benefits from the sale of shea butter if the nuts are collected from the husband’s field?

Women Participant: All married women process the shea butter for cash to cover daily needs. We can collect the nuts anywhere. We can collect the fruits from any field even if it is not in our own.

How old does a woman need to be in order to convince other women? Is it important for women to be married to have authority?

President of the Women's Association: To be heard in the village you have to be a reliable person. I am retired now, but since I came in Dio in my 40's, all the women even older than me have given me responsibility to lead them. Age does not necessarily play a role in being heard in the village. There is more than one association in the village; an age-group association (old, adult, young) is also used to be chosen as a leader.

What are the characteristics of status that affect the respect of women?

President of the Women's Association: The women have to be reliable and respected by their husbands. As you respect the people and the people will respect you. Adjust yourself to the level of the population, do not show off or show you are superior. You need to have good behavior and try to understand people.

What difficulties do you have about Shea butter production and processing?

- Cooking fuel
- Grinding
- Collection of the fruit from long distance and risk to be attacked by wild animals
- After collection if you not dry the nuts within 15 days they will go bad
- After drying if you do not have an appropriate storage device or condition the nuts can be moist and rot.

For your village, what is the area of Shea butter production that needs to be improved in order to receive more money for the Shea butter sold?

Women Participant: We do not get enough profit. The effort we put in the processing is not rewarded. We need to be in a cooperative. Buy or collect the nuts as a group. Produce the shea butter together and sell it. We can buy and store the nuts.

Institutional:

What infrastructures exist to provide you new knowledge or technology that helps you solve problems?

Women Participant: We have some infrastructures: an extension agent is in the village. There is also an NGO helping us.

How do you get it? And how often do you get it on diffusion activities?

Women Participant: We did not receive any training. The mayor is our main source of information as well as TV and radio.

Do you have access to technology when you need it? In other words what infrastructures exist to provide you new knowledge or technology?

Male Participant: The idea came from Rahama, she was here during a short period of the shea season, and she then observed the difficulties women were facing. Later on, she came along with a mechanical engineer team (from UST) with the idea of constructing a shea mixer machine. Rahama was also aware of the non-absorption of the mangoes by the market in Dio and she promised to think about the two issues. Last year the UST team did the conception of the machine and traveled to Mali for testing. They said they propose it but they don't impose it. We are the final decision makers in the advancement in technology.

There was a superior mixer at UST, which the engineers reduced in size to meet our traditional practices and economical situations.

The first year we helped them build the machine with our ideas. The second year, they came with the prototype we tested.

This year they came with a solar water-purifier we tested but which needs further adjustments (the thermostat needs to be changed for a plastic one to avoid rusting).

The idea of introducing these technologies was not our initiatives, but we really appreciate and welcome them because they will increase employment in Dio.

When we form a cooperative and then an infrastructure to produce shea butter (ie. workshops) and a day-care for kids at the same place/time, we will do two things from one. Some women can take care of the kids while others are producing the shea butter, and they won't be worried about their small children.

There is an expert dyer who can train other women to dye fabrics. However, all these initiatives need teamwork and financial support that are missing at this time.

What type of information do you get on new technologies? How do you receive the information and how often?

Male Participant: The information is given to the president of the women's association, who in turn informs all the women in the village through a meeting (topic, date, and place are given in advance).

Another channel is the chief of the village who announces a meeting on the microphone by an authorized person in the village (topic, date, and time are given).

We are also testing a radio station in 25-30 km radius to diffuse or receive information. We need to have some financial support in order to continue our radio messages. Women may use radio information as a medium for their shea butter activities. This medium can enable everybody to have the information at the same time.

How do you get information to solve your problems?

Male Participant: When we talk about information we want to be a team. As a team we need to have an activity to work on. For people to be in a cooperative they want to make sure they meet their daily needs. If you gather few people around an activity and they make profit, many others will be motivated.

How is the information or technologies are made available to you? How do you get your knowledge?

Male Participant:

- Every Saturday women meet and exchange.
- Women association coordination also helps get information for fund raising.
- If we diversify the activities, we can make more sales and more profits, instead of everybody selling the same products and doing the same activity.
- If you create the same product, sometimes the relationship between the demand and the supply and the price is not in favor of women.

Everybody came with her knowledge. The expert dyer learned from mother-to-daughter.

Dispositional:

What is the level of self-confidence in your ability to learn new things?

Woman Participant: If memorization is not involved in the training and the training is hands-on than the learning is enjoyable. Practice and age really help for this process.

Do you think one can be too old to engage in education? Explain.

Woman Participant: Training should be designated to teach younger women like our daughter-in-law.

What are the differences between the new and old technologies?

Woman Participant: The main difference between the hand churning is the use of the hot stone. With the churning machine we do not use the hot water because it heats itself up. In the process of the churning machine, we use hot water instead of hot stone, this way we can have mature foam with high yield.

Is there any difference between the butter extracted from the two processes (traditional vs. machine)?

Woman Participant: There is a difference between the precooked dried nuts (new processing methods) and the traditional process. The butter from the traditional process has some off-odors and flavors.

In the traditional drying methods with fire wood, the nuts get a smoky smell which is not as valued. In the boiling system there is no off-smell.

After boiling, you don't need further grilling, but you have to dry the nuts for at least 5 days. After drying the boiled butts, you can directly mill the nut and get the same type of paste as with the traditional stove. The same type of shea butter is used for body and

food. Quality (smell, bitter taste) due to being germinated and storage of 2 months underground will smell bad. The bad smell or bitter taste will not hurt.

Do think the boiling can make the processing easier?

Woman Participant: Our generation is not used to the boiling system. We all used the traditional stove to dry the nuts. Some of the women think that it is difficult; they would not have time to practice it. This way of thinking is probably because they do not understand it.

One of the participants said, “I learned from a lady in another village whose processing method is the boiling. I decided to learn the boiling process. When she came to visit us, she showed me how to do it. Now I am practicing the boiling method. You have to boil for 1 hour, drain from the boiling water, and dry 4-5 days when it is sunny. When drying you have to expose it to sun on a dry surface. After sunset you have to take it to a room to avoid the cold at night and the humidity which both will affect the nuts.”

Shea butter processing practiced presently

- Collect the nut
- Remove the pulp
- Dry on the traditional stove
- Pound to remove the shell
- Separate the shell from the kernels
- Further drying in the traditional stove
- Grind with the mill

- Mix with paste obtained with water
- Continue mixing until the an oily film appears “tears of the paste”
- Churn by hand beating
- Heat a stone in fire
- Put the hot stone in the paste mixture
- Remove the stone when fairly cool
- Continue beating until you get a big and mature foam
- Add a little bit of water and beat again
- Add a lot of water to wash the foam (3-4 times) or until it is clean enough
- Heat the cleaned foam until the oil and the residue (stays at the bottom of the heating pan) are separated
- Discard the dirty layer at the surface of the oil
- Use a big bowl to collect all the oil on the top of the residue
- The cleared, cleaned oil is conditioned
- The residue can be filtered and the oil obtained is used for soap making. The by-product is mixed with mud for construction or discarded.

NB: The Reason for using the hot stone in the kneading process: to have more foam and allow easy separation between oil and residue. If you don't use the hot stone you won't be able to collect the foam (it will stick on the residue) and reduce the oil yield. If you don't use the hot stone the product will disperse and won't be able to gather the foam.

Is there any difference in healing or treating with the shea butter from the traditional and the boiling method or the machine?

Village traditional healer, therapist, woman: Before the introduction of the machine, we were using the shea butter from the traditional process. Since the new technologies of processing have been introduced, we used both shea butter from the traditional and the new processing, which are the same.

Shea is used for:

Baby's body ache

Thorax

Fever (put all over the body)

Stomachache in association with other plant leaves

Swelling

Sore throat (swallow a little bit)

Body cream (in addition to incense)

Massages

Village traditional healer, therapist, man: the shea butter is used for body cream, food oil, and medicine. As healer there is no difference between the shea butter from the manual and the mechanical processing.

What is the general use of shea butter?

Women participant: the shea butter is used to make black soap, baby treatment, and food oil

What are presently the main issues in Dio?

Male Participant: We don't have activities beside the ones related to the train (sell our products to passengers). The main concern today is to have alternative activities besides those related to the train. We don't have enough land for intensive agriculture activities. Our village was born with the train and our economy is related to the train. This train doesn't show up until 2-4 AM and women are obliged to sleep along the rails waiting for the train to sell their products and be able to meet their basic needs. If you saw the scenario you would feel bad for them. Those doing gardening are prohibited by water shortage. Our rivers are dry. I have two motor pumps for gardening, but there is no water in the river. When our mangoes are ripe we don't have access to our past train market. There is a problem with the train not stopping in our town any more and we have become lost! We never thought that the train would stop one day. We are not active because the train stops have changed.

Male participant: in 1991 I told some people that the activities related to the train would stop one day. At that time people believed that I was crazy. I was reflecting our case to the experiences of Ivory Coast and Burkina Faso. When the train was working normally our market was among the best in Mali. Customers, retailers, wholesalers were coming from everywhere to buy our products (Mauritania, Senegal, Casamance, Burkina Faso). If it were not for the drought during our vegetable season, someone could have bought 1 kg of potatoes for US 10 cents.

Women participant: We did not hope that the train would stop one day. If you put all your hopes into something, which does not belong to you, this is what happens.

We are actually facing a bigger difficulty: our village is no longer a train stop as it originally was. Our village has always relied on the business and transportation of the train. Now the train passes through our village without stopping except for late night pauses. The villagers in Dio are lost; we don't know what to do! There are some surrounding villages where the situation is even worse because of the loss in the train market. Usually, villagers cannot plan more than six months in advance. They think and plan on a day-to-day basis. Our concern is what we are going to eat today. A Male participant is the one who helps us understand things because we are not well informed. Every day we look for vegetables, fruits and wild plants to sell for a modest profit.

Male Participant: It is not because men don't want to work. In our village there are no other income possibilities (i.e. Production units) without our village as a train stop. The main busy period in the year is 45 days in the rainy season. After this period, men don't have much to do. Our hope now lies in the shea butter project. If we can be helped to realize the value of shea butter our region may gain back our economy. What we need now is support to start new enterprises.

The mango project will be another one to work on. The problem with mangos is that they all ripen at the same time; therefore there is no good price, and most are unsold, eaten, deteriorate in the field or be at the mercy of animals. If we can have means to dry and preserve our mango we can enjoy them and sell them either in Mali or in the sub-region countries.

Male participant: If you are talk about follow-up you need to have materials. This year we could not use the mixer because shea trees did not have a high yield.

Therefore, we did not have the raw material to continue the follow-up with the mixer. All seven villages in the Dio commune are involved in the mixer testing and adoption; they all produce shea butter and converge toward Dio with their products. In some villages women can collect and fill 3-4 (200 liters) tanks. They process little by little and sell their products. The biggest market for shea butter is Kayes (first region in Mali). Traders come from Kayes and buy the butter.

The process is difficult, and slow. With the introduction of the mixer the work can be made easier, quicker and with a higher production level.

At this moment we will talk about quality grading (grade1, 2, 3). Each grade will be priced. Our grading will be based on:

- Shea nuts quality: we train people to select between the different qualities in shea nuts.
- Grade 1: nuts from shea fruits which ripened and fallen down, with no germination (the germinated kernels give bitter taste which can only be suitable for soap making); immature fruits which gives a low butter yield which is suitable for lipsticks (the other two grades were no mentioned in the interview).