28

This is to certify that the
thesis entitled

COMPETITIVENESS OF COWPEA-BASED PROCESSED
PRODUCTS: A CASE STUDY IN GHANA

presented by

TOMOKAZU NAGAI

has been accepted towards fulfillment
of the requirements for the

M.S. degree in Agricultural, Food, and Resource Economics

John M. Staatz
Major Professor's Signature

May 27, 2008
Date

MSU is an affirmative-action, equal-opportunity employer

COMPETITIVENESS OF COWPEA-BASED PROCESSED PRODUCTS: A CASE STUDY IN GHANA

By

Tomokazu Nagai

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural, Food, and Resource Economics

2008

ABSTRACT

COMPETITIVENESS OF COWPEA-BASED PROCESSED PRODUCTS:
A CASE STUDY IN GHANA

By

Tomokazu Nagai

In West and Central Africa, cowpeas (blackeye peas) are an important source of protein for low-income consumers. While they are used for a variety of dishes, industrial processing of cowpeas is still negligible. This study examines the competitiveness of two selected processed products using cowpeas in Ghana. Using the data collected through fieldwork, enterprise budgeting and sensitivity analyses are conducted. One of the selected products is dry cowpea meal for preparation of *kosei* (cowpea fritters), which is expected to help street vendors who currently prepare kosei from cowpea grain using time-consuming methods. However, the study shows that under current conditions in Accra, industrially-processed dry meal would be too expensive for the majority of kosei vendors to use as the substitute for cowpea grain. The other selected product is a weaning food called *Weanimix*, which is a fortified product of the traditional roasted-maize-based weaning food, called *Tom Brown*. In addition to groundnuts, either cowpeas or soybeans can be used as a fortifier in Weanimix. The study shows that: (1) cowpeas could be price-competitive with soybeans as an ingredient in Weanimix, unless customers prefer soybeans; (2) typical difference in prices currently observed between Weanimix and Tom Brown seems to be much larger than the difference in the cost of production between these products; and (3) the level of processing and retail margins greatly affect the competitiveness of industrially-processed Weanimix, compared to Weanimix that could potentially be prepared and sold by grain and flour-type product vendors in the market.

To my parents

ACKNOWLEDGMENTS

My deepest gratitude goes to Dr. John Staatz, who has been my academic advisor since I came to MSU in 2004. Without his extreme patience and accurate direction, I definitely could not have survived the program, let alone finished this thesis.

I also would like to thank Dr. Richard Bernsten, my assistantship supervisor, for giving me the great opportunity to work on this study and also for reviewing the draft of this thesis very carefully.

I am also grateful to Dr. Irvin Widders and Dr. Mywish Maredia, both my committee members, for reading this extensive thesis promptly and giving me feedback with insightful comments.

My special thanks go to Dr. Eric Crawford for his help in my search for the budgeting methods and Dr. James Hilker for his help in my search for data on the prices of soybeans.

I would like to sincerely thank Dr. Suzanne Thornsbury. If she had not hired me as a research assistant, I could not have continued my second year of study at MSU. When I was struggling, I was mentally supported by her, Mollie Woods, and other members of Fruitopia.

I owe everything that I obtained during my fieldwork in Ghana to Dr. Esther Sakyi-Dawson, George Annor, and their colleagues in the Department of Nutrition and Food Science at the University of Ghana-Legon. Dr. Sakyi-Dawson kindly and generously provided me with all the support I needed to conduct the fieldwork. Without George's commitment, creativity, and charm, it would have been absolutely impossible to draw so much information from the respondents. Dr. Samuel Asuming-Brempong in the

Department of Agricultural Economics and Agribusiness also provided a variety of input for this study. Also, I greatly appreciate all the respondents who willingly participated in the survey, sacrificing their time. I would also like to thank the Ministry of Food and Agriculture for generously providing the price data that they collected.

I am truly thankful to Dr. Robert Dixon Phillips, Dr. James Lowenberg-DeBoer, and Dr. Joan Fulton for their very helpful guidance and input at the early stage of this study. I am grateful to the Bean/Cowpea Collaborative Research Support Program and through it, the United States Agency for International Development for allowing me to conduct this study and gain invaluable experiences.

My thanks also go to Dr. John Holtzman for kindly sharing the report of the relevant study that he and his colleagues previously conducted.

I want to express my extreme gratitude to my friends from West Africa, Kwami Adanu, Doe Adovor, Marthe Diallo, Nyadia Goita, Clarice Mensah, Patrick Ofori, and Enyo Quist. They were not only kind in spending their precious time for helping me to revise the questionnaires, but they also facilitated my stay in Ghana in a variety of ways.

I am also really grateful to Subu Kumarappan, a Ph.D. student in the Department. His sharp eyes needed only one single glance to point out an important error that I had in my earlier model. That was amazing.

I would also like to acknowledge Dr. Ayumi Onuma, Mr. François Roussel, Mr. Hiroshi Hirabayashi, Mr. Sota Abe, and Dr. Hiroya Ono. Their support made it possible for me to pursue a Master's degree at MSU.

Finally, I would like to thank all my friends whom I met at MSU for their encouragement to complete this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Problem Statement

1.1.1 Background

Cowpea (*Vigna unguiculata* L. Walp.) is an indigenous African annual legume which is also called southern pea, blackeye pea, crowder pea, lubia, niebe, coupe or frijole (Davis et al., 1991; Langyintuo et al., 2003). Its tender green leaves, immature pods and green seeds, as well as dry mature seeds, serve as human food, and after the harvest of the pods the rest of the plant can be used as animal fodder (Davis et al., 1991; International Institute of Tropical Agriculture [IITA], 2006). The grain contains around 24% protein and about 62% carbohydrates (Lambot, 2002). The plant is more drought tolerant than common bean (Davis et al., 1991) and can be grown on and improve poor soils (IITA, 2006). Even though the plant is very susceptible to pests and diseases (IITA, 2006) and the grain to weevils (Lambot, 2002), cowpeas are important in many parts of West and Central Africa as a source of protein for those who cannot afford meats or fish (IITA, 2006), as "a food security crop" (Lambot, 2002, p. 368) for populations that consume cowpeas as a traditional staple food, and as "a major cash crop" (Langyintuo et al., 2003, p. 215).

In West and Central Africa, cowpea grain is used for a variety of dishes; the whole grain is mainly eaten with cereals or used as an ingredient of soups or stews, while milled cowpeas are mostly used to make fritters or steamed cakes (Langyintuo et al., 2003). Artisanally-produced cowpea fritters are "the most common cowpea product sold

throughout Africa" (Dovlo, Williams, & Zoaka, 1976, p. 30). In Nigeria, for example, "in addition to home preparation, akara [cowpea fritters are called *akara* in Nigeria] is prepared and sold by street vendors in the marketplace and by small-scale processors for home delivery and catering services" (McWatters, 1986, pp. 13-15), while Fulton (2004, p. 10) reported that in Dakar, Senegal, "most households do not prepare akara at home, but rather purchase it from street vendors when they want the product for family consumption, or for entertaining."

Figure 1.1 Cowpea grain

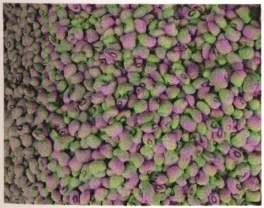


Figure 1.2 Dish with cowpeas 1

Figure 1.3 Dish with cowpeas 2

Figure 1.4 Cowpea fritters

Source: Author.

Although cowpeas are popularly consumed at home and as a street food, industrial processing of cowpeas is negligible. Only a very limited use of cowpeas for producing crackers, flours, and weaning foods has been observed in Senegal and Ghana (Bean/Cowpea Collaborative Research Support Program [B/C CRSP], 2006a; Langyintuo et al., 2003). For the goals of enhancing cowpea consumption, utilization, and food security, many studies have been conducted by B/C CRSP food scientists at the University of Ghana-Legon (UGL) and University of Georgia (UGA) to develop nutritious and affordable cowpea-based processed products[1] (B/C CRSP, 2006a, 2006b; Phillips et al., 2003). Cowpea-based processed products seem to have high potential because currently home- or artisanally-prepared cowpea products have tastes preferred by West African consumers, such as the light texture of fritters, which is difficult to produce with other grain legumes. Furthermore, scientists working on the B/C CRSP have hypothesized that the growing urbanization and the increase in opportunity cost of women's time in West Africa will increase the demand for processed products in the region (B/C CRSP, 2006a, 2006b).

However, various constraints to creating and promoting such processed cowpea products have been identified (B/C CRSP, 2006a). Constraints identified by the UGL and UGA team, as well as Lambot (2002) include higher prices of cowpea grain compared to its substitutes, lower protein content than soybeans (which are substitutes for cowpeas in the production of some of the processed products), fluctuations in price and quality, lack of stable availability, and possibly poor functionality of processed products.

---

[1] In this thesis, the term "cowpea-based processed products" does not necessarily mean products that contain cowpeas as a *major* ingredient. Rather, the term is used to refer to processed products in which cowpeas are used as an ingredient making an important contribution to the nutrient value of the product.

1.1.2 Justification

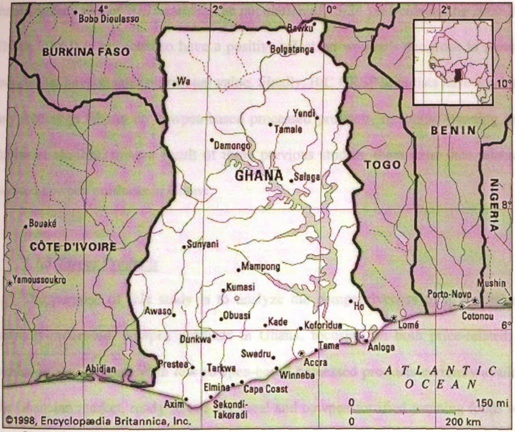
Among the above-mentioned constraints to creating and promoting cowpea-based processed products, price-related constraints seem to have received less attention than others. However, if the price of cowpea-based products is high compared to their substitutes and potential customers are not willing to pay enough of a premium for the attributes of cowpea-based products to let these products overcome that price difference, then these products will never attract enough customers in the market to become profitable. The importance of price-related constraints seems to be becoming even greater today because of the movement in coastal countries of West Africa to promote production and increase consumption of soybeans, a potential substitute for cowpeas in processed products.

Another issue with regard to price-related constraints is how the difference in techniques of processing cowpeas affects the cost of production. When alternative ways exist to process cowpeas into the same end product, we need to examine which way is the most cost-effective.

With regard to non-price-related constraints, extensive studies have been conducted on the functionality of different cowpea-based processed products and the assessment of consumer acceptance and potential demand for such products by the B/C CRSP food scientists and economists (for recent studies, see B/C CRSP, 2006b). However, fewer studies have been conducted on non-price-constraints at the processors' level. This study tries to fill that gap.

Ghana was selected for this case study because there is likely a higher potential for consumers in Ghana to adopt cowpea-based processed products, compared to

Figure 1.5 Map of Ghana



Source: http://www.britannica.com.

consumers in many other West African countries. Ghana was a major consumer of cowpeas (the second biggest importer of cowpeas after Nigeria, recording the largest percentage deficit [67%] during 1990s [Langyintuo et al., 2003]). The Ghanaian per capita income level was in the middle in the West African region, with an annual average of about US$350 during 1995-2004 (United Nations Statistics Division [UNSD], 2005), and Ghana experienced a strong growth rate of 2.2% per year during 2000-2004 (World Bank, 2006). This suggests that the opportunity cost of women's time, especially in urban areas, is higher than that in lower-income countries, thus opening the potential scope for economically viable commercial processing. Also, a relatively high level of income would be necessary for consumers to adopt more nutritious but at the same time more

expensive cowpea-based processed products. In addition, a higher education level in Ghana (literacy rate of 70.7% among the population of 15-24 year-olds during 2000-2004 [UNSD, 2006]) is expected to have a positive effect on women's decisions to purchase products that have greater nutritional value. Finally, B/C CRSP scientists have conducted many studies in Ghana on cowpea-based processed products, including weaning foods (Phillips et al., 2003). As a result of these previous studies, there exist data related to processed cowpea products in Ghana.

1.1.3 Target Products

The purpose of this study is to analyze the competitiveness of a few selected industrially-processed[2] cowpea products in Ghana, focusing on both price-related and non-price-related factors. With few cowpea-based processed products currently available in the Ghanaian market, ready-to-use dry meal and cowpea-fortified weaning foods were selected[3] as promising products, based on personal communications with agricultural economists and food scientists associated with the B/C CRSP's West Africa regional project team (J. Lowenberg-DeBoer and J. Fulton, personal communication, June 15, 2006; R. D. Phillips, personal communication, August 22, 2006).

Dry cowpea flour/meal is a primary processed product that can be used as an ingredient in further processed products. The difference between flour and meal is that

---

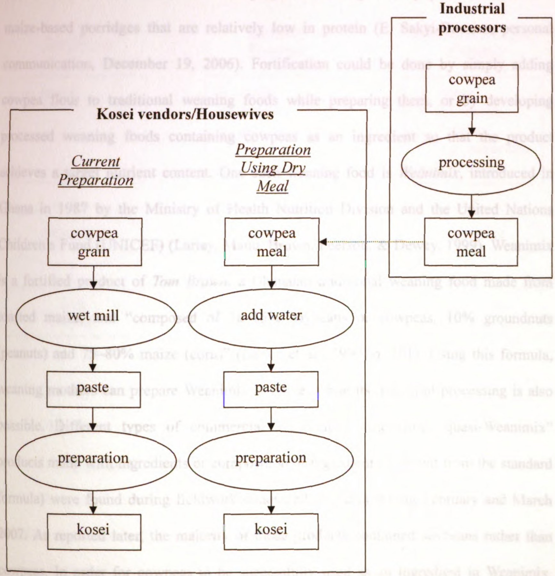
[2] The term "industrial processing" in this thesis does not necessarily mean processing activities by companies with large scale personnel and/or capital. Rather, it includes processing activities by companies of any size (i.e., minimum size is one single person) meeting the following criteria: (1) outputs have a consistency in quality and unit quantity; (2) outputs have a relatively long shelf life; and (3) outputs are mainly sold on a wholesale basis to buyers who in turn resell them to others.

[3] Cowpea-fortified *gari* (grated, fermented, and roasted cassava) was also among the suggested target products for this case study. However, during the field survey in Ghana, it was found out that gari processors were different from the processors of other flour-type products. Due to time constraints, it was not possible to include gari as a potential product in this study. However, preliminary analysis using the data collected from one gari producer is reported in Appendix 8.

flour is more finely milled than meal. Studies by the B/C CRSP's West Africa regional project team have found that dry cowpea flour/meal can be used for fortification of other food products and that cowpea meal processed in a certain way is suitable for making cowpea fritters (called *kosei* in Ghana[4]). If dry cowpea meal is used to make kosei, it competes with wet plate- or hand-milled cowpea paste that housewives and street vendors of kosei currently use (Figure 1.6).

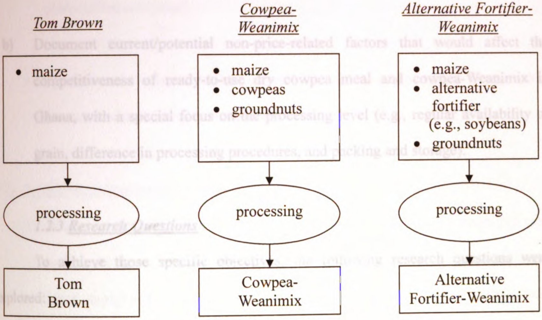
[4] Cowpea fritters have different names in different places of West Africa, such as akara, *kosai*, *akla*, and *accara* (Langyintuo et al., 2003). It is called kosei in Ghana. In the literature, the product seems to be most often called akara. In this thesis, the terms kosei and akara refer to the same product.

Figure 1.6 Competition between wet plate-/hand-milled cowpea paste and dry cowpea meal



Weaning foods are among the products that could be fortified with cowpeas because most of the traditional home-prepared weaning foods popular in Ghana are maize-based porridges that are relatively low in protein (E. Sakyi-Dawson, personal communication, December 19, 2006). Fortification could be done by simply adding cowpea flour to traditional weaning foods while preparing them, or by developing processed weaning foods containing cowpeas as an ingredient so that the product achieves a target nutrient content. One such weaning food is *Weanimix*, introduced in Ghana in 1987 by the Ministry of Health Nutrition Division and the United Nations Children's Fund (UNICEF) (Lartey, Manu, Brown, Peerson, & Dewey, 1999). Weanimix is a fortified product of *Tom Brown*, a Ghanaian traditional weaning food made from roasted maize, and "composed of 10–15% soybeans or cowpeas, 10% groundnuts (peanuts) and 75–80% maize (corn)" (Lartey et al., 1999, p. 391). Using this formula, weaning mothers can prepare Weanimix at home, while its industrial processing is also possible. Different types of commercial Weanimixes (including "quasi-Weanimix" products made with ingredients or composition of ingredients different from the standard formula) were found during fieldwork conducted in Accra during February and March 2007. As reported later, the majority of those products contained soybeans rather than cowpeas. In order for cowpeas to be successfully used as an ingredient in Weanimix, cowpeas would likely have to compete with maize (the major ingredient of traditional Tom Brown, a part of which cowpeas would replace) and with alternative sources of protein, most likely soybeans, in terms of different criteria such as price of grains, tastes, and ease of processing (Figure 1.7).

Figure 1.7 Competition among Tom Brown, cowpea-Weanimix, and alternative fortifier-Weanimix



1.2 Objectives

1.2.1 General Objective

The general objective of this study is to determine under what conditions cowpeas would be an economically competitive ingredient in selected industrially-processed food products in Ghana.

1.2.2 Specific Objectives

The specific objectives are to:

a) Develop representative budgets for industrially-processed ready-to-use dry cowpea meal (as an ingredient in kosei) and cowpea-Weanimix in order to

estimate the price gaps that those products would need to overcome to be competitive with their substitutes in Ghana;

b) Document current/potential non-price-related factors that would affect the competitiveness of ready-to-use dry cowpea meal and cowpea-Weanimix in Ghana, with a special focus on the processing level (e.g., regular availability of grain, difference in processing procedures, and packing and storage).

1.2.3 Research Questions

To achieve those specific objectives, the following research questions were explored:

a-1) Price competitiveness of dry cowpea meal as an ingredient in kosei

i. What are the cost components and how much does each component cost for preparing a unit of kosei using the wet-and-plate-milled[5] cowpeas?

ii. What are the cost components and how much does each component cost for industrially processing a unit of ready-to-use dry cowpea meal suitable for making kosei?

iii. How much does it cost to prepare a unit of kosei using ready-to-use dry cowpea meal?

[5] During the field survey in Accra, no kosei vendor was observed hand-milling cowpeas. Therefore, the analysis focused on the plate-milling.

iv. Given the current production and marketing costs, how competitive would industrially-processed ready-to-use dry cowpea meal be, compared to wet-and-plate-milled cowpeas?

v. How does the competitiveness of ready-to-use dry cowpea meal change when the value of cost components changes?

a-2) <u>Price competitiveness of cowpea-Weanimix</u>

i. What are the alternative processing procedures (including technologies and scales) and cost components for producing and marketing (e.g., ingredients, labor, equipment, and transportation) cowpea-Weanimix, Tom Brown, and soybean-Weanimix?

ii. How much does each component cost for processing a unit of cowpea-Weanimix, Tom Brown, and soybean-Weanimix?

iii. Given the current production and marketing costs, how competitive is industrially-processed cowpea-Weanimix, compared to its substitutes?

iv. How does the competitiveness of industrially-processed cowpea-Weanimix change when the value of cost components changes?

b) Non-price competitiveness

i. What non-price-related factors, especially at the processing level, affect the competitiveness of industrially-processed ready-to-use dry cowpea meal and cowpea-Weanimix in Ghana (e.g., regular availability of grain, difference in processing procedures, and packing and storage)?

1.3 Organization of Thesis

The thesis organization is as follows: Chapter 2 reviews the literature on the cowpea subsector and development of processed cowpea products in Ghana and West Africa, as well as the use of budgeting methods to analyze the profitability of productive activities. Chapter 3 describes the approach, instruments, and analytical methods used for this study, as well as field data collection conducted in Ghana. Chapter 4 presents descriptive analysis of the data collected on dry cowpea meal, discusses the findings about the non-price-related constraints, and describes the steps taken to prepare the data for the budget analysis. Chapter 5 presents the model and results of the budgeting and sensitivity analysis carried out to assess the economic viability of industrially producing dry cowpea meal. Chapter 6 presents descriptive analysis of the data collected on cowpea-Weanimix, discusses the findings about the non-price-related constraints, and describes the steps taken to prepare the data for the budget analysis. Chapter 7 presents the model and results of the budgeting and sensitivity analysis carried out to assess the economic viability of industrially producing cowpea-Weanimix. Finally Chapter 8, providing a summary of the thesis, identifies policy implications and limitations of this case study, and proposes suggestions for future research.

CHAPTER 2

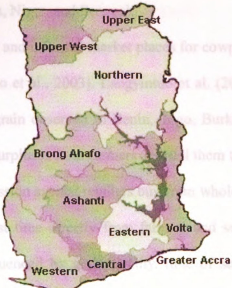
LITERATURE REVIEW

2.1 Cowpea Subsector in Ghana and West and Central Africa

Today cowpeas are grown worldwide, with Africa producing the largest share. Langyintuo et al. (2003) estimated that 3.7 million mt of cowpeas were annually produced on about 9.7 million hectares during the 1990s in Africa, the Americas, Europe and Asia, of which West and Central Africa accounted for 2.6 million mt (69% of the world's production) on 7.8 million hectares (80% of the world's harvested area). As individual countries, Nigeria, the largest cowpea grower in the world, accounted for 45% of the world production, followed by Brazil (17%), and Niger (10%) during the same period. Although "cowpea is a warm-season crop well adapted to many areas of the humid tropics and temperate zones" (Davis et al., 1991), the drier areas in West Africa have a comparative advantage in producing legumes, compared to humid areas, because pests and diseases make production in the humid areas more difficult (Langyintuo et al., 2003). The primary cowpea production zone in West and Central Africa lies between the 300 and 1,000 mm annual rainfall isohyets or approximately between 10 and 15 degrees north latitude (Langyintuo et al., 2003). In Ghana, cowpeas are mainly produced in the Northern and Upper West Regions (see Figure 2.1) (Nimoh, 2004).

A special characteristic of the cowpea trade in Africa is that the trade occurs internally within Africa, unlike other cash crops such as cocoa, coffee and cotton, which are exported to other continents (Langyintuo, Lowenberg-DeBoer, & Arndt, 2005). In West and Central Africa, drier Sahelian countries producing a larger amount of cowpeas

Figure 2.1 Map of regions in Ghana



Source: http://www.ghanatelecom.com.gh/images/gt/general/regions_map.gif

tend to be net exporters, while more humid coastal countries tend to be net importers (Langyintuo et al., 2003). An important exception is Nigeria, which is both the largest producer and the largest importer of cowpeas in the region. Langyintuo et al. (2003) identified two largely independent cowpea trade zones. The first is the "Nigerian cowpea grainshed," composed of Niger, Burkina Faso, Mali, Cameroon, Chad, Benin (net exporters, listed in descending order by the average annual amount exported during 1990s) and Nigeria, Ghana, Côte d'Ivoire, Togo, and Gabon (net importers, listed in descending order, except for Gabon, for which data are unavailable). The second is the "Senegalese cowpea grainshed," composed of Senegal (a net exporter during 1990s) and Mauritania, Gambia and Guinea Bissau (net importers). Per capita consumption of cowpeas estimated in Langyintuo et al. (2003) showed enormous differences among countries: in Nigeria, people were estimated to have consumed 18 kg of cowpeas per capita per year during 1990s; while per capita annual consumption was estimated at 9 kg

in Benin, Ghana and Togo; and between 1.5 to 2.5 kg in Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Mali, Mauritania, Niger, and Senegal.

Both publicly-managed and informal market places for cowpea grain exist in West and Central Africa (Langyintuo et al., 2003). Langyintuo et al. (2003) described typical market channels for cowpea grain observed in Benin, Togo, Burkina Faso, and Ghana: rural assemblers buy cowpea surpluses from farmers and sell them to small or large urban wholesalers or through commission agents; retailers buy from wholesalers or commission agents or sometimes at harvest time directly from farmers and sell to consumers. The price of cowpea grain is influenced by grain quality, time of selling, transport costs, storage costs, market tolls and taxes, and sales location (Langyintuo et al., 2003). Storage is important for maintaining grain quality, protecting them from pests and weevils (Langyintuo et al., 2003). Price declines during and soon after the harvest season (i.e., October through January in Niger, Benin, Nigeria and Ghana) and increases in the following months when grain is scarce; and geographically, as one would expect, lower prices have been observed in production sites and in exporting countries, compared to cities and importing countries (Langyintuo et al., 2003).

Cowpea varieties have different attributes, such as texture of the testa (skin), grain size, and skin and eye color (Langyintuo et al., 2003). The share of different varieties sold in markets varies by country and even by market within the same country. This variation is affected by the types of foods prepared and storage conditions (smooth skin texture tends to be preferred in humid areas with poor storage conditions) (Langyintuo et al., 2003; Langyintuo, Ntoukam, Murdock, Lowenberg-DeBoer, & Miller, 2004). Consumers paid a premium for larger grains in most markets of Cameroon and Northern Ghana

studied by Langyintuo et al. (2004), most markets of Southern Ghana studied by Mishili (2005), and all the markets of Senegal studied by Faye (2005).

2.2 Development of Processed Cowpea Products in Ghana and West Africa

According to FAO (1997), food processing has a variety of positive impacts on individual human nutrition and society as a whole—including: (1) improving digestibility of foods; (2) diversifying diet; (3) transforming raw materials into products that are more convenient to use; (4) extending the availability of foods beyond the area and season of production, which increases food security; and (5) creating employment, thus improving income of those who are involved. More than a decade ago, Smith (1995) reported that there was a trend among African women to prefer convenience foods because of women's changing role and participation in the workforce. However, today popular but susceptible-to-weevil cowpeas are still mainly sold as grain and cooked at home in West Africa (B/C CRSP, 2006a).

Through the B/C CRSP project, a variety of processed products using cowpeas as an ingredient have been developed. Phillips et al. (2003) has summarized studies on these products, focusing on different quality aspects of the developed products, including chemical composition, nutritional quality, physical and functional behavior, sensory quality and consumer acceptance, and costs and impacts of technology adoption. The products developed and tested included: (1) baked products and snack chips (e.g., yeast-raised bread, muffins, buttermilk doughnuts, tortillas, and tortilla and corn chips) in which cowpea flour/meal was used to replace their main ingredients; (2) ready-to-use cowpea meal for preparation of kosei; (3) extruded snacks; (4) different types of weaning

foods; and (5) cowpea-fortified traditional foods including *hausa koko* (a spiced millet-based drink) and *gari* (grated, fermented and roasted cassava). Among these products, ready-to-use dry cowpea meal and cowpea-fortified weaning foods were selected as the target products of this case study, as mentioned in Chapter 1.

2.2.1 Kosei and Dry Cowpea Meal

Kosei are traditional cowpea fritters, which are popular as a breakfast or snack food in West Africa (McWatters, Resurreccion, & Fletcher, 1990). The traditional method of preparation described by Dovlo et al. (1976) involves (1) dehulling (meaning "remove seed coats of") cowpea grain by either the "wet method" (soak in water and dehull cowpeas by hand) or "combined dry and wet method" (break cowpeas into smaller bits using a grinding stone, blowing off seed coats, and then soaking); (2) grinding into a paste; (3) whipping to incorporate air; (4) adding chopped onions, peppers and salt; and (5) frying as small balls in vegetable oil. These dehulling and grinding procedures are time-consuming and labor-intensive (McWatters et al., 1990). Development of ready-to-use dry cowpea flour/meal, which can be turned into a paste by simply adding water, has been proposed by B/C CRSP food scientists to help lighten the burden of kosei preparation. Many tests have been conducted to create a good quality flour/meal, especially suitable to make kosei, by examining how the quality of end products was affected by factors such as the difference in the variety of cowpeas used, particle size of the flour/meal, dehulling method (wet or dry), presoaking time, and storage condition of the meal (Henshaw, McWatters, Oguntunde, & Phillips, 1996; Kethireddipalli, Hung, McWatters, & Phillips, 2002; McWatters & Brantley, 1982; McWatters et al., 2002; Singh

et al., 2005)[1].

This research led to the development of a mechanical procedure to produce a dry cowpea meal, from which kosei very similar in taste to traditional kosei can be made (Phillips et al., 2003). The detail of the processing procedure is shown in Figure 2.2. It is important to note that the developed product is a meal, not flour. Another point to note is that the processing procedure for making this newly-developed meal requires drying the

Figure 2.2 Procedure for making a functional (suitable for making kosei) cowpea meal

1. Briefly soak cowpea grain (dipping for about 1 minute is usually sufficient).
2. Dry the grain at a temperature less than 60°C until the moisture content is less than 10%, preferably 7-8%.
3. Loosen seed coats using a plate mill with the gap adjusted to crack (not grind) the grain. This operation can be done using a mortar and pestle by those 'skilled in the art'.
4. Using either a readjusted plate mill or hammer mill with an about 3 mm screen, grind the cotyledons so that about 50% of particles are larger than 400 μm in diameter. Particles larger than about 800 μm require longer soaking and possibly some wet grinding to produce a smooth batter.
5. This meal can be hydrated for 30-60 min, whipped to incorporate air, spiced with chopped or ground peppers/onions/garlic, and fried in hot oil.

Source: R. D. Phillips, personal communication, August 22, 2006.

[1] From the historical perspective, the production and use of dry cowpea flour does not seem to be new phenomena in West Africa. Dovlo et al. reported in 1976 that cowpea flour processed by wet dehulling and drying was common in the arid zone of Ghana, and that kosei made from this flour was as crisp as kosei made from wet paste (the only difference was that one made from the flour got drier when it cooled down). From the available literature, it is not clear whether the northern Ghanaian method was tried elsewhere, nor whether cowpea flour is still commonly produced and used in that region.

cowpea grain, which implies that this meal can only be produced by processors who have access to drying equipment—if the meal is to be produced on a regular basis without relying on solar drying.

In Senegal, Fulton (2004) and Faye (2005) conducted studies of the industrial processing of cowpeas into flour. In 1999, they found five small-scale processors who used cowpeas to make flour and weaning foods. However, in 2004, only one of these processors was still producing cowpea flour, and none was still using cowpeas to produce weaning foods. The processors reported several constraints with regard to cowpea flour, including: (1) low demand (possibly and partly because of lack of promotion) and (2) deterioration during storage (related to poor packaging). Also, a food processor interviewed, who had not tried cowpea flour, mentioned the lack of drying machines and high transportation costs (for selling products to vendors) as problems. These constraints may also apply to any processors producing cowpea flour/meal. As for the use of cowpea flour/meal for preparing kosei, a vendor interviewed reported that by adding baking powder, it was possible to make kosei from the commercial cowpea flour that tasted the same as traditional kosei. However, while Fulton noted that there is a potential market for cowpea flour as an ingredient in kosei, she noted that the cost of the flour must be sufficiently low and the taste of kosei acceptable. Finally, she noted that because making kosei using the traditional method was time-consuming and labor-intensive, the kosei business was becoming "extinct" in Dakar, where the opportunity cost of women's time was high.

In Ghana, Nimoh (2004) studied, among other topics, the financial benefits of processing cowpeas, in six communities of the coastal regions of Ghana. He conducted a

profit margin analysis, using data collected on the daily revenue and costs of cowpea processing businesses including kosei vending. The results showed that the average profit margin[2]—calculated as {[revenue] – [cost]} / [revenue]—in the six studied communities for kosei business was 26.3%, ranging from a high of 35.8% in two communities in the Greater Accra Region to a low of 18.6% in a community in the Volta Region. The present thesis conducts a similar analysis and also analyzes the effect of the use of cowpea meal (instead of grain) on the profit.

2.2.2 *Cowpea-Fortified Weaning Foods*

Weaning foods are foods prepared for children in transition from breast milk to solid foods (6 to 18 months old) (Phillips et al., 2003). Such foods have to be carefully prepared to promote young children's healthy growth. According to FAO/World Health Organization (WHO) and Heimendinger, Zeitlin, and Austin (as cited in Mensa-Wilmot, Phillips, Lee, & Eitenmiller, 2003), a good weaning food should be: (1) nutrient dense; (2) easily digestible; (3) of suitable consistency; and (4) affordable to the target market. In developing countries, children are often given weaning foods that do not meet these criteria. Until the age of four to six months, the growth rates of fully breast-fed infants do not differ much between developing and developed countries, while unsatisfactory growth among children in developing countries commonly begin after this period. The main reason for this difference is considered to be the lack of access to nutrient-dense weaning foods, together with frequent infections (Lartey et al., 1999).

---

[2] It is not clear if the calculation made by Nimoh (2004) imputes the value of the vendors' labor. While it is clear that Nimoh includes the "employee's wage/salary," it is not stated whether or not the opportunity cost of vendor's labor [i.e., the labor of the respondents themselves] is included as well. If not, the result should be referred to as "return to vendor's labor, capital, and management" rather than "profit."

Cereals are the main ingredients in most of the traditional weaning foods in West Africa. However, it is almost impossible for small children to meet their needs for calories and proteins from the amount of these low-nutrient-density weaning foods that they can digest (Nti & Plahar, 1995; Onofiok & Nnanyelugo, 1998). Many studies have been conducted to improve the nutritional quality of traditional weaning foods while maintaining adequate sensory and functional (e.g., digestibility) quality (Afoakwa, Sefa-Dedeh, & Sakyi-Dawson, 2004; Annan & Plahar, 1995; Bentley et al., 1991; Egounlety, Aworh, Akingbala, Houben, & Nago, 2002; El-Habashy et al., 1995, 1997; Lartey et al., 1999; Mensa-Wilmot, et al., 2003; Nti & Plahar, 1995; Plahar et al., 2003). In these studies, cereal-based weaning foods were often fortified with locally-available low-cost ingredients in order to make them widely affordable. Legume crops such as cowpeas and soybeans have been frequently used as a source of protein. In its early stage, research by food scientists to develop such weaning foods usually used linear programming methods to identify a least-cost combination of potential ingredients that meet the target nutrient content (El-Habashy et al., 1995; Hayes, Mwale, Tembo, & Wadsworth, 1995; Mensa-Wilmot, Phillips, & Sefa-Dedeh, 2001b). This ensured that the new formulas were not arbitrary combinations of nutritious ingredients, but passed a systematic cost test. However, the price of ingredients used in such analyses seems to be limited to a single set of representative prices (either average of the prices during a certain period or price at the time of purchase). Further economic analyses, such as the impacts of seasonal price changes of ingredients on the cost of preparation, would provide information needed to fully develop optimal sets of ingredients that might differ—depending on the seasons of the year or on the locations in a country.

In Ghana, cereals such as maize, millet and sorghum are traditionally used as the main ingredients of weaning foods (Plahar, Onuma Okezie, & Gyato, 2003). Among them, there are two types of maize-based popular weaning foods: one is a porridge made from wet fermented maize, and the other is a porridge made from roasted and dried maize (E. Sakyi-Dawson, personal communication, December 19, 2006). The former is called *koko* and the latter is popularly called Tom Brown. Since the main ingredient in both porridges is maize, they tend to be low in protein. Also, since they are porridges with high moisture content, their overall nutrient density is low as well.

In order to enhance the nutrients of these traditional weaning foods, new formulas have been developed. The suggested method for fortifying koko is to add dehulled cowpeas or soybeans to soaked maize to make a cowpea-fortified fermented maize dough (CFMD) or soybean-fortified fermented maize dough (SFMD), from which fortified koko can be prepared. As is the case with traditional fermented maize dough, both CFMD and SFMD can be used not only for koko but also for various popular Ghanaian staple dishes (Afoakwa et al., 2004; Plahar, Nti, & Annan, 1997; Sefa-Dedeh, 2005).

The method suggested for fortifying Tom Brown is to add roasted cowpeas or soybeans and roasted groundnuts to roasted maize before milling. As introduced in Chapter 1, fortified Tom Brown, originally developed by the Ghanaian Ministry of Health in collaboration with UNICEF, was named Weanimix. This thesis focuses on the cost analysis of Weanimix because the fieldwork conducted in Ghana (see Chapter 3) revealed that information on the cost of production was more readily available for Weanimix than for fortified fermented maize dough. A standard recipe for making Tom Brown and Weanimix is shown in Figure 2.3.

Figure 2.3 Recipe for making Tom Brown and Weanimix

A. <u>Tom Brown</u>

1. Roast the maize grain
2. Dry-mill the grain to produce a flour
3. Cook the flour into porridge and add sugar

B. <u>Fortified Tom Brown (Weanimix)</u>

1. Roast maize, **cowpea/soybean, groundnuts, and mix them together (maize:cowpea/soybean:g-nuts = 7.5:1.5:1 or 8:1:1)**
2. Dry-mill the mixture to produce a flour
3. Cook the flour into porridge and add sugar

Source: Lartey et al. (1999); G. A. Annor, personal communication, February 16, 2007.

Before Weanimix was first introduced in 1987, the Ministry of Health tried to teach weaning mothers to add groundnut paste to porridge that they fed their children (J. G. Amarh, personal communication, April 2, 2007). However, mothers often did not follow the instructions for using groundnut paste. Consequently, the Ministry decided to make flour that already contained groundnuts, as well as another nutritious high-protein legume (i.e., cowpea/soybean). According to Sefa-Dedeh (as cited in Bernsten, 1993, p. 29), mothers were first advised to prepare Weanimix by themselves. However, this attempt also failed—mothers often did not follow the right formula. These experiences led to the development of commercialized Weanimix, which had three major objectives: (1) improvement of the nutritional status of children; (2) income generation for the producers of the products; and (3) reduction of drudgery for preparation at a household level (J. G. Amarh, personal communication, April 2, 2007).

2.2.3 *Soybeans in Ghana*

Soybean is a legume crop that has a higher protein and fat content, but lower in carbohydrates than cowpeas. The nutrient content of cowpeas and soybeans is presented in Table 2.1 for comparison.

Table 2.1 Nutrient content of cowpeas and soybeans (grains, dried)

	Composition in terms of 100 g edible portion					
	Food Energy (calories)	Moisture (%)	Protein (g)	Fat (g)	Carbo-hydrate, total (incl. fiber) (g)	Ash (g)
Cowpea	342	11	23	1	61	3
Soybean	405	10	34	18	34	5

Source: Leung (1968).

As soybean is not an indigenous legume in Ghana, there are no Ghanaian traditional dishes that use soybeans as an ingredient (Mensa-Wilmot et al., 2001b). However, the use of soybeans as an ingredient in weaning foods has been promoted by the Ministry of Health (Mensa-Wilmot, Phillips, & Hargrove, 2001a). Mensa-Wilmot et al. (2001b) reported that among 133 mothers interviewed in the Greater Accra Region, 65% used soybean flour for weaning their children, while they could not identify whether soybeans were familiar to women in villages in the Central Region because there was no word in the local language that meant soybeans.

2.3 Enterprise Budgets—Purpose and Procedure

This study uses budgeting as a basic tool to analyze the profitability of producing processed cowpea products. "Budgeting is a basic analytical tool of forward planning"

(Crawford, 2002, p. 1). It is a method that is usually taught in farm management courses, as well as general courses in business management. Harsh, Connor, and Schwab (1981, p. 178) divided the analyses of farm business into three categories: (1) "descriptive analysis" ("What is …?"); (2) "diagnostic analysis" ("What is wrong …?"); and (3) "predictive analysis" ("What would happen if …?"). Budgeting is a technique to conduct this predictive analysis, building on the first two analyses. "It is a method of estimating on paper the dollars-and-cents effects of changes in farm organization or production practices before resources are actually allocated to such changes" (Crawford, 2002, p. 1).

Among different budgeting techniques, enterprise budgets state the income, expense, and resource needs of one particular productive activity on a per unit basis (e.g., income, expense, and resource needs of corn production per acre) (Harsh et al., 1981, p. 190). The purposes of enterprise budgets include: (1) assessment of the profitability of that enterprise (targeted productive activity) and (2) comparison of the relative profitability of different enterprises (Crawford, 2002). Although budgeting in general is a tool mainly used for forward planning, enterprise budgets can also be summaries of actual costs and returns (Crawford, 2002). In this thesis, the tool is applied to assess the profitability of: (1) industrially-processed dry cowpea meal *per se*; (2) kosei made from industrially-processed dry cowpea meal, as opposed to the kosei made from wet-milled cowpea grain; and (3) industrially-processed cowpea-Weanimix, as opposed to its substitutes.

To prepare enterprise budgets, a variety of information has to be gathered, including the input/output relationships, that is, "the quantity and quality of inputs needed to achieve a certain level of output" (Harsh et al., 1981, p. 185). While the inputs can

include variables such as materials, labor, land, and equipment (Debertin, 1986, p. 295), which variables to include depends on the purpose of analysis. Input/output relationship will change if a new production technology is applied. Among the sources of data on input/output relationships are accounting records and experimental data. Another set of information needed is the prices of inputs and output. Once all the information is obtained, enterprise budgets can be prepared, which are usually presented in a table format where calculated variables are shown in categories such as the value of output, variable costs, and fixed costs (Crawford, 2002; Harsh et al., 1981, p. 177-193). In interpreting the results, caution is needed when accounting records are used as a source of costs. For example, family labor is often not included in accounting records. In such a case, the calculated profit figure of the enterprise includes a return to the family labor and management (Debertin, 1986, p. 296).

CHAPTER 3

METHODS AND DATA

3.1 Approach

First, B/C CRSP researchers at Purdue University, the University of Georgia (UGA), and the University of Ghana-Legon (UGL) were consulted to obtain key information needed to decide which products to analyze. Based on these discussions, ready-to-use dry cowpea meal and cowpea-fortified weaning foods were selected as target products for this case study. Once the decision was made regarding product choice, additional information was obtained including the common procedures used for kosei preparation by street vendors in Ghana, types of weaning foods that are currently available in the market, and the scale of existing companies producing dried flour-type products in Accra, Ghana. Finally draft questionnaires for conducting a field survey were prepared.

Second, during February and March 2007, fieldwork was conducted in the Greater Accra Region, with support of the Department of Nutrition and Food Science, UGL. The goal of the fieldwork was to obtain both quantitative and qualitative data to analyze the competitiveness of the two target cowpea-based processed products. Structured questionnaires were prepared for collecting data from five different categories of survey respondents: street vendors of kosei, custom millers, retailers, weaning mothers, and industrial grain flour and/or weaning food processors. The Ghanaian Ministry of Food and Agriculture was visited to obtain time-series price data on different commodities including cowpeas. Experiments of dry cowpea meal and kosei preparation

were also conducted to estimate the input-output ratios. Finally, weights of different crops per *olonka* (a standard measuring container used in Ghana) were measured from samples purchased at a market in order to convert prices recorded in these standard volumetric measures to prices per kg.

Third, using these data, budgeting and sensitivity analyses were conducted to calculate the price-competitiveness of industrially-processed dry cowpea meal and cowpea-Weanimix under different scenarios.

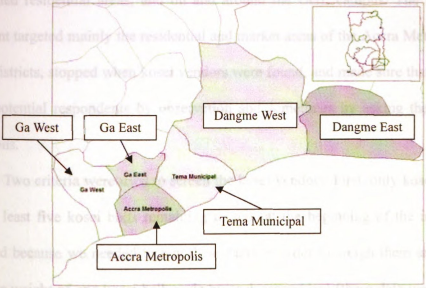
3.2 Survey Respondents and Instrument Design

Respondents interviewed during the field survey were identified and selected with the help of UGL researchers. The purpose of this case study is to use data gathered from survey respondents to develop typical budgets to assess the profitability of various processes and to use sensitivity analysis to estimate the range in the values of cost variables over which the target products are price-competitive. Therefore, "purposive (non-probability) sampling method" (Bernsten, 2005) rather than random sampling was used to select respondents for each of the five groups.

The interviews were conducted in four out of six districts in the Greater Accra Region: Accra Metropolis (the capital city of Ghana), Ga West, Ga East, and Tema Municipal. The Greater Accra Region is bounded by the Gulf of Guinea on the south, the Central Region on the west, Eastern Region on the north, and Volta Region on the East (see Figure 2.1). Within the Greater Accra Region, Accra Metropolis District is bounded by the Gulf of Guinea on the south, Ga West District on the west, Ga East District on the north, and Tema Municipal District on the east. The other two districts, Dangme West and

Dangme East are located to the east of Tema Municipal District (Figure 3.1). While the Greater Accra Region is the smallest administrative region of Ghana with a land area of 3,245 km^2 (Briggs, 2004), it has the second largest population (2.9 million), following the Ashanti region (3.6 million), according to the 2000 census (as cited in Briggs, 2004).

Figure 3.1 Districts of the Greater Accra Region



Source: http://www.answers.com/topic/districts-of-ghana.

All respondents were visited by the author and his assistant, George A. Annor, who was a research assistant of the Department of Nutrition and Food Science, UGL. When necessary, he translated the questions written in English into local languages (most of the time, Twi) and translated the respondents' answers from the local languages into English. The translation was done question-by-question, and the author wrote those answers on the questionnaires. When the respondent spoke English fluently, the author administered the interview. Sample size, interview location, and type of data collected are described below for each category of respondents (for the complete questionnaires used

for the interviews, see Appendix 1).

3.2.1 Street Vendors of Kosei

Although no list of kosei vendors doing business in Accra exists, there are so many vendors that it is easy to find one when someone wants to buy kosei. During the fieldwork, vendors were observed along the main roads, relatively small roads in populated residential areas, and on and around the UGL campus. The author and the assistant targeted mainly the residential and market areas of the Accra Metropolis and Ga East Districts, stopped when kosei vendors were found, and made sure that those vendors were potential respondents by observation and sometimes by asking the vendors brief questions.

Two criteria were used to screen the kosei vendors. First, only kosei vendors who had at least five kosei balls remaining to sell (at the beginning of the interview) were selected because we needed to buy those balls in order to weigh them and estimate the average weight of one kosei ball made by each respondent (these data were later used to estimate the number of balls the respondents sold during the day before the interview was conducted). Because the size of kosei balls fluctuated from one to another, the number "at least five" was decided for obtaining an accurate average weight, although there was no scientific reason to choose the five kosei balls. Second, the vendors who were selling food products that shared ingredients with kosei were avoided to the extent possible because, depending on their way of preparing those products, it would be difficult to

accurately estimate the share of kosei in the payment for such ingredients[1]. Only vendors who passed these two screening criteria were asked to participate in the survey.

A total of 20 kosei vendors were interviewed (Accra Metropolis: 9; Ga East: 11). All of the vendors were interviewed while they were preparing or selling kosei or right after finishing selling (therefore, to obtain daily data needed for the budgeting analysis, the questions were asked about the business of the day before the interview was conducted). All of the vendors were interviewed by the author's assistant because they did not speak English or felt more comfortable being interviewed in the local language.

The respondents were asked questions related to: (a) the composition of the costs for preparing kosei; (b) processing procedures; (c) daily sales; (d) seasonal variations in operation, costs, and sales; and (e) willingness to use commercially-processed cowpea flour/meal and constraints associated with it.

3.2.2 Custom Millers

The term "custom miller" refers to a professional miller who owns one or more milling machines (set up in a small building), mills food items that customers bring, and charges a fee, which varies depending by the types and conditions (wet or dry) of the items milled. Custom millers play an important role in the preparation of Ghanaian cuisine because many Ghanaian staple dishes are made from milled grains such as fermented maize dough. Kosei vendors are among the regular customers of these millers.

[1] In reality, as reported in Chapter 4, it was very rare to find a vendor who sold only kosei—typically, the vendors used at least some elements of the cost components of kosei preparation for preparation of other food products. Also, some respondents mentioned that they used some of the kosei ingredients for family cooking. Therefore, in order to secure enough interviews, we had to accept some vendors who used a part of ingredients for preparing other products or for family cooking. In such a case, we asked them to report the share of ingredients used in kosei preparation. However, we did not interview vendors from whom we thought it would be very difficult or impossible to obtain accurate information on the cost of kosei preparation because of their business style.

Figure 3.2 Milling machine (plate mill 2-A type) used by a custom miller in Ga East District

Source: Author.

Cowpeas, which were traditionally hand-milled using a mortar and pestle, are today custom-milled in most West African cities including Accra (J. Lowenberg-DeBoer, personal communication, October 25, 2006; E. Sakyi-Dawson, personal communication, December 19, 2006). In Accra, custom millers are located inside the markets (there are often areas in the markets where many custom millers are placed together and work as a group) and in residential areas. During the field survey, we learned that there is an association of custom millers called the Greater Accra Co-Operative Food Crop Processors Union.

A total of 15 custom millers, located in the Accra Metropolis, Ga East, and Ga West Districts, were interviewed. Interviews were conducted in the local language, except with one respondent who spoke English fluently.

The respondents were asked questions related to: (a) types of products milled, frequency milled, and fees charged for food items that they milled; (b) how they milled cowpeas for kosei vendors; and (c) characteristics of the machines they used.

*3.2.3 **Retailers***

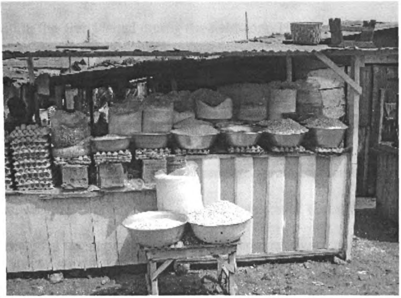
Retailers in Accra who currently or could potentially sell ready-to-use dry cowpea meal and Weanimix can be categorized into three groups: (1) grain/flour-type product vendors in the markets; (2) small shops; and (3) supermarkets.

The main purpose of interviewing retailers was to obtain data on the retail margin of industrially-processed cowpea flour/meal and Weanimix, where available. Therefore, only retailers were selected as respondents who sold either dry cowpea flour/meal or Weanimix, or similar flour-type products such as soybean flour/meal and Tom Brown, from which we could obtain reasonable estimates of retail margins for the target products (although this sampling approach did not work with small shops. See Section 3.2.3.2). The respondents were asked the purchasing and selling prices of these products, as well as the seasonal variation in prices. Also, the respondents were asked who were the major customers of cowpea/soybean flour/meal (and of weaning foods, when these products were sold by grain/flour-type product vendors).

3.2.3.1 Grain/flour-type product vendors in the market

Grain/flour-type product vendors in the markets sell different types of grains such as maize, millet, sorghum, cowpeas, soybeans, and groundnuts, and ground or primary processed products such as Tom Brown, fermented maize dough, and gari (i.e., grated, fermented, and roasted cassava). Market vendors sell their commodities by volume using a set of standard containers, rather than by weight.

Figure 3.3 A grain/flour-type product vendor stall at a market in Accra Metropolis District



Source: Author

While pre-testing the questionnaire, it was learned that those primary processed products were very often prepared by the sellers themselves. This meant that these sellers were also potential/current processors of the targeted products. Therefore, we decided to ask these vendors an additional set of questions regarding the cost of production (current/seasonal price of ingredients and roasting and/or milling costs), when the respondents indicated that the target products were self-prepared[2].

A total of seven grain/flour-type product vendors located in five different major markets were interviewed (2 at Madina market, Ga East District, 1 at Mallam-Atta, 3 at Kaneshie, and 1 at Agbogbloshie markets, Accra Metropolis District). All the interviews were conducted in the local language.

[2] The questionnaire was not modified to formally include these additional questions.

3.2.3.2 Small shops

Small shops, located inside the markets or along the roads, were observed everywhere within the area visited during the fieldwork. However, the size of these shops varied to a certain degree. Also, the commodities sold were diverse, ranging from food products such as beverages, oil, rice, and weaning foods to goods for daily use such as detergent, polyethylene bags, and insect repellent. Most of the commodities sold by these retailers were commercially produced, well-packaged products including imported goods.

After observing several small shops, it was found that only few of them sold industrially-processed target products (cowpea flour/meal, Weanimix, soybean flour/meal, or Tom Brown), while most sold Cerelac, one of the most popular commercial weaning foods in Ghana, produced by the company Nestlé. After making this observation, it was decided to ask about the purchasing and selling price of Cerelac when interviewing small

Figure 3.4 A small shop located in the Accra Metropolis District

Source: Author.

shops, although the retail margin of Cerelac (produced by a large scale company) might not provide useful information to estimate the retail margin of our target products. Also, to obtain an idea of the potential retail margin of dry cowpea flour/meal—a product which most small shops were not selling—the respondents were shown a sample bag of cowpea flour (purchased from one of the weaning food processor respondents) and asked a question designed to explore its potential selling price. The question asked was "If you buy this product for ¢7,000/10,000/12,000[3], at what price would you sell it?"

Interviews were conducted at a total of seven small shops (1 in Ga East District and 6 in Accra Metropolis District). All the interviews were conducted in the local language.

3.2.3.3 Supermarkets

Compared to the other two categories of retailers, there were far fewer supermarkets in Accra, and they seemed to be patronized only by the rich. Supermarkets varied in size, ranging from about the same size as a convenience store in the US to about one-half the size of a typical US supermarket. While a large share of the commodities sold in the Ghanaian supermarkets seemed to be imported goods, local products were also on the shelf—including industrially-processed flours and weaning foods.

Staff of a total of four supermarkets were interviewed (2 in Accra Metropolis District and Ga East District, respectively). The local language was used for one interview, and the remaining three interviews were conducted in English.

---

[3] These three different purchasing prices were proposed to each respondent. This additional question does not appear in the questionnaire in Appendix 1; ¢: Ghanaian cedis (US$1 = approximately ¢9,200 at the time of the survey. In July 2007, Ghana denominated its currency, and ¢10,000 became GH¢1. However, the currency of the time when the survey was conducted is used throughout this thesis.)

Figure 3.5 A supermarket located in the Ga East District

Source: Author.

3.2.4 Weaning Mothers

To interview weaning mothers, four healthcare institutions were selected, which were located in Ga East and Accra Metropolis Districts: Adenta Clinic (Ga East), Maternal/Child Health/Family Planning Clinic in Madina (Ga East), Princess Marie Louise Hospital (also called Children's Hospital) (Accra Metropolis), and Mamobi Polyclinic (Accra Metropolis). These locations were selected because of the convenience for finding potential respondents: each clinic/hospital had a day of the week when mothers could have their small children weighed and keep the record (such a day was called "weighing day"). During the opening hours of weighing day (it was often during the morning and early in the afternoon), the clinics/hospital were crowded with mothers and their small children. Permission to conduct a survey was obtained from the authority

of each clinic/hospital[4]. Then, a nurse in charge of weighing introduced us to mothers and asked for cooperation before the interviews were conducted.

A total of 30 interviews were conducted (Adenta: 6; Madina: 9, Children's Hospital: 7; and Mamobi: 8). Most interviews were conducted in the local language, except in a few instances when the respondent was fluent in English.

The respondents were asked questions related to their weaning practices such as: (1) frequency of giving weaning foods to their children; (2) types and the recipe of weaning foods that they prepared at home; (3) types and costs of weaning foods that they purchased; and (4) relative frequency of using self-prepared weaning foods compared to commercial ones. The mothers were also asked some additional questions about their consumption of cowpea grain and kosei at home. The intention was to obtain information from the consumers' perspective that would supplement the analysis of ready-to-use dry cowpea meal. Respondents were asked questions such as: (1) whether they prepared kosei at home and (2) if they had ever purchased commercial cowpea flour.

3.2.5 Industrial Grain Flour and/or Weaning Food Processors

The number of industrial grain flour and/or weaning food processors and their scale of production is small in Ghana (E. Sakyi-Dawson, personal communication, December, 19, 2006). To identify potential respondents, retail shops (mostly supermarkets) were visited to look for the target or similar products that were on the shelf, and the processors' information (mainly telephone numbers) of the products found was

[4] To obtain permission to conduct these interviews, we were required to submit an official letter from the Department of Nutrition and Food Science, UGL. Dr. Esther Sakyi-Dawson prepared this letter for us. We used it in many situations, such as for obtaining the permission to conduct interviews with supermarket managers, for building a friendly relationship with grain flour/weaning food processors, and for obtaining information from the Ghana Standards Board, Ministry of Food and Agriculture, etc.

noted. The Food Research Institute (FRI) and Ghana Standards Board (GSB) were also visited to collect additional information needed to identify more processors. A total of 24 companies were identified.

Out of these 24 potential respondents, 16 companies were contacted by the UGL assistant, who briefly explained the purpose of the survey, and asked for an appointment to visit. Several companies had to be excluded from the list at this stage for several reasons, such as the company was not producing the target product anymore. Twelve companies were visited. During the first visit, the potential respondents were informed that the goal of the survey was to conduct an economic analysis and that we would like to collect accounting data. The refusal rate was surprisingly small (only one company refused). The respondents were also asked to name all the products that they produced. From the list of products obtained, we found out that there was a significant overlap among grain flour processors and weaning food processors, that is, many of the respondents produced both some type of grain flour products and weaning foods[5]. Another finding was that only two of the companies were producing cowpea flour. Therefore, we decided to ask soybean flour processors the same set of questions prepared for cowpea flour processors[6]. At the end of the first visit, the appointment for a second visit was made, and a full interview was conducted during the second visit. Although this strategy was taken at the beginning of the survey, it turned out that this method took too much time (the respondents, who were most of the time the owner of the company, were very busy, and it was difficult to meet with them twice). Therefore, we tried to conduct a full interview during the first visit. It worked to a certain degree, especially when the

[5] The questionnaire was revised so that it could be used for the respondent producing either of the target products and those producing both of them.
[6] Again, the questionnaire was revised accordingly.

respondents had available the company's accounting record[7].

Out of the 11 processors who agreed to participate in the survey, one processor was interviewed for pre-testing of the questionnaire. All the remaining 10 respondents were producing at least one of the following products: Weanimix (whether cowpea- or soybean-), "quasi-Weanimix" (similar product to Weanimix but not exactly the same), and Tom Brown. Among the 10 respondents, 1 produced both cowpea and soybean flour. This respondent was asked about cowpea flour production (in addition to Weanimix). Another respondent who produced cowpea flour (but not soybean flour) was asked questions about its production as well. Soybean flour was produced by four other respondents, who were also asked about its production. To summarize, interviews were conducted with processors of Weanimix/quasi-Weanimix/Tom Brown (10), cowpea flour (2), and soybean flour (4). The locations where the interviews were conducted were as follows: Accra Metropolis: 2; Tema: 1; Ga East: 4; and Ga West: 3.

The respondents were asked questions related to: (1) general information about their facility (e.g., operation time, number of workers, and products they produce); (2) quantity of each product produced during the past month and past year (when the information was available); (3) price of the target products; (4) total sales of the company during the past month and past year (when the information was available); (5) equipment they used to produce the target products (e.g., types, size, year of purchase, price when purchased, and maintenance costs); (6) costs of operating the facility (e.g., labor, electricity, fuel, water, rent, transportation, printing, stationery, and telecommunication); and (7) information specific to the target products (e.g., input-output ratio, processing

[7] Interviews with two respondents were completed in one visit, while most of the remaining respondents were visited twice.

procedures, seasonal change in production quantity and price, main customers, and their experience of and perceptions about using cowpeas as an ingredient).

3.3 Secondary Data

Historical price data on cowpeas as well as other grain crops were collected from the Statistics Research & Information Directorate (SRID) of the Ghanaian Ministry of Food and Agriculture (MoFA). The data set included monthly retail and wholesale prices of cowpeas, maize, millet, and groundnuts for five years (from 2002 to 2006; but with many missing months) at "urban markets" of the Greater Accra Region (average of Accra Metropolis, Ga [Ga East and Ga West combined], and Tema Municipal Districts). Since no data on the price of soybeans were collected by the MoFA, a wholesaler in Nima market (Accra Metropolis District) was consulted to obtain a seasonal trend in prices of soybeans. To estimate a representative price of each crop in February 2007, prices observed during the fieldwork in different markets were noted. Also, data sets were collected from Tradenet (http://www.tradenet.biz), a website providing detailed up-to-date price data of different commodities in different countries mainly in West Africa[8].

The monthly Consumer Price Index (CPI) for Ghana, covering the period from January 1990 to February 2007, was obtained from the International Monetary Fund's (IMF) website (http://www.imf.org/external/data.htm). These data were used to convert the prices and monetary values at different points in time to the current prices and values.

Ghana's minimum daily wage rate during February and March 2007 was obtained from the website of the Bank of Ghana (http://www.bog.gov.gh/index1.php?linkid=174).

[8] Derived representative prices of each crop as well as the methods used to derive these prices are summarized in Appendix 3.

The data were used to estimate the opportunity cost of labor when analyzing the profitability of kosei prepared using dry cowpea meal.

3.4 Dry Cowpea Meal and Kosei Preparation Experiments

Two types of experiments were conducted—a laboratory experiment at the Department of Nutrition and Food Science, UGL and a field experiment with a kosei vendor. The laboratory experiment was conducted to estimate the input-output ratio for preparing the B/C CRSP-developed dry cowpea meal suitable for making kosei (i.e., how many kg of cowpea grain is needed to make 1 kg of B/C CRSP dry cowpea meal). Cowpea grain (type called "Togo") was purchased from a grain vendor at a market, weighed, washed with water, soaked for about five minutes, and machine-dried overnight at 50°C. The next day, the dried cowpea grain was dehulled using a plate mill, machine-winnowed, milled into meal using a hammer mill, and weighed.

Then, the kosei preparation experiment was conducted to estimate the input-output ratio for two different kosei preparation processes: (1) wet-milled kosei, prepared using cowpea grain; and (2) dry-milled kosei, prepared using B/C CRSP dry cowpea meal. These input-output ratios were needed because, first, for the wet-milling procedure, many kosei vendor respondents could not estimate their daily revenue from kosei (see Chapter 4), and second, none of the respondents used the dry meal developed by the B/C CRSP because it was not commercially available. These facts made it impossible to calculate the total weight of the kosei that vendors prepared in a given day by the formula:

$$\left(\frac{\text{[revenue from kosei]}}{\text{[price of 1 kosei ball]}} \times \text{[average wt. of kosei balls purchased during interview]}\right).$$

However, the total weight of prepared kosei is an indispensable piece of information required to calculate the unit cost of kosei (i.e., cost per kg). Thus, an alternative formula based on the weight of ingredients used by the vendors was used to obtain the total weight of prepared kosei, for those respondents who could not provide the revenue of the day before the interview was conducted. This formula is explained in detail in Section 4.2.6.3.

Among the 20 kosei vendors interviewed, one vendor with five years of experience who prepared kosei using the "standard" method (i.e., the method used by many of the respondents) was selected and asked to participate in this experiment. After she agreed, she was provided two sets of ingredients for preparing kosei: (1) cowpea grain, onion, pepper, and oil and (2) laboratory-prepared B/C CRSP cowpea meal, onion, pepper, and oil. With the first set of ingredients, she was asked to make kosei following her normal procedures, using all the grain provided and the corresponding amount of the other ingredients. For the second set of ingredients, she was asked to make kosei by first soaking all the dry cowpea meal provided and then using the corresponding amount of the other ingredients. The ingredients were weighed before, during[9], and after the experiment. Then, the kosei balls were counted and weighed.

This series of experiments were conducted twice with the same kosei vendor (one in March and another in May 2007).

3.5 Per Olonka Weight of Different Crops

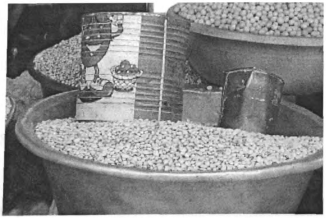
Much of the quantity data collected during the fieldwork were reported by the

[9] Although the experiments were conducted twice, for the first replication, there is missing information on the weight of ingredients during the experiment (see Table 4.15).

respondent in volume units rather than weight units. The units regularly used in Ghana to measure grains and flour-type products are the olonka container and *margarine tin* (Figure 3.6). The volume of one olonka is six times the volume of one margarine tin. During the fieldwork, a sample of each container was purchased at a market, and the circumference and height were measured. The olonka container had a circumference of 51.0 cm and a height of 17.2 cm, making its volume 3,560 cm^3, while the margarine tin had a circumference of 28.0 cm and a height of 10.2 cm, making its volume 636 cm^3. The ratio of the calculated volumes is 5.6, which is not exactly six. Since the ratio is known to be exactly six[10], this discrepancy implies that some errors occurred when measuring either the olonka container, the margarine tin, or both. Therefore, these volumetric values obtained from the purchased container and tin samples have to be considered as approximation.

Nima market was visited in late March and one olonka of different crops was

Figure 3.6 Olonka container (left) and margarine tin (right)



Source: Author.

[10] This was verified by pouring water from six full margarine tins into one olonka container, which exactly filled the container.

purchased, including cowpeas (type called "Niger"), maize, millet, groundnuts, and soybeans. The weight of each crop was measured in a laboratory at the Department of Nutrition and Food Science, UGL, using an electronic scale. The representative olonka-kg conversion rates obtained for different crops are presented in Appendix 2. These rates were used throughout this study when unit conversions were necessary between olonka and kg.

However, a potential problem of this method was found. When the samples of grains were purchased or when markets were visited for interviews, we observed that "one" olonka or "one" margarine tin does not equal the volume of commodities that fits into the measuring container (i.e., flat at the ceiling level of the container), because the grain is conventionally heaped up to form a cone shape. This implies that the volume of one olonka and margarine tin is arbitrary to a certain degree because the vendors can, for example, reduce the amount of the heaped-up part when the purchasing price of the commodity is high, or add one more handful of grains to the cone if her friend is the customer. Moreover, this means that the weight of the one-olonka samples that we purchased is just one observation out of a whole population of olonka volumes, and might be inaccurate if applied to the same commodities but purchased at different times and/or locations. If this occurred, the estimated prices per kg of corresponding commodities, derived using the "representative" olonka-kg conversion rates, were inaccurate as well (see Section 4.2.5.3 for an additional discussion).

3.6 Analytical Methods

The data collected from five different categories of respondents were entered and

cleaned in separate spreadsheets of Microsoft Excel. When necessary, monetary values were converted to current prices using the CPI obtained from the IMF.

3.6.1 Dry Cowpea Meal as an Ingredient in Kosei

First, a descriptive analysis was conducted, using the data collected from kosei vendors, custom millers, cowpea/soybean flour processors, retailers, and weaning mothers (as consumers of kosei). The analysis included both a description of quantitative data and a discussion of qualitative data with regard to non-price competitiveness of dry cowpea meal. The results of this analysis are reported in Chapter 4.

Second, to estimate the price of industrially-processed dry cowpea meal, an enterprise budget for industrially producing 1 kg of dry cowpea meal was prepared for each of the cowpea/soybean flour processors interviewed. However, because of missing information, the budgets could be constructed only for four out of six respondents.

Third, an enterprise budget for producing 1 kg of kosei was prepared for each of the kosei vendors interviewed (a total of 13[11]). Based on the 13 budgets derived, three representative budgets, for different levels of profitability, were constructed.

Fourth, by replacing the cost of cowpea grain in each of the three representative budgets with the estimated cost of dry cowpea meal, representative budgets were prepared for producing 1 kg of kosei from dry cowpea meal.

Fifth, the representative budgets for preparing 1 kg of kosei using cowpea grain and dry meal were compared to each other to examine the price-competitiveness of dry cowpea meal, as an ingredient in kosei.

---

[11] As discussed in Section 4.1, among 20 kosei vendors interviewed, 7 vendors were selling a different, if strictly speaking, product from kosei. For the budgeting analysis, it was judged appropriate to not include these vendors.

Finally, sensitivity analysis was conducted by assuming changes in different variables in the budgets, which would potentially change the price-competitiveness of industrially-processed dry cowpea meal.

The mathematical method (model) used to prepare the budgets and the results of analysis are discussed in Chapter 5.

3.6.2 Cowpea-Weanimix

First, a descriptive analysis was conducted using the data collected from custom millers, weaning food processors, retailers, and weaning mothers. The analysis included both a description of the quantitative data and a discussion of the qualitative data with regard to non-price competitiveness of industrially-processed cowpea-Weanimix. The results of this analysis are reported in Chapter 6.

Second, to estimate the processor prices of industrially-processed Tom Brown, cowpea-Weanimix, and soybean-Weanimix, enterprise budgets for producing 1 kg of these products were prepared for each of the weaning food processors interviewed. However, because of missing information, the budgets could be constructed only for five out of 10 respondents. Based on the five budgets derived, two representative budgets, for different levels of profitability, were constructed. Then, to estimate the retail price of the three weaning food products, a representative retail margin (derived using the information collected from the retailer respondents) was added to the estimated processor prices of the products.

Third, using the data collected from the grain/flour-type product vendors who were self-preparing Tom Brown (7 observations), a representative enterprise budget for

self-preparing 1 kg of Tom Brown was constructed. In turn, this budget was used to construct enterprise budgets for self-preparing 1 kg of cowpea-Weanimix and soybean-Weanimix, by changing the raw material costs from only maize to maize + cowpeas/soybeans + groundnuts.

Fourth, to examine the price-competitiveness of industrially-processed cowpea-Weanimix, its estimated retail price was compared to the estimated retail price of: (1) industrially-processed Tom Brown; (2) industrially-processed soybean-Weanimix; and (3) self-prepared cowpea-Weanimix.

Finally, sensitivity analysis was conducted by assuming changes in different variables in the budgets, which would potentially change the price-competitiveness of industrially-processed cowpea-Weanimix.

The mathematical method (model) used to prepare these budgets and the results of analysis are discussed in Chapter 7.

3.7 Summary

In this chapter, the sources of data used in this study were described, and the analytical methods used were summarized.

Fieldwork was conducted in the Greater Accra Region during February and March 2007. Interviews were conducted with 20 kosei vendors, 15 custom millers, 18 retailers, 30 weaning mothers, and 10 industrial grain flour/weaning food processors. Price data for different commodities were collected from different sources, including the Ministry of Food and Agriculture. Laboratory and field experiments were conducted to estimate input-output ratios of dry cowpea meal and kosei.

Using the qualitative data collected, descriptive analysis was carried out to examine non-price-related factors that would affect the competitiveness of industrially-processed dry cowpea meal and cowpea-Weanimix. Quantitative data were used to prepare enterprise budgets to analyze the price-competitiveness of the target products. Sensitivity analysis was conducted to analyze the change in price-competitiveness under different scenarios.

CHAPTER 4

DRY COWPEA MEAL FOR PREPARATION OF KOSEI —DESCRIPTIVE ANALYSIS

4.1 Overview of Kosei Business and Grain Flour Production in Accra

As described in Section 2.2.1, kosei is a deep-fried cowpea fritter that usually contains dehulled and milled cowpeas, water, onions, peppers, and salt. However, during the fieldwork in Accra, some street vendors were observed not using pepper, while others used additional ingredients such as spices, eggs, green leaves, and soybeans. Some vendors only sold kosei during the morning, while others also sold it in the afternoon[1]. Kosei was rarely sold alone but along with other food products such as *hausa koko* (millet-based porridge with spice and sugar), bread, groundnuts, and other fried foods such as *pinkaso* (small-doughnut-looking fried wheat flour containing onions and eggs with sprinkled sugar). Customers could buy kosei in individual balls or in bulk. Most vendors sold kosei in polyethylene bags: a thin inner transparent bag and a thicker-outer black bag.

Two types of "kosei" were sold in Accra—one type was made from wet-milled cowpeas, and the other type was made from dry-milled cowpeas[2]. Street vendors called the wet-milled type kosei and the dry-milled type *agawu*. However, the majority of consumers in Accra seemed to call both types kosei. Although they did not distinguish between kosei and agawu by name, these products were very different in appearance and

[1] Some vendors may only sell kosei in the afternoon. However, since most of the kosei vendor interviews were conducted during the morning, we did not observe such vendors.
[2] The difference is whether cowpeas are wet or dry when milled. Therefore, both "wet method" and "combined dry and wet method" described by Dovlo et al. (1976) are considered as wet-milled.

taste. In general, kosei has a rounder shape, while agawu has a more jagged shape (see Figures 4.1 and 4.2), and kosei has a light spongy texture, while agawu has a harder and drier texture[3]. Therefore, it was expected that consumers preferred one over the other, and patronized the vendors who sold the type that they preferred. In Accra, kosei seemed to be more popular than agawu (E. Sakyi-Dawson, personal communication, March 21, 2007).

Figure 4.1 Kosei

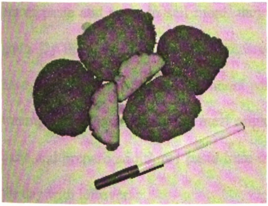
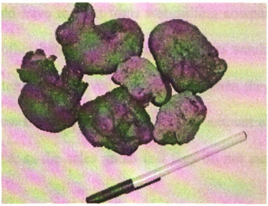


Figure 4.2 Agawu



Source: Author.

To make agawu, cowpeas are first dry dehulled and milled into flour. Since it is dry, this flour can be kept for a longer time—compared to wet-milled cowpea paste that spoils quickly. Vendors decide on the amount of flour needed for one day of business, add water, whip, add other ingredients, and fry. This procedure is the same as when using dry cowpea meal developed by the B/C CRSP. However, it is important to note that the B/C CRSP-developed meal is for preparing kosei, not agawu. As described in Section 2.2.1, this meal can be used to make kosei that tastes similar to the one prepared from wet-milled cowpeas.

[3] The color of the inside is largely affected by the amount of pepper used. Therefore, it is not clear whether the difference in color is attributed to the difference in processing procedures (i.e., wet or dry mill).

If it becomes commercially available, dry cowpea meal suitable for making kosei is expected to have various advantages. These advantages include[4]:

(1) it would reduce preparation time because kosei vendors could skip time-consuming parts of processing procedures such as sorting out bad grains, dehulling, and milling;

(2) since the meal can be turned into paste simply by adding water, it might allow kosei vendors to make a fine adjustment in the quantity of kosei to prepare, depending on the sales of the day. This is not possible with the current procedure because if vendors run out of paste and want to sell more, they would have to start from wet-milling cowpea grain. By the time vendors have prepared another batch of paste, all customers would have left. Likewise, for kosei vendors who often have leftover paste or balls when they want to finish for the day, dry meal might allow them to start with a smaller amount of paste and prepare additional paste little-by-little, as the sales go so that they do not end the day with leftovers;

(3) if packaged in an air-tight container, the meal could be kept longer than when it is self-prepared and stored in an open-to-air condition[5]. This would enable kosei vendors to purchase the main ingredient at a stable price, compared to the current situation where vendors have to buy cowpea grain regularly, which exposes them to price fluctuations; and

(4) it might stimulate the preparation of kosei at home, thereby increasing the demand for cowpeas—anecdotal evidence suggests that some potential kosei consumers do not currently buy kosei from street vendors because they dislike the ways the vendors

[4] Collected through personal communications with B/C CRSP food scientists and economists.
[5] Dry flour/meal is not totally insect-free if not stored in an air-tight container (G. A. Annor, personal communication, February 16, 2007).

prepare kosei. If ready-to-use commercial cowpea meal becomes available, these potential consumers might start preparing kosei at home, tailoring it to their taste.

These potential benefits of commercial dry cowpea meal are analyzed in the rest of this chapter, based on the data collected during the fieldwork.

In today's Ghana, a wide range exists in the types and scales of grain flour processors. At the most commercial level are multinational companies such as Nestlé Ghana. The company produces a variety of weaning foods that are made from grain flours mixed with other ingredients. Producing weaning foods and meal require similar equipment and processing procedures. Therefore, a large multinational company currently producing weaning foods is a potential processor of dry cowpea meal. If companies of such a scale produce dry cowpea meal, unit costs would most likely be lower than when it is produced by smaller companies due to economies of scale.

The smallest scale processors of grain flour are individuals. Anybody who has access to custom millers can self-prepare grain flour. Custom millers also make it possible for grain vendors in the market to produce and sell grain flour. In fact, anyone can be a potential dry cowpea meal processor, if he/she has access to a dryer and if a custom miller can mill cowpeas into the appropriate particle size with the mill that they are currently using.

Between the above-mentioned largest- and smallest-scale grain flour processors, there exist small- to medium-scale local companies that either specialize in grain-flour production or produce a wide range of food products. There exists a variety in scale within these companies: some have more than 50 workers including managers and accountants, while others are owned and operated by just a person or run as a family

business, possibly hiring temporary workers when busy. Some own all or most of the equipment they need for processing, while others outsource some or many parts of processing procedures (e.g., having a hand sealer for packaging but using custom millers for milling). Some have a constant demand for their products and operate throughout the year, while others produce with interruption depending on the demand. All the 10 companies interviewed during the field survey were small- to medium-scale locally owned processors.

4.2 Description and Implication of Data

This section presents descriptive analyses of the data collected during the fieldwork and describes the steps taken to prepare these data for the budget analysis.

4.2.1 Street Vendors of Kosei and Agawu

4.2.1.1 Characteristics of kosei and agawu vendor respondents

Of the 20 street vendors interviewed, 13 were kosei and 7 were agawu vendors. Characteristics of these respondents are shown in Table 4.1.

While all kosei and agawu vendors were women, the number of years they were in business varied widely across the respondents. Many respondents were assisted by members of their family such as daughters and sisters or, with a lower frequency, hired workers. Among kosei vendors, only two respondents worked without their family members, although one of these two respondents worked with two hired workers. Among agawu vendors, three respondents had no family assistance, although one of these three respondents worked with one hired worker. The majority of respondents worked everyday,

Table 4.1 Characteristics of kosei and agawu vendor respondents

Characteristics		kosei vendor (n = 13)	agawu vendor (n = 7)
Sex	Male	0	0
	Female	13	7
Experience in kosei/agawu business	Fewer than 1 year	2	0
	1 – less than 3 years	2	3
	3 – less than 10 years	6	3
	10 years or more	3	1
Number of family members assisting with the business	0	2	3
	1	5	1
	2	4	2
	3	2	1
Number of hired workers	0	12	6
	1	0	1
	2	1	0
Number of working days per week	6	5	2
	7	8	5
Other food products selling along with kosei	None	3	0
	Hausa koko	9	7
	Bread	5	7
	Groundnuts	2	3
	Pinkaso	2	0
	Boflot	0	1
Have other source of income	No	12	3
	Yes	1	4

Note: Hausa koko: a spiced millet-based drink; Pinkaso: small-doughnut-looking fried wheat flour containing onions and eggs with sprinkled sugar; Boflot: a fried wheat flour ball

Source: Field survey in Accra, February and March 2007.

while the remaining respondents worked six days a week.

As briefly mentioned earlier, most respondents, as well as other kosei/agawu vendors observed during the fieldwork, sold other food products along with kosei or agawu. Among kosei vendors, three respondents were specialized kosei vendors, while the other 10 respondents sold one or several other products. Among such foods sold with kosei, the most popular was hausa koko, a spiced millet-based drink, which was served with sugar in a bowl for customers who wanted to eat it at the place of purchase or in a transparent polyethylene bag for takeout. Among the 10 multiple-product-selling kosei respondents, 9 sold hausa koko. While the other one did not sell hausa koko herself, she

worked with another person who sold hausa koko right next to her. The second most popular product among kosei vendors was bread. When customers requested, the vendors cut the bread, put kosei balls into it to make a sandwich, and sold it wrapped in a paper. The other food products that kosei respondents sold were groundnuts and pinkaso. Among agawu vendors, all seven respondents sold both hausa koko and bread. In addition, three respondents sold groundnuts, and another respondent had just started selling *boflot*, which is a fried wheat flour ball. There was no agawu respondent who sold pinkaso. While the sample size is too small to make any generalization, based on the observation during the field survey and discussion with food scientists at UGL, it seems that one could safely say hausa koko and bread are often sold with both kosei and agawu in Accra.

Of the 13 kosei respondents, only 1 had another source of income (selling clothes), while four of the seven agawu respondents had another source of income (selling fruits, selling soaps, selling charcoal, and working as a seamstress). When asked to estimate the share of their income from selling kosei/agawu, two of them, including the clothes-selling kosei vendor, did not know the answer, while the remaining three reported that agawu and the products sold along with agawu made up the majority of their total income[6]. Again, given the small sample size, no generalization can be made. However, it is interesting to see such a large difference between the kosei and agawu vendor respondents in terms of the percentage who had another source of income. A possible hypothesis is that agawu preparation requires less labor (than kosei) because agawu is prepared from dry-milled cowpea flour. Therefore, agawu vendors have more time that

[6] The agawu vendor who was also a seamstress implied that she would have her shop in the future. Whether kosei/agawu business creates enough return for vendors to save money and eventually allow them to invest in a potentially more profitable job is an interesting topic to study.

they can allocate for other activities. If a survey were conducted to test this hypothesis, the results would provide useful information to help to assess the benefits of developing dry cowpea meal for kosei preparation.

4.2.1.2 Types and sources of cost components to prepare kosei and agawu

Data collected to estimate the cost components for preparing kosei and agawu are shown in Table 4.2.

Table 4.2 Types and sources of cost components to prepare kosei/agawu among the respondents

Cost components		kosei vendor (n = 13)	agawu vendor (n = 7)
Origin of cowpeas used	Burkina	0	1
	Niger	8	4
	Nigeria	3	1
	Togo	2	1
Source of cowpeas	Vendor in the market	7	2
	Wholesaler	6	5
Other ingredients	Onion	13	7
	Pepper	13	3
	Soybean	0	2
	Ginger	5	0
	Garlic	1	0
	Green leaves	1	0
	Salt	13	7
	Spice	3	0
Source of water	Water vendor	10	5
	Use house water	2	0
	Do not buy water	1	2
Type of oil	Vegetable	13	7
Type of fuel	Charcoal	11	7
	Firewood	1	0
	LP-gas	1	0
Use of custom miller	To dehull	10	6
	To mill	13	7

Source: Field survey in Accra, February and March 2007.

There are a large number of different cowpea varieties (see for example Dovlo et al., 1976, frontispiece, for a picture of 42 varieties of cowpea grains, which differ in color and size). In Accra, grain vendors and customers mainly distinguish varieties based on the country of origin. The varieties observed during the fieldwork were referred to as "Burkina," "Niger" (there were two different types of "Niger"), "Nigeria," "Togo," and another was called "small bean." The eight kosei vendor respondents who used Niger preferred it because of its: (1) better taste (mentioned by 5 respondents); (2) better swelling capacity (2 respondents); and (3) better look of kosei (2 respondents). The three respondents who used Nigeria preferred this type because: (1) of its better taste (2 respondents); (2) of its better swelling capacity (2 respondents); (3) kosei does not break easily after fried (1 respondent); and (4) the respondent thought customers liked Nigeria and felt that she made more money by using it (1 respondent). The two vendors who used Togo preferred it because of its: (1) better taste (1 respondent); and (2) better look of kosei (1 respondent). It was interesting to find that while the respondents used different types, they mentioned the same reasons for choosing the type.

Among the agawu vendor respondents, four used Niger, which they preferred because of its: (1) better taste (mentioned by 3 respondents); and (2) better swelling capacity (1 respondent). Burkina, Nigeria, and Togo were each used by one respondent, respectively, which was preferred because of its better swelling capacity (Burkina), softness and better swelling capacity (Nigeria), and better taste (Togo).

All the respondents, including both kosei and agawu vendors, answered that they purchased cowpeas from either vendors in the market or wholesalers. However, since wholesalers sold cowpeas in the market, the respondents who answered "vendor in the

market" might have meant "wholesaler in the market." As a result, it is not clear from the data how many of the vendors purchased cowpeas from retailers and how many purchased from wholesalers. No respondent bought cowpeas from a retail store outside of the market or directly from farmers.

Onion, pepper, and salt were the most common ingredients added to kosei/agawu. All 13 kosei vendor respondents used these three ingredients. In addition, some of the respondents added other ingredients such as ginger, garlic, green leaves, and spices. All seven agawu vendor respondents added onion and salt, but only three added pepper (one of these 3 respondents added pepper powder to already fried agawu, but only when customers requested). The only other ingredient added by two out of seven agawu respondents was soybeans; one of them reported that she added soybeans because it made agawu taste better and more nutritious.

The majority of respondents bought water from water vendors, mostly on a daily basis. All the respondents, both kosei and agawu vendors, used vegetable oil to fry their products. Almost all the respondents used charcoal to heat the oil.

For dehulling cowpeas, two kosei respondents reported that they used mortar and pestle while another kosei respondent simply mentioned wet-dehulling without specifying the tool she used. While one agawu vendor made agawu without dehulling cowpeas, all the other kosei and agawu vendors custom-dehulled cowpeas. For milling cowpeas, all the kosei and agawu respondents used custom millers.

4.2.1.3 Prices and sales

Data related to the price of kosei/agawu and daily sales are shown in Table 4.3.

Table 4.3 Product price and daily sales of kosei/agawu among the respondents

Product price and daily sales		kosei vendor (n = 13)	agawu vendor (n = 7)
Price per ball*	¢500	13	7
Weight per ball	20-30 g	5	1
	30-40 g	8	2
	40-50 g	0	1
	50-60 g	0	3
	Mean (g)	32	43
	Standard deviation (g)	5	13
Size of ball changes during the day	No	12	7
	Yes	1	0
Scale of business: revenue from kosei (¢) the day before the interview was conducted**	0 < revenue ≤ 50,000	3	
	50,000 < revenue ≤ 100,000	3	
	100,000 < revenue ≤ 200,000	4	
	200,000 < revenue ≤ 500,000	2	
	500,000 < revenue	1	
Scale of business: quantity of cowpea grain (kg) used the day before the interview was conducted***	0 < cowpea grain ≤ 2	3	2
	2 < cowpea grain ≤ 4	3	2
	4 < cowpea grain ≤ 8	4	3
	8 < cowpea grain ≤ 16	2	0
	16 < cowpea grain	1	0

* Exchange rate: US$1 = approximately ¢9,200 (Ghanaian cedis) at the time of the survey. In July 2007, Ghana denominated its currency, and ¢10,000 became GH¢1. However, the currency of the time when the survey was conducted is used throughout this thesis.

** Includes estimates (see Section 4.2.6.3); leftover balls, if any, were assumed to be sold; the variable is not available for agawu vendors because of missing information.

*** Includes estimates (the methods used are available from the author upon request); for two agawu respondents who used soybeans, the values were the sum of cowpeas and soybeans.

Source: Field survey in Accra, February and March 2007.

All respondents sold kosei and agawu for ¢500 (Ghanaian cedis) per ball (approximately US$0.054 at US$1 ≈ ¢9,200). However, the weight per ball showed a wide range, implying that the unit price of kosei/agawu was different across the respondents. The mean weight per ball of five or six kosei balls measured after the interview averaged 32 g with a standard deviation of 5 g. The mean weight per ball of

five or six agawu balls averaged 43 g with a standard deviation of 13 g.

All the respondents except one kosei vendor stated that they usually kept balls the same size throughout the day. This means that most vendors did not make smaller balls during the peak time, although they could possibly make more money by doing so. Therefore, the unit price of kosei/agawu within a day seemed to be constant *per* respondent, although it varied *across* respondents[7].

The scale of business (measured in terms of daily revenue and quantity of cowpeas used) varied widely across the respondents: for kosei, three respondents earned ¢0 – ¢50,000 (US$0 – US$5.44) from kosei alone (i.e., not including the revenues from other food products) from the 0-2 kg of cowpea grain used the day before the interview was conducted; three respondents earned ¢50,000 – ¢100,000 (US$5.44 – US$10.88) using 2-4 kg; four respondents earned ¢100,000 – ¢200,000 (US$10.88 – US$21.76) using 4-8 kg; two respondents earned ¢200,000 – ¢500,000 (US$21.76 – US$54.34) using 8-16 kg; and one respondent earned more than ¢500,000 (over US$54.34) using more than 16 kg. For agawu, two respondents used 0-2 kg of cowpea grain the day before the interview was conducted (sum of the weights of cowpeas and soybeans for one of them); two respondents used 2-4 kg; and three respondents used 4-8 kg (sum of the weights of cowpeas and soybeans for one of them).

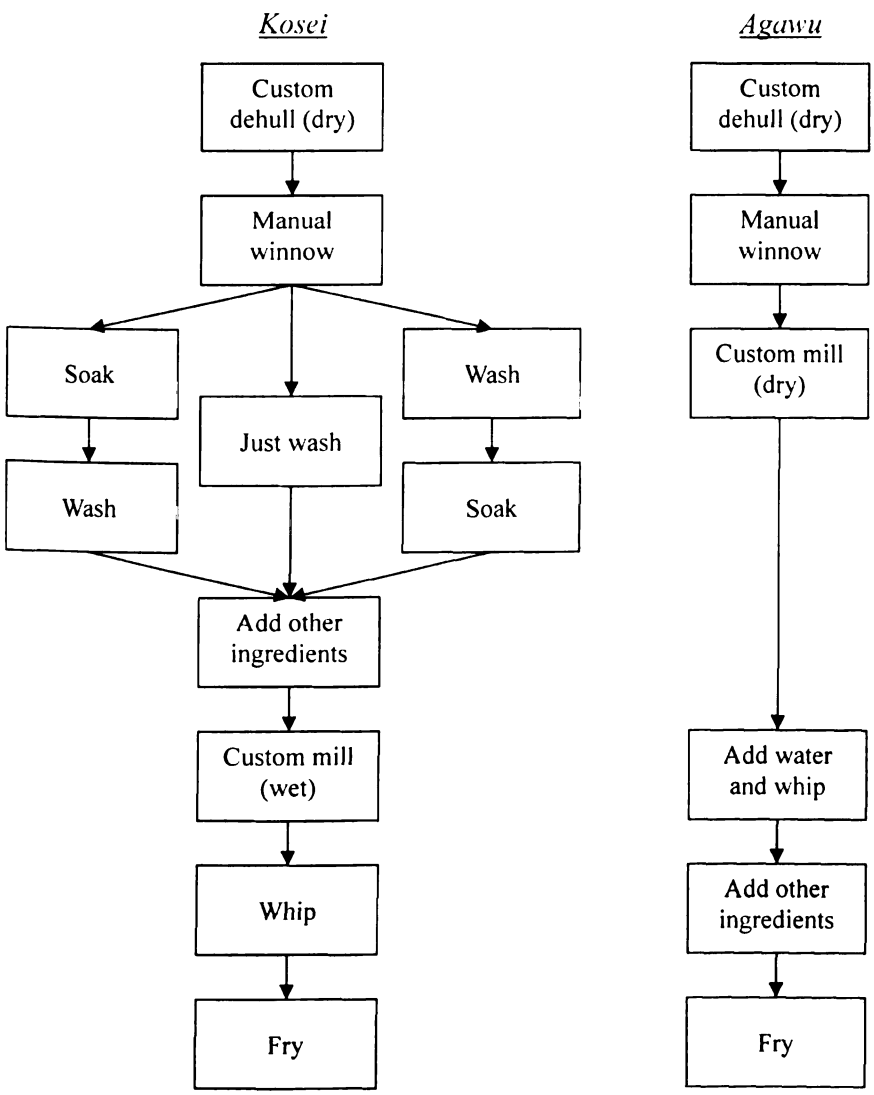
4.2.1.4 Processing procedure for kosei and agawu

Each respondent had her own way of preparing kosei or agawu. These procedures might have been developed based on the vendors' experience, or they might have been

[7] One might doubt if the respondents honestly answered this question. However, as is shown later in Section 4.2.1.7, many respondents mentioned that they changed the size of balls when cowpeas were scarce. Therefore, their reply that they kept the size of balls throughout the day seemed to be trustworthy.

the methods passed down from generation to generation. However, although their procedures were not exactly the same, it still is possible to derive a representative processing procedure that was typically followed by the majority of respondents. Figure 4.3 describes the typical procedure for preparing kosei and agawu.

Figure 4.3 Representative processing procedures for kosei and agawu



Whether the vendor prepared kosei or agawu, most respondents first "custom-dehulled" dry cowpea grain, that is, they brought cowpeas to a custom miller, who adjusted the plates so that the machine did not mill but just cracked the cowpeas. After the cowpeas were passed through the machine, they broke into smaller pieces, and most hulls were separated from the endosperms. Then, the vendors manually winnowed the hulls. Kosei vendors brought home these dry-cracked cowpeas, while agawu vendors had the custom millers put these cowpeas back into the machine to mill them into flour. Using these procedures, the vendors could have dehulled/milled a large quantity of cowpeas (e.g., 1 sack of 40 olonka), if they could afford to buy such a large amount at once. By doing so, these vendors could save money because of the discount associated with bulk purchase and bulk custom dehulling/milling.

For kosei vendors, the next step was to select the quantity of cracked cowpeas that they needed for one day and do one of the following: (1) wash and then soak; (2) just wash; or (3) soak and then wash. There was no typical soaking time among the 13 respondents[8]: 8 respondents reported they soaked for 0-1 hour; 2 respondents for 2-3 hours; and 3 respondents overnight. No relation was found between the length of soaking time and the vendor's experience in kosei business. Then, the vendors added other ingredients to the cowpeas, had them custom milled into paste, and finally whipped and fried them. Whipping time also varied among the respondents[9]: two respondents reported that they whipped for less than 10 minutes; three respondents for 30 minutes; and another three respondents for 60 minutes (5 respondents could not recall exactly how long they whipped). From the data, no obvious relationship was found between the whipping time

[8] Including the three respondents who did not custom-dehull cowpeas.
[9] Again, including the three respondents who did not custom-dehull cowpeas.

and vendor's experience in kosei business. On the other hand, a negative relationship was found between soaking and whipping time.

To prepare agawu, most respondents added water to the flour and whipped it to form a paste (no respondent mentioned that she soaked the flour before whipping). Then, they added the other ingredients to the paste and fried the batter. Whipping time, which was reported by five respondents, varied from 10 to 40 minutes[10].

Even though the use of custom millers for dehulling cowpeas allows kosei vendors to skip the tedious procedure of traditional wet dehulling, kosei preparation still seems to be more time and labor consuming than agawu preparation. In the morning, kosei vendors began with soaking or washing cowpeas, and then brought their cowpeas and other ingredients to a custom miller. Even when vendors soaked cowpeas overnight, they still needed to go to a custom miller. On the other hand, agawu vendors could start whipping after simply adding water to the flour. Preparation of other ingredients is the only more involved step in agawu preparation, compared to kosei preparation: while kosei vendors can have other ingredients ground with cowpeas by custom miller, agawu vendors have to grind or chop other ingredients separately. The difference in time needed to prepare kosei and agawu seemed to affect the difference in time when vendors started preparation: on average, kosei vendors started preparation at 3:54 am[11], while agawu vendors started at 5:38 am.

[10] A kosei vendor respondent who apparently knew how to prepare agawu mentioned that dry-milled cowpeas take more time for whipping because they take more time to swell.
[11] Mean of 10 respondents: excluded are one vendor who dehulled cowpeas in the morning using a mortar and pestle and two vendors who reported information about their processing procedures for their evening sales.

4.2.1.5 Time and labor saving effects of dry cowpea meal

The use of commercial dry cowpea meal to prepare kosei means that the processing procedure becomes closer to that of agawu, and perhaps even simpler because vendors would not need to bring cowpeas to a custom miller to prepare dry meal by themselves. However, there are at least four elements that must be considered to accurately estimate the potential advantage for kosei vendors of using dry cowpea meal in terms of time and labor saving effects:

(1) Although the use of dry meal would most likely allow vendors to start preparation later in the morning, it does not necessarily mean the vendors could wake up later than their current wake-up time. In fact, four agawu vendors[12] reported that they woke up, on average, 1 hour 45 minutes earlier than they started preparation of agawu. This was because they had to prepare hausa koko, which they sold along with agawu. This finding implies that if kosei vendors also sell hausa koko and if hausa koko takes more time to prepare than kosei, the time and labor saving effect of using dry cowpea meal would have to be valued based on what kosei vendors could do during the spare time created by the use of cowpea meal while preparing hausa koko. To estimate the value of saved time and labor, we would need to know how each member of the respondents' family is currently involved in the business (e.g., just helping sell kosei or helping prepare both kosei and hausa koko), and how that involvement would change if the respondent switched to using dry meal;

(2) Soaking dry meal would be an additional task, and the time needed for this procedure should be considered. While agawu vendors did not report that they soaked

[12] Wake-up time was not obtained from the other three agawu respondents.

flour, dry cowpea meal developed by the B/C CRSP needs to be soaked for 30 to 60 minutes (see Figure 2.2);

(3) Whipping time might change. As discussed later in the section for the kosei preparation experiment, too short whipping time negatively affected the quality of kosei. There was a wide range in the current whipping time among the kosei vendor respondents. Therefore, depending on the current practice of whipping, a kosei vendor might need either a shorter or longer whipping time after switching to dry cowpea meal;

(4) Grinding onion, pepper, and other ingredients, if any, would be an additional task. As mentioned earlier, kosei vendors currently have custom millers mill these ingredients together with cowpeas. If dry cowpea meal is used, these ingredients would have to be ground separately. Whether they are chopped manually by the vendors or ground using a mortar and pestle or a home blender, this new step would require additional time and labor for the kosei vendors, although the amount of time and labor needed would be much smaller than the overall amount of time and labor saved by using dry meal. The vendors could bring onion, pepper, and other ingredients to a custom miller, if the quantity is large enough. However, it would reduce the benefit of using dry meal because one of the big advantages of dry cowpea meal is that vendors would no longer have to go to a custom miller early in the morning.

The use of dry cowpea meal would definitely save overall time and labor of kosei vendors. However, the above mentioned elements would affect how much is saved, and therefore affect the premium that kosei vendors would be willing to pay for dry cowpea meal.

4.2.1.6 Fine adjustment in the quantity of kosei to prepare

Among the potential advantages of dry cowpea meal discussed earlier in this chapter was that the meal might allow kosei vendors to make a fine adjustment in the quantity of kosei prepared, according to the sale of each day. To examine this potential, data related to the respondents' experience in daily shortages and leftovers of kosei/agawu balls were collected. The results are shown in Table 4.4.

Table 4.4 Daily shortage and leftover of kosei/agawu among the respondents

Shortage and leftover		kosei vendor (n = 13)	agawu vendor (n = 7)
Experienced daily shortages in the past month	No	0	0
	Yes	13	7
Feeling when kosei/agawu ran out	Unhappy	7	3
	Happy	4	2
	Both	2	2
Experienced daily leftovers in the past month	No	3	0
	Yes	10	7
Typical amount of leftover (number of balls)	1-20	4	5
	21-40	0	1
	41-60	2	1
	It depends (with max 40 or 50)	3	0
	Don't know	1	0
What to do with leftover	Threw away	0	0
	Gave to family	7	6
	Gave to friends	5	4
	Gave to children	2	0
	Re-fried and sold (when a lot)	1	0
In the past month, shortages happened:	More often than leftovers	6	7
	Less often than leftovers	0	0
	As often as leftovers	1	0
	Don't know	6	0

Source: Field survey in Accra, February and March 2007.

All the respondents reported that in the past month they experienced running out of kosei/agawu when there were still customers who wanted to buy their products. When kosei/agawu ran out, seven kosei and three agawu respondents felt they should have prepared more kosei/agawu to make more money and that they would prepare more the

next day; four kosei and two agawu respondents felt happy that the kosei/agawu sold out and that they would prepare the same amount of kosei/agawu the next day; and two kosei and two agawu respondents answered they had both of these feelings[13]. For those respondents who answered that they felt they should have prepared more, methods to avoid daily shortages would be helpful.

All except three kosei vendors reported that they had experienced leftover paste or balls during the past month. The quantity of leftovers that they usually had varied across the respondents, with a maximum of 60 balls (measuring the leftover in terms of the number of balls). The methods utilized by those three kosei respondents who did not have leftover were as follows: always bring the amount she thinks she can sell; when there is leftover in the morning, re-fry and sell it in the evening; and when the end of the day approaches and if there are remaining balls, give customers more balls than they paid for.

No respondent threw away the leftovers[14]. Rather, she gave the balls to family, friends, or children in Muslim schools. When there was a lot of leftover, one kosei respondent reported that she put them in the freezer, re-fried, and sold them at another time.

Except six kosei vendors who did not answer the question, most respondents ran out kosei more often than they had leftovers.

---

[13] Obviously, a vendor cannot feel at the same time that she will prepare "more" and "the same amount" the next day. Those vendors might have answered "both" because they were actually asked two different questions at the same time (i.e., whether or not they felt happy for running out of kosei/agawu and whether or not they felt they would prepare more the next day). They could have thought "unhappy for running out, but will prepare the same amount the next day," or "happy for running out, but will prepare more the next day." Another possible explanation would be that their feelings were not always the same. In fact, one of the two kosei vendors answered "it depends." It probably depends on what else she has to do on that day.

[14] If the respondents had leftover in the form of paste, they most likely could not give it to somebody and therefore threw it away. The result of zero "throw away" implies that the respondents fried all the paste they prepared, whether or not they could sell all the balls.

It was unexpected that all the agawu respondents experienced daily shortages and the majority of them felt they should have prepared more. Rather, it was expected that agawu vendors, who prepare their product from dry cowpea flour, could easily make additional balls by quickly adding water to flour, whipping and seasoning the paste with other ingredients, and frying it. One of the agawu respondents mentioned that she wanted to fry all the paste at once and did not want to start preparation over again (whip the paste, put charcoal on fire, and fry). In fact, she did not bring extra flour to the place where she was selling agawu. Her statement matches the observation made during the fieldwork: no vendors were found frying agawu based on customers' orders. Rather, they prepared a relatively large amount of paste at once, fried it, kept agawu balls in a container, and waited for customers (perhaps preparing another batch if she was a large-scale vendor).

Under the current conditions, kosei vendors are unlikely to be able to make additional balls when they run out of kosei because they most likely do not have time to run to a custom miller and prepare kosei before the customers leave. If they used dry cowpea meal, they would not need to go to a custom miller anymore. However, as field observations and this story from the agawu vendor indicate, using dry meal would not be a sufficient condition for kosei vendors to be able to make additional balls when they run out of kosei. They would have to be diligent enough to be willing to start the procedure from the beginning after frying a whole batch of paste.

Soaking time might be another and perhaps more significant constraint for using dry cowpea meal to respond to an unexpected demand. Following the above discussion, one might argue that dry cowpea meal is still useful for making quantity adjustments in situations as follows: a relatively large-scale kosei vendor prepares three batches of paste

everyday. One day, when she finishes frying the second batch, she realizes that she is receiving many more customers than usual, and she is sure that she will run out of kosei. If she used dry cowpea meal, she could make the third batch a larger volume to capture the demand from additional customers. In such a case, dry cowpea meal would help the vendor. However, as mentioned earlier, to use dry cowpea meal developed by the B/C CRSP, 30 to 60 minutes of soaking time is necessary to prepare good quality kosei. Therefore, the vendor using this meal would need to predict whether she would run out of kosei and how much more to prepare at an early point in the day, so that she would have enough time for soaking the meal.

Both of the above mentioned constraints (i.e., cumbersomeness of starting over the preparation and soaking time) would apply when discussing the usefulness of dry cowpea meal for avoiding leftovers. The idea was to begin with a smaller amount of paste and prepare more paste as the vendors sell kosei. To succeed in this method, vendors would have to accept the less convenient not-all-at-once preparation, and they would also have to be able to accurately predict the amount of the day's sale.

4.2.1.7 Seasonality

Data were collected to examine how much dry cowpea meal would help kosei vendors to cope with the seasonal fluctuation in the availability of cowpea grain. This data set is shown in Table 4.5.

All the 20 respondents answered they sold kosei/agawu throughout the year, using the same ingredients, without changing the amount of kosei/agawu they prepared (in terms of the amount of ingredients, not the number of balls) regardless of the seasonal

Table 4.5 Seasonality in kosei/agawu business among the respondents

Seasonality		kosei vendor (n = 13)	agawu vendor (n = 7)
Sell kosei/agawu throughout the year	No	0	0
	Yes	13	7
Use the same ingredients throughout the year	No	0	0
	Yes	13	7
Change the amount of kosei/agawu, depending on the seasonal availability of cowpeas	No	13	7
	Yes	0	0
Change the size of kosei/agawu, depending on the seasonal availability of cowpeas	No	4	4
	Yes	9	3
Daily sale levels change, depending on the seasonal availability of cowpeas	No	5	1
	Yes	5	0
	Don't know/Can't tell	3	6

Source: Field survey in Accra, February and March 2007.

availability of cowpea grain[15]. On the other hand, nine kosei and three agawu[16] respondents stated that they changed the size of kosei/agawu, and five kosei vendors stated that the daily sales from kosei/agawu varied, depending on the seasonal availability of cowpeas. This data set needs to be interpreted with caution because many inconsistencies were found in the respondents' answers[17]. However, the finding that many respondents changed the size of kosei/agawu at different times of the year seems to be relatively trustworthy (because it was a straightforward question and easy to answer unless they had incentives to lie) and an important factor to consider for estimating the benefits of dry cowpea meal.

[15] Including two kosei vendors who were in business for seven and eight months, respectively (these respondents provided information for the time they had been in business). This applies to all the data presented in this section.

[16] One of the agawu respondents mentioned that she kept the same size of balls because the price of cowpeas had not changed for two years at the place where she purchased cowpeas, implying that she may change the size if the cowpea price fluctuates.

[17] Some respondents increased the size of balls when cowpeas were more available while, according to them, the sales were either constant or even increased. On the other hand, another respondent mentioned that her sales increased while keeping the same size of balls. These answers are not possible if they always used the same amount of ingredients and sold kosei at a constant price (assuming that the input-output ratio does not change. One of the kosei respondents stated that fresh cowpeas swelled less. If this is true, when cowpeas are more available, less swelling would lower the sales of those vendors who use the same amount of ingredients. This would make the respondents' answers even more inconsistent.)

Since the price per ball of kosei/agawu in Accra does not change depending on the season of the year (G. A. Annor, personal communication, February 16, 2007), change in the size of balls means change in the unit price of kosei/agawu. The degree to which customers allow kosei/agawu vendors to reduce product size when cowpeas are scarce would determine how easily the vendors could handle the seasonality by adjusting the ball size. The less tolerant the customers are, the more difficult it would be for the vendors to reduce the ball size, and therefore, the more valuable the dry cowpea meal would be because dry cowpea meal is an input which would have little or no price fluctuation. One of the agawu respondents who always sold the same size balls mentioned that customers would complain if she reduced the size after she had increased it, implying her customers were not tolerant of the change in size. On the other hand, one of the kosei respondents who changed the ball size mentioned that customers knew about the availability of cowpeas and would complain if the ball size was too small when cowpeas were cheap, implying that her customers were tolerant to a certain degree of the change in ball size. Unfortunately, the data are not extensive enough to estimate how tolerant general customers are of the change in size of kosei/agawu balls. However, even if customers are sufficiently tolerant to let the vendors change the ball size to offset the change in cowpeas' cost, dry cowpea meal would still help the vendors, because as long as the price of meal is constant, it would allow them to constantly provide large size balls, which would probably attract more customers. Discussions with industrial processor respondents indicated that they sold their products at a constant price over a certain period of time and raised prices only occasionally and in a stepwise fashion as their input cost increased.

For the purpose of this study, the discussion has been limited to how useful dry cowpea meal would be for kosei vendors. However, if the use of commercial cowpea flour/meal in general (e.g., for fortification of traditional foods at home) is considered, the benefit from reduced storage losses (due to insect damage) could be substantial—assuming that cowpea grain is processed into flour/meal soon after harvest and subsequent storage cost is less than for grain. The total demand for dry cowpea flour/meal would determine how big the benefit would be.

4.2.1.8 Experience and interests in commercial dry cowpea meal/flour

The respondents' experience and interests in using commercial dry cowpea flour/meal to prepare kosei/agawu are shown in Table 4.6.

Table 4.6 Experience and interests of the respondents in commercial dry cowpea meal/flour

Experience/Opinion		kosei vendor (n = 13)	agawu vendor (n = 7)
Ever used commercial cowpea flour to prepare kosei/agawu	No	13	7
	Yes	0	0
Interested in using commercial flour/meal to prepare kosei/agawu	No	7	1
	Yes	6	6
Would want to buy commercial flour/meal from: (multiple choices)	Vendor in the market	1	0
	Supermarket	0	1
	Wholesaler	0	1
	Processor	4	4
	Other	1	1

Source: Field survey in Accra, February and March 2007.

No respondent had ever used commercial dry cowpea flour to prepare her products. Most of the vendors had never used it because they had never seen it.

Among kosei vendors, six respondents were interested in using commercial flour/meal. This number should be interpreted with caution because at the early stage of

conducting interviews, it was not emphasized that good quality kosei could be made from dry meal. Some respondents were not interested because they thought dry flour/meal was used for making agawu and not kosei. After we started to clarify the respondents that we were describing a special meal developed for preparation of kosei, all the kosei respondents were interested in the product. In terms of the quality concern, one kosei (as well as 1 agawu) respondent mentioned that the processor of the flour/meal might contaminate the flour/meal by mixing maize into the cowpeas.

Those respondents who were interested in the meal were asked how much they would be willing to pay. However, none of them could answer the question; they told us they would need to first try making kosei using the meal. After samples of commercial cowpea flour (400 g, packaged in a polyethylene bag) were obtained from processor respondents, we showed a sample bag to the kosei respondents after the interviews were conducted. All three kosei respondents who were shown the sample and told the price (price at the processors' level) mentioned that it was too expensive.

These results indicate that kosei vendors would be interested in using dry cowpea meal if: (1) they are informed that the meal is not for preparing agawu but for kosei; (2) they are assured that the meal is of a good quality (no contamination by other milled grains); and (3) the price is attractive.

The agawu respondents, who use dry flour everyday for preparing their products, showed a strong interest in the commercial flour[18] (6 out of 7 respondents answered that they were interested). One of the respondents stated that she would only be interested if the cowpea variety was the one she wanted. Another respondent stated she would be

[18] Of course, the B/C CRSP-developed meal was for preparing kosei, but the same questions were asked to agawu vendor respondents as well without revealing to them that our focus was dry meal for preparing kosei.

interested only if the quality of output would not change. The respondent who was not interested gave the quality concern (maize contamination) as a reason. Vendors' answers to the question about acceptable price of flour and reactions to the sample varied across the respondents: three respondents answered that they would have to try it first; two respondents answered that they would pay a higher price per olonka than the price they were paying for cowpea grain (33% and 50% higher, respectively); and one respondent answered she would pay less than the price of her cowpea grain (14% less). The price of sample bag was too high for all the respondents except one, who was very interested and said she would accept the price (price at the processor's level).

The benefits and potential of commercial dry flour to agawu vendors might be very different from those of commercial dry meal to kosei vendors because of the difference in the processing procedures for these two products. Therefore, to understand the competitiveness of dry cowpea flour for agawu preparation, another study would be needed.

The respondents' most preferred outlets for cowpea meal/flour were meal/flour processors, while vendors in the market, supermarkets, wholesalers, anywhere, and a place close to the house were each mentioned by one respondent. No respondent mentioned a small retail store. Many respondents preferred to directly purchase from a processor because they thought the price would be lower.

4.2.1.9 Home Preparation of Kosei

Among the potential benefits of the new dry cowpea meal is that its availability could increase the demand for cowpeas by increasing home preparation of kosei. Indeed,

as reported later, two cowpea flour processors who were interviewed mainly targeted sales towards housewives rather than kosei vendors.

It should be noted that an increase in home preparation of kosei would not automatically increase the demand for cowpeas: if home kosei preparation using commercial dry cowpea meal results in replacing street-vended kosei by the same amount of home-prepared kosei, it would simply reduce the sales of kosei vendors without increasing the total demand for cowpeas. However, the demand for cowpeas would increase if: (1) women who currently neither prepare kosei at home nor buy kosei from street vendors—because they dislike the ways the vendors prepare it, or for any other reasons—start preparing kosei at home using dry cowpea meal; (2) women who do not currently prepare kosei at home but buy kosei from street vendors increase their consumption of kosei by preparing an additional amount at home using dry cowpea meal; or (3) women who currently prepare kosei at home from cowpea grain increase the amount they prepare by using dry cowpea meal.

To assess how much incremental demand for cowpeas, if any, would be created through these channels, a full survey on kosei consumption among targeted population would be required. Weaning mothers who were interviewed to obtain information on their weaning habits (data to be analyzed in Chapter 6) were also asked a brief set of questions related to their consumption and home preparation of kosei to provide supplemental information on this topic. Among the 30 respondents, 10 knew how to prepare kosei. Of these 10 respondents, 8 were interested in dry cowpea flour/meal (details of the results are reported in Appendix 7).

4.2.2 Custom Millers

4.2.2.1 Characteristics of custom miller respondents

Characteristics of the 15 custom millers interviewed are shown in Table 4.7.

Table 4.7 Characteristics of custom miller respondents

Characteristics		custom miller (n = 15)
Number of years the facility is operating	0-3	1
	3-10	0
	10-20	4
	More than 20	6
	Don't know	4
Type of mill	Plate mill	15
Size of mill	2-A	14
	Missing information	1
Source of power	Electricity	15
Horsepower of the motor	10	5
	15	6
	20	1
	25	3
Type of customers (for cowpeas)	Mainly kosei/agawu vendors	13
	Don't know / Missing info.	2

Source: Field survey in Accra, February and March 2007.

The majority of facilities had been in business for more than 10 years. All the respondents used a plate mill, 2-A type[19] (except 1 respondent for whom the information

[19] During the fieldwork in Accra, different types (or sizes) of plate mill were observed. The most custom miller and grain flour/weaning food processor respondents used a 2-A type. According to the machine dealer we met at the 11th Ghana International Trade Fair (Feb. 21 – Mar. 8, 2007, Accra), there are 1-A and 2-A types for grinding mill, and these are an international standard (Machine dealer, personal communication, March 2, 2007). Basic product information on each type of the grinding mills sold by the seller is shown below.

Product information on 1-A and 2-A type grinding mill sold by a machine dealer at the 11th Ghana International Trade Fair (Feb. 21 – Mar. 8, 2007, Accra)

Type	RPM	Brake Horsepower Required	Approximate Output for Dry Material	Approximate Output for Wet Material	Diameter of Plate
1-A	550-650	6HP	180 kg/hour	100 kg/hour	10 inches
2-A	550-650	8HP	275 kg/hour	140 kg/hour	12 inches

Source: Fieldwork in Accra, February and March 2007.

is missing), which was powered by an electric motor[20]. The horsepower of motor varied across the respondents, ranging from 10 to 25 HP. Most respondents mentioned that kosei/agawu vendors were their main customers for processing cowpeas.

4.2.2.2 Milling charge

Respondents reported that the milling charge for each food product was set by the Greater Accra Co-Operative Food Crop Processors Union (the Union, hereafter) and that all custom millers operating in the region were obliged (in theory) to follow those common guidelines. Many respondents had a one-page price list that was printed by the Union. According to one respondent, the Union reviewed the prices and issued a new price list every three years. Therefore, the milling charge was expected to be the same across the respondents. However, this was not the case: respondents reported a range in the milling charges. One of the reasons seemed to be that not all the respondents had the latest price list. The latest list was dated August 1, 2005, while another list dated September 2, 2002 was also observed being used (a wide range in the charges was found between the two lists). Moreover, not all the respondents strictly followed the listed charges. As a result, the milling charges for dry and wet cowpeas collected from the respondents diverted from the charges on the list. This is shown in Table 4.8.

While the list noted the same charge for dry and wet cowpeas, respondents generally charged more for milling dry cowpeas than for wet cowpeas. Compared to the charges on the current price list, the respondents' charges were generally much lower.

Among the respondents, there was a difference in preference for dry and wet

[20] Several respondents had more than one milling machine. The data reported in the table is for their principal mill.

Table 4.8 Milling charges for dry and wet cowpeas among the 15 custom miller respondents

Charge	Charge per olonka (¢)	
	Dry cowpeas	Wet cowpeas
Current price list (Aug. 2005)	4,500	4,500
Older price list (Sep. 2002)	3,264	3,264
Respondents mean	3,400	2,550
(standard deviation)	(890)	(956)
Respondents median	3,000	2,000
Respondents mode	3,000	2,000

Source: Field survey in Accra, February and March 2007.

cowpeas. Out of the 15 millers, 8 charged more for milling dry than for wet cowpeas because they needed to mill dry cowpeas several times to obtain a fine output, while wet cowpeas required only one milling; 2 charged the same price; 2 charged more for milling wet than for dry cowpeas and another 1 only accepted wet cowpeas when the customer had a large amount because cleaning after wet-milling cowpeas was tedious[21]; and the other 2 did not mill wet cowpeas (one respondent had never milled wet cowpeas, and the other asked customers who brought wet cowpeas to go to his neighbor miller who had a small mill [probably specialized in wet milling]).

All the respondents stated they offered a discount when customers brought a large volume to mill. This was in accordance with the price list in which the charges for certain commodities were listed for two or three different units (olonka, pan, and bag)—apparently[22] with discounts for the larger units. However, it was found that many respondents were offering a larger discount rate than those noted on the official price list.

Since data on the cost of custom dehulling/milling were not reported by many

[21] The majority of respondents opened and cleaned the mill after milling, whether they milled dry or wet cowpeas.

[22] "Apparently" because it is not clear how many olonka of each commodity one pan and one bag contain. The information collected from different respondents indicates that one bag usually contains between 40 and 60 olonka of commodities. If this is the case, the price list offered discounts for larger volumes.

kosei vendor respondents, representative charges to be used for the budgeting analysis of kosei preparation were estimated, based on the data collected from custom millers and those kosei respondents who reported the charge[23]. These estimated representative charges are shown in Table 4.9.

Table 4.9 Representative custom milling/dehulling charges for cowpeas

Dehulling (dry cowpeas)		Milling (wet cowpeas)	
Olonka	Charge (¢)	Olonka	Charge (¢)
Up to 1	1,500	Less than 2	2,000
> 1 up to 2*	2,000	2 – less than 3	4,000
> 2 up to 3*	2,500	3 – less than 4	6,000
> 3 up to 4*	3,000	4 – less than 5	8,000
> 4 up to 5*	3,500	5 – less than 6	10,000
> 5 up to 6*	4,000	6 – less than 7	12,000
> 6 up to 7*	4,500	7 – less than 8	14,000
> 7 up to 8*	5,000	8 – less than 9	16,000
> 8 up to 9*	5,500	9 – less than 10	18,000
> 9 up to 10	6,000		
20	15,000		
40*	37,500		
60	60,000		

* Assumed value from other data points.
Source: Fieldwork in Accra, February and March 2007.

Interestingly, the data shows increasing unit costs for dehulling, as volume increased after 10 olonka. This might be due to the too small sample size (i.e., 5), or millers might charge less for customers with small volumes in order to attract patronage (as opposed to hand dehulling).

4.2.2.3 Custom millers and dry cowpea meal

As mentioned earlier in this chapter, there is a potential for any individuals having access to a dryer and custom miller to produce dry cowpea meal *if* custom millers can

[23] Since no information was obtained from custom miller respondents about the charge for custom dehulling, representative dehulling charges were estimated based on the information obtained from five kosei vendor respondents.

mill cowpeas into the appropriate particle size. To explore this point, data were collected to determine how easy it is for custom millers to mill cowpeas into different particle sizes.

The miller respondents reported that they adjusted the particle size in two ways: by tightening or loosening the plates (i.e., changing the distance between the two plates) and by changing the number of times the grain is milled. The tighter the plates are set, and the more times the grain is milled, the finer the flour will be.

Although the ways that respondents adjusted the plates to obtain a specific particle size seemed to be technically the same across the respondents, their perceptions about the process were different: 11 respondents stated that it was easy for them to mill cowpeas into different particle sizes, while 4 respondents stated that it was not easy. Previous studies in food science have found that it is very important to mill dry cowpea meal to a specific particle size range, if the meal is to be used for kosei preparation (50% of particles must be larger than 400 μm in diameter; see Figure 2.2). Therefore, it is also important for custom millers to be able to consistently achieve this particle size range, if custom millers prepare dry cowpea meal. Success in consistently milling cowpeas to the correct particle size would depend on the skill of each miller. However, generally speaking, it would not be easy to mill cowpeas into the exact particle sizes using a plate mill alone—the miller would have to also use a sieve to separate out large particles for further milling (E. Sakyi-Dawson, personal communication, March 21, 2007). If the miller used a hammer mill, the work could be done much more easily[24]. However, no respondent used a hammer mill. A further survey of custom millers would be needed to

[24] Hammer mills, which can only be used for dry products, are more expensive than plate mills. However, it is easier to obtain a desired particle size with a hammer mill because it has a built-in sieve. Also, with a hammer mill, fewer millings may be required; cleaning of a hammer mill is easier, and the hammer lasts for a long time, although the sieve has to be replaced more frequently (G. A. Annor, personal communication, March 21, 2007).

find out how successfully custom millers can mill cowpeas into the right particle size range for dry cowpea meal (with or without a sieve) and whether they are willing to do this when asked by customers.

4.2.3 Industrial Cowpea/Soybean Flour Processors

4.2.3.1 Characteristics of cowpea/soybean flour processors

Among 10 grain flour/weaning food processor respondents, 6 were producing either cowpea or soybean flour. The characteristics of these respondents are shown in Table 4.10.

As described earlier in this chapter, while all the respondents were small- to medium-scale companies, there was a wide range in scale *among* them. One-half of the companies were managed by women and two by men (the other company appeared to be co-managed by a woman and a man), and these companies ranged from a pure family business operating in their house to a structured enterprise which hired personnel and operated in an isolated production facility. The majority had been in existence for more than 10 years. All of the respondents utilized a total of fewer than 15 workers, including family members (information is missing for 1 respondent). The value of the products that the respondents produced during February 2007 ranged from less than ¢50 million to more than ¢100 million (information is missing for 1 respondent).

None of the respondents specialized in flour products—they all produced eight or more different commodities[25]. Commodities other than processed grain products included honey, oil, spices, groundnut paste, and fruit jam. In fact, some respondents started their business with other products such as spices and later began producing flour products.

[25] Not all of the products were necessarily produced when the interview was conducted.

Table 4.10 Characteristics of cowpea/soybean flour processor respondents

Characteristics		flour processor (n = 6)
Sex of the manager	Female	3
	Male	2
	Missing information	1
Number of years the company has been in business	Fewer than 5	1
	5-10	1
	11-20	3
	More than 20	1
Total number of workers (including family members)	1-5	0
	6-10	3
	11-15	2
	Missing information	1
Value of all products produced in Feb. 2007* (¢; US$1 ≈ ¢9,200)	Less than 50 million	3
	50-100 million	1
	More than 100 million	1
	Missing information	1
Total number of products (including cowpea and/or soybean flour)	1-5	0
	6-10	2
	11-15	2
	More than 15	2
Whether producing cowpea and/or soybean flour	Cowpea flour only	1
	Soybean flour only	4
	Both	1
Number of years the company has produced cowpea/soybean flour	Fewer than 2	2
	2-5	2
	6-10	1
	Missing information	1
Share of cowpea/soybean flour in the total revenue (Feb. 2007)	Less than 5%	3
	Missing information	3
Major source of raw materials	Vendors in the market	1
	Wholesalers	1
	Owned farm	1
	Middlemen/Suppliers	3

* Include one respondent from whom only the annual revenue in the past year was available—the figure was divided by 12 and used as approximate monthly revenue.
Source: Field survey in Accra, February and March 2007.

Cowpea flour was produced by two respondents, while soybean flour was produced by five respondents. Although the respondents had been in business for a long time, they only started producing these products in recent years, and the share of these products in the total sales seemed to be small. These findings indicate that the production

of cowpea/soybean flour was just a small and relatively new part of the respondents' entire business.

The respondents procured their raw materials from different sources: one respondent purchased mainly from vendors in the market, one respondent from wholesalers, one respondent had his own farm where he grew crops for his products, and the other three respondents obtained their raw materials from "middlemen" or "suppliers"—people who brought crops to the respondents' facility, apparently from rural production zones. Although the respondents were not asked how much they paid for raw materials, it is expected that those respondents who owned a farm or who had access to middlemen or suppliers paid lower prices for their inputs than the other two respondents[26].

4.2.3.2 Processing procedure and equipment use

If the processing procedure for B/C CRSP-developed dry cowpea meal is different from the procedure currently used by the respondents to mill cowpeas, whether that difference causes any difference in the costs of production must be considered before making cost calculations using the data collected from the respondents. Furthermore, since the data collected from the four respondents were for soybean flour production, the difference between the processing procedure for cowpea flour and that for soybean flour also needs to be examined to justify the use of their data for estimating the cost of production of dry cowpea meal. For this purpose, information was collected on how the respondents produced cowpea/soybean flour.

---

[26] In terms of the type of cowpeas, one of the two respondents who produced cowpea flour used Niger because this respondent felt that Niger tasted better and kosei vendors also used Niger. The other respondent used both domestically produced cowpeas and Togo. According to this respondent (one of the larger processors), domestically produced cowpeas were hard and difficult to dehull, but easier to trace back to their point of origin than imported cowpeas, an important consideration for assuring food safety.

Data collected during fieldwork indicated that the procedure that the respondents used to make cowpea flour was almost the same as the agawu vendors prepared their flour, that is, dry-dehulling by plate mill followed by manual winnowing and dry-milling. Therefore, the major differences compared to the processing procedure for the B/C CRSP dry cowpea meal were that: (1) the respondents' process did not include soaking and drying; and (2) they milled cowpeas into flour rather than coarser meal. In the budgeting analysis, the first difference was addressed by assuming that the respondents used a dryer to produce cowpea flour and adding into the budget the assumed share of cowpea flour in the cost of dryer use[27]. For the second difference, it was assumed that processors currently producing flour using a plate mill could also produce meal if they used a sieve. Based on this assumption, the share of cowpea meal in the cost of sieve use was assumed and added into the budget[28].

The differences between the processing procedures for cowpea flour vs. soybean flour were that the majority of respondents cooked soybeans before milling[29] and some respondents did not dehull soybeans. Thus, strictly speaking, to estimate the cost of producing dry cowpea meal, data on the cost of production of soybean flour would have to be adjusted to handle these differences in processing procedures. However, it would be very difficult to accurately estimate the difference in costs of production associated with

[27] The additional cost associated with soaking was ignored because such a cost seemed to be minor. For the cost of dryer, monthly share of cowpea flour in the purchase price of the dryer was assumed for each respondent based on the data collected and added to the cost of equipment of their budgets. Although the use of dryer would also increase other costs such as labor and fuel, such additional costs were very difficult to estimate and therefore were not included into the budget.

[28] This adjustment was made for those respondents who did not currently use a sieve or hammer mill to produce cowpea/soybean flour. As done for the dryer, only the assumed monthly share of cowpea meal in the purchase price of sieve was added to the budgets (i.e., potential increase in the costs other than the equipment cost was ignored).

[29] Respondents cooked soybeans: (1) to improve the taste; (2) to extend shelf life; and (3) because they expected consumers to just add the soybean flour to other foods and consume without further cooking, while cowpea flour was expected to be further cooked.

these identified differences in processing procedures. Therefore, the difference in the cost of production between cowpea and soybean flour was assumed to be only the difference in the cost of raw materials (i.e., cowpea and soybean grains).

Major equipment that processors would need to produce dry cowpea meal (following the B/C CRSP-developed instructions) and sell outputs on a commercial basis are: (1) a dryer (not limited to machines exclusively designed for a drying function, as some respondents used a gas oven or roaster to dry their ingredients); (2) a mill (plate mill [for dehulling] and hammer mill [for milling] or plate mill and sieve); and (3) a packaging machine. Current possession of such equipment by the respondents is summarized in Table 4.11.

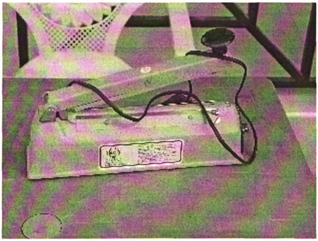
Table 4.11 Equipment for producing dry cowpea meal and possession by the respondents

Equipment inventory		flour processor (n = 6)
Own any equipment that can serve as a dryer	No	0
	Yes	6
Mill	Own plate mill and sieve	2
	Own only hammer mill	1
	Own only plate mill	2
	De not own mill	1
Own sealing machine	No	0
	Yes	6

Source: Field survey in Accra, February and March 2007.

All the respondents owned some type of equipment that could serve as a dryer. With regard to mills, two respondents owned both a plate mill and a sieve. One of these two respondents owned a hammer mill, as well, but was not using it for some reason. Also, one of them described the sieve as a "sieving machine," implying that it was a mechanical sieve. The one respondent, who owned only a hammer mill, custom-dehulled raw materials. Two of the respondents owned only a plate mill. The remaining respondent, who did not own a mill, used a custom miller. The plate mills that we had the opportunity to observe at the respondents' facility were the same size as the mills owned by custom millers (i.e., 2-A type) or slightly smaller. All the respondents packaged outputs at their facility into polyethylene bags for sale. The most commonly used packaging machine was a hand sealer (Figure 4.4). One of the respondents also used a foot sealer.

Figure 4.4 Hand sealer



Source: Author.

To summarize, most respondents processed cowpea/soybean flour using the same technology as custom millers (i.e., plate mill), and most of them looked technically capable of producing dry cowpea meal with their current equipment or with a small investment (those who do not have a sieve would need to purchase one)[30].

[30] Originally, this study intended to identify optimal technologies to produce our target products (i.e., dry cowpea meal and cowpea-Weanimix). However, since the technologies used by the industrial grain flour/weaning food processor respondents and custom millers were very similar to each other, such an analysis could not be conducted. Although large-scale multinational companies most likely used different technologies to produce similar type products, the information was missing. It would be interesting to explore *why* there were few differences in technologies among local processors—i.e., were they constrained in the types of technologies available to them, or was the technology observed the optimal one under the current circumstances?

4.2.3.3 Demand for cowpea flour and its shelf life

One of the two industrial processor respondents who produced cowpea flour sold it mostly to retailers and exported a small amount. The other respondent mainly sold cowpea flour to retailers (supermarkets), but also sold to restaurants, hotels, and individuals, and exported a small amount. Both respondents mainly targeted housewives, who prepared kosei[31] at home. The cowpea flour produced by one of the processors contained onion as an ingredient, while the other respondent produced 100% cowpea flour.

Of the two respondents, one was not producing cowpea flour when the interview was conducted because of an equipment problem. Therefore, the questions about recent demand were skipped. The other respondent mentioned that because the demand for cowpea flour was irregular, the quantity of production varied from month-to-month. This respondent, who stored cowpea flour at her facility, reported that shelf life of the flour was one year. This answer confirms a potential advantage of dry cowpea meal—a more stable input price for kosei vendors. Processors could purchase cowpeas and produce the meal when the grain is inexpensive, and store the outputs for sale later during the cowpea-scarce season, fixing the price at a season-average price.

Among the four respondents who produced soybean flour, rather than cowpea flour, three mentioned that they either planned or had thought about producing cowpea flour. One of the respondents commented that advantages of cowpea flour were that consumers were more knowledgeable of cowpeas than soybeans and that the cowpea

[31] The label of their products had the word "kose" or "koose," both different spellings of kosei. However, since both products were flour, fritters made from their products would be more like agawu than kosei. Therefore, these products might not gain popularity among consumers who prefer kosei over agawu.

flour could be used for preparing a greater variety of dishes than soybean flour. As a constraint, another respondent observed that launching a new product would be costly.

4.2.4 Retailers

Before discussing the data collected from retailers, it is important to discuss whether or not retailers would have a role to play, if commercial dry cowpea meal becomes available to kosei vendors. As reported earlier, the majority of kosei vendor respondents said that they would prefer to buy cowpea meal directly from processors, expecting that the price would be cheaper. Their expectation is definitely correct, if processors would allow vendors to come to their facility and buy cowpea meal at the same price as they sold it to other outlets such as retailers. Among the six cowpea/soybean flour processors interviewed, three sold their products to individuals. Therefore, there is no reason to assume that those processors would refuse to sell cowpea meal directly to kosei vendors. Following these observations, the budgeting analysis assumed that the kosei vendors could purchase dry cowpea meal directly from meal processors. Therefore, a retail margin was not added to the estimated processor price of dry cowpea meal when calculating the price that kosei vendors would have to pay for the meal.

However, although it seemed to be less likely, it would still be useful to examine the case in which kosei vendors purchased cowpea meal from intermediaries for two reasons: (1) the analysis would provide information regarding how much the retail margin would negatively contribute to the price-competitiveness of dry cowpea meal; and (2) the potential customers of dry cowpea meal are not only kosei vendors. If housewives

are to buy dry cowpea meal to prepare kosei at home, they would probably prefer buying it where they usually shop, rather than from the processors. If so, the price-competitiveness of cowpea meal for housewives has to be examined at the retail level. For these reasons, estimates of the retail margin for cowpea meal were derived from the collected data, and the case in which the kosei vendors (and housewives) purchased meal from retailers was examined in a sensitivity analysis.

As described in Chapter 3, during the fieldwork, three different types of retailers were identified in Accra: grain/flour-type product vendors in the market, small shops, and supermarkets. Among them, grain/flour-type product vendors seemed less likely to become an outlet for industrially-processed dry cowpea meal because they were rarely observed selling packaged products. Although few small shops were observed selling locally-produced-and-packaged milled grain products, their retail margins were still of interest because this type of shop was common in residential areas, seemingly serving ordinary-level income customers. Therefore, if dry cowpea meal becomes available and popular among housewives, these small shops would be a high potential outlet for the product. As reported in the previous section, supermarkets were the major outlet for industrially-processed cowpea flour. Therefore, their retail margins were included in the analysis.

Since the data obtained from one of the four supermarket respondents were inconsistent, these data were excluded from the analysis. The mean retail margins for milled grain products[32] were estimated for the remaining respondents (3 supermarkets

[32] Including both cowpea/soybean flour and weaning foods. Since the sample size was limited for cowpea/soybean flour and there was no reason to assume that the retail margins were different between these two types of products, they were treated together. Therefore, the same retail margins obtained here are used for the analysis of weaning foods in Chapters 6 and 7.

and 7 small shops)[33]. The results are shown in Table 4.12. Throughout this study, a retail margin is defined in percentage terms, as the mark-up the retailers charge over the price paid to their suppliers.

Table 4.12 Mean retail margin for milled grain products among small shop and supermarket respondents (%)

Respondents	Min.	Mean	Max.	S.D.*
Small shop (n = 7)	3	13	31	9
Supermarket (n = 3)	20	28	37	8

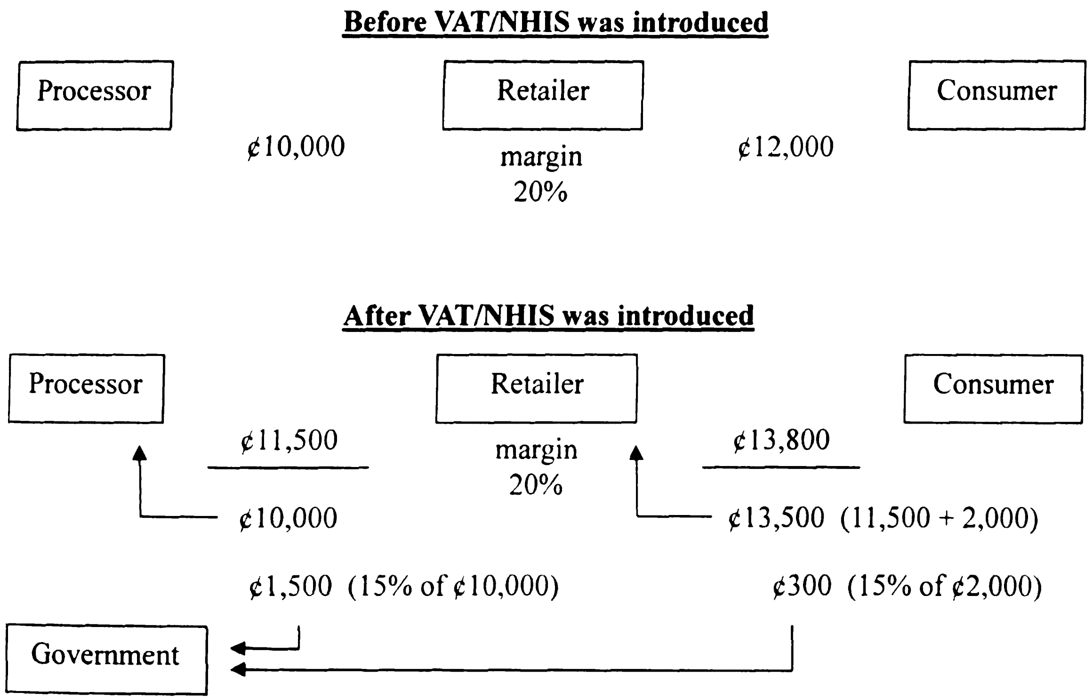
* S.D.: standard deviation.
Source: Field survey in Accra, February and March 2007.

The data varied widely across the respondents: the mean retail margin among small shops ranged from 3% to 31%, while that of supermarkets ranged from 20% to 37%. The mean margins of supermarkets were all higher than those of small shops, except for the highest-margin small shop respondent.

The consumer price is not equal to the processor price plus retail margin. In Ghana, a 12.5% of Value Added Tax (VAT) and a 2.5% of National Health Insurance Scheme (NHIS)—total of 15%—are levied on all goods and services. While "locally produced foods," as opposed to "imported foods," are among the goods exempted, products such as flour are considered to be "processed" or "refined" products and are not exempted (VAT officer, personal communication, March 29, 2007). The VAT and NHIS are supposed to be collected at each stage of supply chain to the value added by each actor. Figure 4.5 describes how the VAT/NHIS are collected using a numerical example.

[33] Details of the calculation to obtain mean values are reported in Appendix 6.

Figure 4.5 Collection of VAT/NHIS



Source: VAT officer, personal communication, March 29, 2007.

If the demand were perfectly price-inelastic, when processors sold their products to retailers, they would sell them at a 15% higher price than the original price (¢11,500 in the above example). This extra revenue (¢1,500) would be paid to the government as VAT/NHIS. Then, the retailers would set the margin 15% higher than their original margin (2,000 + 300 = ¢2,300). Again, this extra revenue (¢300) would be paid to the government. In the end, both processors and retailers would receive the same revenue as they did before the VAT/NHIS was introduced (¢10,000 and 13,500 – 11,500 = ¢2,000, respectively). However, consumers would pay a 15% higher price than before (¢13,800), and the government would receive that 15% extra surcharge paid by the consumers (¢1,800). Therefore, the formula for obtaining the consumer price is given by $Pc = 1.15 (1 + m) Pp$, where Pc is consumer price, m is retail margin, and Pp is processor price.

However, if processors increase the price of a product, it is expected that the demand for the product will decrease (i.e., demand is not perfectly price-inelastic), leading to a new equilibrium point where the quantity of the product produced and sold is smaller, the consumer price is higher, and the processor price is lower than the original values. Although the consumer price should be 15% higher than the processor price (due to the VAT/NHIS; under the assumption of no retail margin), the difference between the new consumer or processor price and the original price depends on the elasticity of demand and supply for the product. In particular, the more price elastic the demand for the product, the more the processor would have to absorb the cost of the tax. We would expect that the demand for dry cowpea meal would be price elastic because of the presence of a close substitute, namely wet-milled cowpea paste.

However, the purpose of this study is not to examine the effect of VAT/NHIS on the price of dry cowpea meal. Rather, it is to examine the price-competitiveness of dry cowpea meal as an ingredient in kosei. Moreover, as discussed later in Section 5.2.3, the VAT/NHIS may not be collected when kosei vendors purchase dry cowpea meal directly from processors. Therefore, for the budgeting analysis, two extreme cases were assumed: (1) the VAT/NHIS is not collected; and (2) the VAT/NHIS is paid entirely by the customers (i.e., the consumer price increases by 15%, while the processor price does not change). In reality, the consumer price would likely not increase that much, while the processor price would decrease, unless the supply of dry cowpea meal is perfectly price-elastic. Although a lower processor price would decrease the profitability of dry cowpea meal for industrial processors, this effect was not analyzed in the budgeting analysis.

The mean retail margins for milled grain products among small shop and supermarket respondents reported in Table 4.12 were modified to include VAT/NHIS (15%). The results are shown in Table 4.13.

Table 4.13 Mean retail margin for milled grain products combined with the VAT/NHIS among small shop and supermarket respondents (%)

Respondents	Min.	Mean	Max.	S.D.*
Small shop (n = 7)	19	29	50	11
Supermarket (n = 3)	38	47	57	10

* S.D.: standard deviation.
Source: Field survey in Accra, February and March 2007.

Since the mean retail margins vary without showing any general tendency, a representative value for the retail margin, combined with the VAT/NHIS, could not be determined. Therefore, for the sensitivity analysis, different values from 20% to 60%, with a 10% range (i.e., 20, 30, 40, 50, and 60), were used.

4.2.5 Price of Cowpeas

As reported earlier, six cowpea/soybean flour processor respondents purchased raw materials from different sources, implying that the price they paid for cowpeas/soybeans most likely varied. However, to conduct the budgeting analysis, a representative price of cowpeas for a bulk purchase, which was derived from the prices reported by kosei/agawu vendor respondents, as well as the prices observed in the Nima market during the fieldwork, was used as an approximate price that the processor respondents paid for cowpeas[34]. For the sensitivity analysis, the range of seasonal fluctuation in cowpea prices was estimated using historical data obtained from the

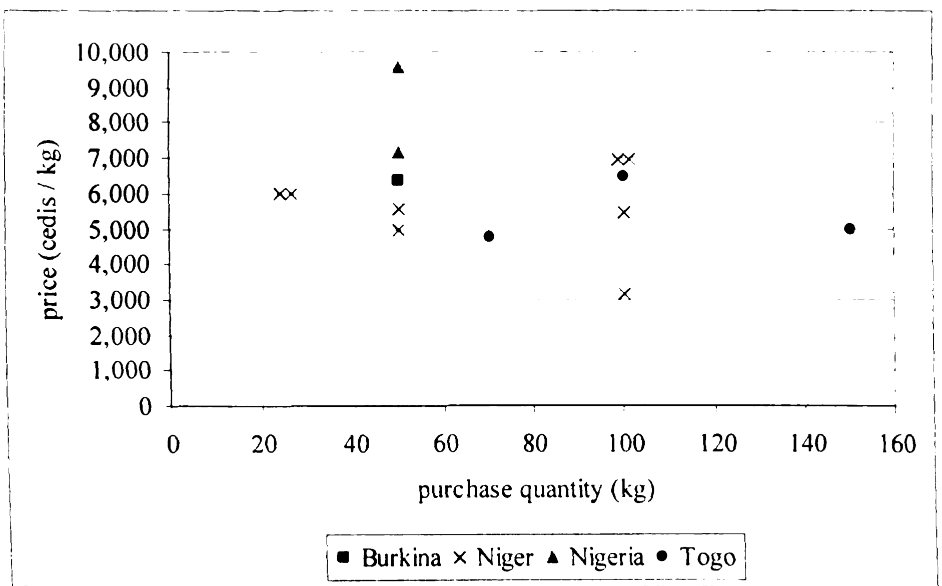
[34] To save interview time, the processor respondents were not asked about the cost of raw materials. The same representative cowpea price derived here is used across the respondents in the budgeting analysis.

Ghanaian Ministry of Food and Agriculture. Described below is how the values used in the analyses were derived from the collected data.

4.2.5.1 Cowpea prices in Accra in March 2007

Prices of four different types of cowpeas (for a bulk purchase[35]) in March 2007[36], which were reported by kosei/agawu vendor respondents[37], as well as observed in the Nima market, are shown in Figure 4.6.

Figure 4.6 Reported/observed cowpea prices in Accra in March 2007



Source: Fieldwork in Accra, February and March 2007.

As shown above, the prices varied *within* the same cowpea type. Although the data are not presented here, price variation within the same type was also observed for small quantity purchases. Unfortunately, the cowpea price data obtained from the MoFA

[35] Defined for this study as equal to or more than 10 olonka.
[36] The data obtained for February were too few to derive a representative price for February.
[37] The majority of kosei/agawu vendor respondents providing these data also purchased cowpeas at the Nima market.

were not separated by cowpea type. Rather, the data reported a single price for "cowpeas" for each month. Therefore, it was impossible without additional data to say which types were more expensive than others[38].

Among kosei respondents, Niger was the most commonly used cowpea type. Therefore, the prices of Niger were used to derive the representative cowpea price used in the budgeting analysis. The mean price of Niger (for a bulk purchase in March, as shown in Figure 4.6) was ¢5,635 per kg (sample size: 8; standard deviation: 1,225). Since most processor respondents provided us with their cost of production in February, this representative cowpea price for March was then converted into a representative price for February, using the historical data obtained from the MoFA. This calculation is explained below.

4.2.5.2 Historical data obtained from the MoFA

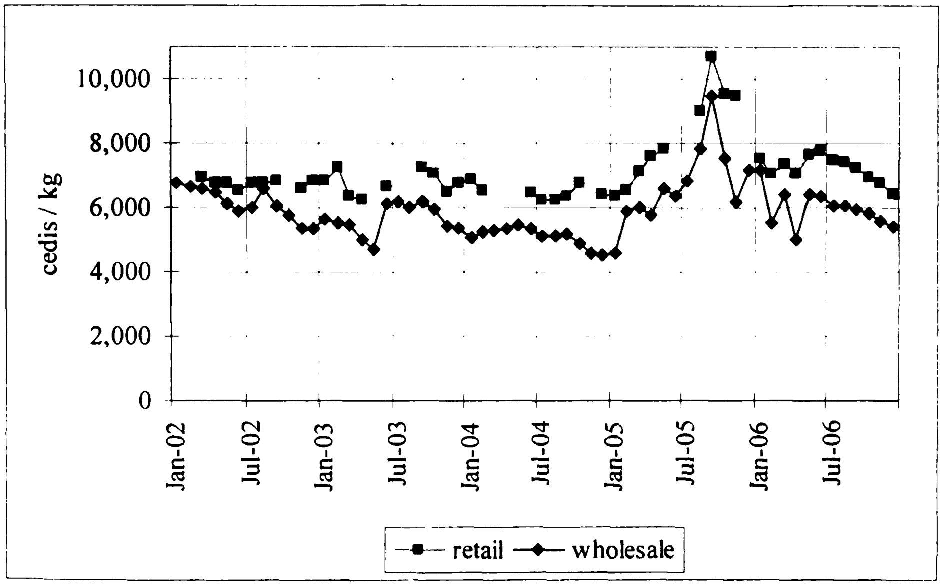
The price data of cowpeas obtained from the Ghanaian Ministry of Food and Agriculture are summarized in Figure 4.7.

Figure 4.7 shows the 5-year trend (2002-2006) in wholesale and retail prices of cowpeas in real terms (base month = February 2007) at urban markets of the Greater Accra Region. Both wholesale and retail prices were relatively stable over this period, except in 2005. In 2004 and 2005, drought and locust infestation reduced production and increased the price, particularly in Sahelian areas that exported cowpeas to Ghana.

Seasonal indices were constructed to examine the monthly fluctuation in the real wholesale price: first, the mean real wholesale price over five years was calculated for

[38] For this very small sample size, it appears that Nigeria cost more than the other types. However, the small sample size prevents us from making a definite conclusion. Casual observation during the study did seem to indicate that Nigeria was priced higher than the other types.

Figure 4.7 Real monthly cowpea wholesale and retail price at urban markets of the Greater Accra Region, Ghana (average of Accra, Ga, & Tema Districts) (2002-2006)



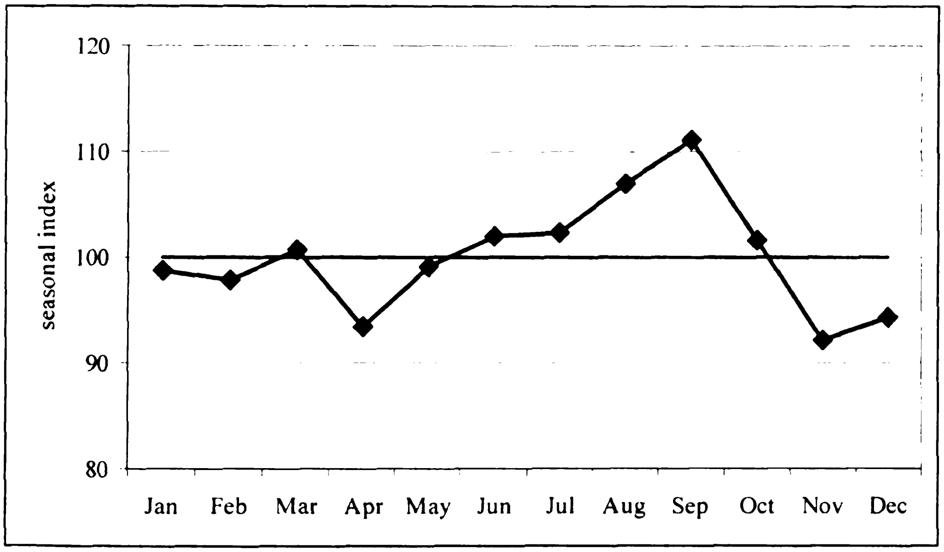
Note: base month for real price = Feb. 2007; retail prices in Oct. and Nov. 2005 were the same, not only for cowpeas but for all the commodities for which the data were obtained. It is possible that either the data for Oct. or Nov. was mishandled and recorded as the data for the other month.

Source: (for the price series) SRID, MoFA; (for the CPI) IMF.

each month; second, the mean real wholesale price of all the data points (from January 2002 to December 2006) was calculated; and third, the derived monthly mean prices were indexed based on the mean price of all the data points as 100. The result is shown in Figure 4.8.

The index for March was 101 while the index for February was 98. The minimum index was 92 (November), and the maximum index was 111 (September). Using these indices and the representative price of cowpeas in March 2007, as derived in the previous section (¢5,635 per kg), the representative price of cowpeas in February 2007 and the range in price fluctuation to be used for the sensitivity analysis were determined, as shown in Table 4.14.

Figure 4.8 Seasonal index of cowpea wholesale prices at urban markets of the Greater Accra Region, Ghana (average of Accra, Ga, & Tema Districts) (2002-2006)



Source: (for the price series) SRID, MoFA; (for the CPI) IMF.

Table 4.14 Representative cowpea price paid by processor respondents in February 2007 and estimated range in price fluctuation during the year

	Lowest price		February 2007		Highest price
Price (¢ / kg)	5,155	↔	5,474	↔	6,221

Source: Fieldwork in Accra, February and March 2007.

4.2.5.3 Conversion from olonka to kg and potential problem with this method

To convert one olonka (volume unit) of cowpeas to kg (weight unit), a conversion rate of 2.5094 was used throughout this study. The rate was obtained from the sample purchased during the fieldwork, as described in Chapter 3. As price data obtained from the MoFA were reported per kg, they did not need to be converted. However, it is not clear whether the commodities were weighed at each purchase date or if a representative conversion rate was used to calculate prices per kg. The price data obtained from kosei/agawu vendor respondents were all per olonka (or containers containing a certain number of olonka); therefore, these data were converted to prices per kg using the representative conversion rate of 2.5094.

As mentioned in Chapter 3, the potential problem of this method for converting olonka to kg is that the volume of one olonka varies because the amount that is heaped on the olonka cup is subjectively decided by vendors. Langyintuo et al. (2004, p. 209) reported "As a result of the non-standardized volume measures, the weight of a bowl of cowpea on a given market day on … the Tamale, Bolgatanga and Wa markets in Ghana, … ranges from 2.25 to 3.2 kg, 2.2 to 3.5 kg and 2.1 to 3.1 kg, respectively." Therefore, one olonka of cowpeas purchased by a kosei vendor respondent might have not weighed the same as one olonka of cowpeas purchased by another respondent. Moreover, if the MoFA's per-kg price series were obtained using a representative conversion rate throughout the year, then the data likely understated the seasonal variation in prices, as one olonka probably contained less in terms of weight when cowpeas were scarce and more when cowpeas were abundant. In addition, the difference in varieties and moisture contents of grain may make the weight of one olonka of cowpeas vary significantly. Although these potential problems were recognized, it was not possible to obtain better estimates of the unit price of cowpea grain using the available data.

4.2.6 Dry Cowpea Meal and Kosei Preparation Experiments

As described in Section 3.4, a set of experiments for kosei preparation using the wet-milling method (i.e., field experiment with a kosei vendor, using her usual procedures) and dry-milling method (i.e., laboratory experiment for preparing dry cowpea meal and field experiment with a kosei vendor, using that meal) was conducted twice. The major objectives of conducting these experiments were to obtain a representative input-output ratio for converting: (1) cowpea grain to dry cowpea meal, (2) cowpea grain and other ingredients to kosei, using the wet-milling method, and (3) dry cowpea meal and other ingredients to kosei. The procedures to derive these ratios and the results of the experiments are described below.

4.2.6.1 Results of the experiments

The results of the experiments are presented in Table 4.15.

Before analyzing the data, it should be noted that the first dry-milling method replication (i.e., the laboratory experiment for making dry meal and the field experiment for preparing kosei using that meal) failed: the kosei had a heavier texture and coarser particles than wet-milled kosei, and the difference in taste was obvious. Both the kosei vendor who conducted the experiment and UGL food scientists suspected that this failure was due to inadequate whipping time, which did not allow cowpeas to swell sufficiently[39]. Therefore, it was decided not to use the data obtained from the first dry-milling method replication.

The second dry-milling method replication successfully produced kosei that had a texture close to that of wet-milled kosei. This time, the dry meal was soaked for 116 minutes and then whipped for 55 minutes with occasional breaks. While the taste improved, compared to the first replication, this long soaking and whipping time would not allow kosei vendors to use dry meal for making a fine adjustment in the quantity of

[39] For the first replication, dry meal and ground onion and pepper were given to the vendor. She started preparing the paste while she was frying wet-milled kosei. The paste (seasoned with the other ingredients) was whipped with interruptions. The total soaking and whipping time was 97 minutes (i.e., from the time the ingredients were mixed to the time she started frying), although the exact whipping time was not measured.

Table 4.15 Results of the wet- and dry-milled kosei preparation experiments

			Wet-Milling Method		Dry-Milling Method	
			1st replication*	2nd replication*	1st replication*	2nd replication*
INPUT	Cowpeas	Raw (g)	2,543	2,497	2,540	2,438
		Before milling (g)**	no data	2,100	no data	2,091
		After milling (g)	no data	*1,862*[a]	1,965	2,066
	Onion	Raw (g)	1,033	1,550	1,680	1,700
		Before milling (g)**	no data	1,400	no data	1,500
		After milling (g)	no data	*1,242*[a]	no data	*1,164*[b]
	Pepper	Raw (g)	182	40	31	40
		After milling (g)	no data	*35*[a]	no data	*31*[b]
	Salt	(g)	*56*[c]	*53*[c]	no data	no data
	Water	(g)***	no data	1,700	no data	2,094
	Oil	(g)****	1,242	1,159	463	723
OUT PUT	Kosei	(g)	5,223	5,000	4,300	4,800
		Number of balls	157	128	104	117
		Weight per ball (g)	33	39	41	41

Notes:

* Italicized figures are estimated values. See the other notes for how they were estimated.

** The weight of cowpeas "before milling" refers to dehulled and winnowed cowpeas; and the weight of onion "before milling" refers to peeled onion.

*** For the 2nd wet-milling method replication, the weight of water reported refers to the water absorbed by cowpea grain during soaking. For the 2nd dry-milling method replication, the weight of water reported consists of: (1) the water added to onion and pepper before custom-milling these ingredients; and (2) the water added to cowpea meal for whipping it.

**** The weight of oil reported consists of the oil absorbed by kosei and the oil evaporated during frying (the amount evaporated would most likely be minor, compared to the amount absorbed by kosei). To convert the unit of oil from liters to grams, the ratio of 0.93 was used. The ratio was calculated from data in the United States Department of Agriculture Commodity Requirements Vegetable Oil Products (VP7 and VO10) (Retrieved August 6, 2007, from http://www.fsa.usda.gov/FSA/webapp?area=home&subject=coop&topic=pas.)

a. For the wet-milling method, cowpeas, onion, and pepper were custom-milled together. The total weight of these mixed ingredients before and after milling was measured during the 2nd replication. The loss rate was 0.113. This rate was used to estimate the weight of each ingredient after milling.

b. For the dry-milling method, onion and pepper were custom-milled together with added water during the 2nd replication. The loss rate was 0.224. This rate was used to estimate the weight of each ingredient after milling.

c. For the 2nd wet-milling method replication, the weight of salt was estimated by the weight of paste before frying, minus the weight of all the other ingredients (including added water). Then, the share of salt in the total weight of kosei (53/5000) was used to estimate the weight of salt in kosei in the 1st wet-milling method replication.

Source: (1st replication) fieldwork in Accra, February and March 2007; (2nd replication) G. A. Annor.

kosei they prepare, depending on the sales of the day. A further study to determine the soaking and whipping time necessary to prepare a good quality kosei using dry cowpea meal would have to be conducted.

Comparing the results of the first and second wet-milling method replications with that of the second dry-milling method replication, the wet-milled kosei absorbed more oil per gram of kosei ([1,242/5,223 = 0.24 g] and [1,159/5,000 = 0.23 g] vs. [723/4,800 = 0.15 g])[40].

With regard to the taste, the kosei prepared from dry cowpea meal (the second replication) still did not have the exact same taste as the wet-milled kosei. Originally, this study intended to include the analysis of consumers' willingness to pay for kosei prepared from dry meal, if its taste is different from kosei prepared from wet-milled cowpeas. However, to conduct such an analysis, a whole food scientific study would be needed to test the consumers' acceptance, which was beyond the scope of this study. Therefore, for this study, it was assumed that the difference in taste of the two types of kosei is undetectable to general consumers.

4.2.6.2 Input-output ratio calculation 1: dry cowpea meal

During the second replication, 2,066 g of dry cowpea meal was produced from 2,438 g of cowpea grain. The input-output ratio was thus derived as 2,066/2,438 = 0.8474. The loss of about 15% consisted of bad grains that were sorted out, husks that were

[40] The comparison between the number of kosei balls obtained from the wet-milling and dry-milling method replications of this experiment does not provide a rigorous argument because the weight of ingredients used in each replication differed (the purpose of this experiment was to obtain input-output ratios within each replication, rather than to compare the results across the replications). However, how many kosei balls can be made from a unit of cowpea grain is a crucial question for kosei vendors because it directly affects the profitability of their business.

dehulled[41], and other losses during the washing, dehulling, and milling procedures.

Since the first dry-milling method replication failed, this is the only estimate available to use as a representative input-output ratio for dry cowpea meal. However, since the figure was derived from data obtained by a laboratory experiment, it might not reflect the reality: Harsh et al. (1981, p. 186) warned that experimental data obtained from farm research centers commonly achieve better outcome than under actual farm conditions. This may apply to the input-output ratio derived here. Thus, the input-output ratio that industrial processors would experience, if they produce dry cowpea meal at their facility, might be lower because the laboratory experiment was conducted using well maintained equipment, and the researchers paid attention to having as little waste as possible. In contrast, small- to medium-scale industrial processors might use older equipment and might not pay as much attention to minimizing losses because they mill in bulk. During the interview, only a few processor respondents could provide the quantities of input and output of cowpea/soybean flour[42]. The input-output ratio calculated using the data obtained from those limited number of respondents ranged from 0.7488 to 0.8469. Therefore, for the budgeting analysis, it was assumed that the input-output ratio of the respondents does not change between processing flour and meal, while the "representative" input-output ratio obtained from the laboratory experiment (i.e., 0.8474) was only used as the maximum input-output ratio in the sensitivity analysis.

---

[41] According to a UGL food scientist, about 6% of the weight of cowpeas are hulls (E. Amonsou, personal communication, March 29, 2007).

[42] Some respondents provided the quantities of both input (in olonka) and output (in number of containers and kg per container). However, when the unit of input was later converted into kg, it turned out that their outputs were heavier than their inputs. This result did not make sense because there must have been some waste as a result of the processing. Therefore, these respondents' input-output ratios were not used in the analysis.

4.2.6.3 Input-output ratio calculation 2: kosei

A representative kosei input-output ratio was needed for: (1) the wet-milling method of kosei preparation, to estimate the weight of kosei prepared by kosei respondents who could not or did not want to report their revenue on the day before the interview was conducted; and (2) the dry-milling method of kosei preparation (i.e., preparation using dry cowpea meal), to calculate the weight of dry cowpea meal that each respondent would need to prepare the same weight of kosei as they prepared by the wet-milling method. First, the representative kosei input-output ratio for the wet-milling method was calculated based on the data reported in Table 4.15, using the procedure described below.

To prepare kosei, the main ingredients—cowpea grain, onions, and peppers—are generally dehulled or peeled, mixed with each other, and milled into paste. Both dehulling/peeling and milling involves waste. The waste rate would be different across kosei vendors, depending on how they prepared the ingredients. Water is added to form paste, but all three main ingredients originally contain different percentages of moisture. To consider the water content in kosei as a whole, it is necessary to separate the moisture content out from the other ingredients. The ratio of the weight of ingredients that are dehulled, milled, and dehydrated to the weight of raw ingredients—called "dry equivalent rate" hereafter—can be mathematically expressed as follows:

$$r_{ij} = (1 - d_{ij})(1 - f_{ij})(1 - h_i) \tag{1}$$

where,

r = dry equivalent rate for the wet-milling method,
i = raw material (cowpea grain, onion, and pepper),
j = kosei vendor, d = dehulling/peeling waste rate,
f = milling waste rate, h = moisture content

Using this expression, the weight of kosei can be decomposed into the weight of each ingredient as follows:

$$Q_{kj} = r_{cj}Q_{cj} + r_{oj}Q_{oj} + r_{pj}Q_{pj} + Q_{vj} + Q_{lj} + Q_{sj} \tag{2}$$

where,

Q = quantity in kg, k = kosei, c = cowpea grain, o = onion
p = pepper, v = water, l = oil, s = salt

It is a reasonable assumption that the ratio of water and oil to the dry equivalent ingredients does not fluctuate much when kosei is made by experienced vendors. This assumption is expressed as follows:

$$Q_{vj} = \varepsilon_j\left(r_{cj}Q_{cj} + r_{oj}Q_{oj} + r_{pj}Q_{pj}\right) \tag{3}$$

$$Q_{lj} = \varphi_j\left(r_{cj}Q_{cj} + r_{oj}Q_{oj} + r_{pj}Q_{pj}\right) \tag{4}$$

where,

ε = ratio of water to dry equivalent ingredients in terms of weight
φ = ratio of oil to dry equivalent ingredients in terms of weight

By substituting Q_{vj} in equation (2) with the expression (3) and Q_{lj} in equation (2) with the expression (4), and manipulating the new equation algebraically, a kosei input-output equation (based on weight, rather than volume) can be derived as:

$$Q_{kj} = \alpha_j \left(r_{cj} Q_{cj} + r_{oj} Q_{oj} + r_{pj} Q_{pj} \right) + Q_{sj} \quad (5)$$

where, $\alpha_j = 1 + \varepsilon_j + \varphi_j$

Based on the data obtained from the second wet-milling method replications and the moisture content of each ingredient reported by Leung (1968), the values of dry equivalent rates and α_j—called "input-output conversion rate" hereafter—were calculated, as shown in Tables 4.16 and 4.17.

Table 4.16 Dry equivalent rates of the kosei preparation experiment (wet-milling)

r_c	=	$(1 - d_c)$	$(1 - f_c)$	$(1 - h_c)$
0.67		$\frac{2,100}{2,497}$	1 – 0.113	1 – 0.108
r_o	=	$(1 - d_o)$	$(1 - f_o)$	$(1 - h_o)$
0.09		$\frac{1,400}{1,550}$	1 – 0.113	1 – 0.885
r_p	=	$(1 - d_p)$	$(1 - f_p)$	$(1 - h_p)$
0.23		1 – 0	1 – 0.113	1 – 0.742

Note: since the dehulling/peeling waste and milling waste were not measured during the first replication, the rates were calculated based on the data collected during the second replication.

Source: (experiment) G. A. Annor; (the values of h_c, h_o, h_p) Leung (1968).

Table 4.17 Input-output conversion rates of the kosei preparation experiments (wet-milling)

	Q_k	=	α (	r_c	Q_c	+	r_o	Q_o	+	r_p	Q_p	) + Q_s
1st repl.	5.223		**2.83**	0.67	2.543		0.09	1.033		0.23	0.182	0.056
2nd repl.	5.000		**2.73**		2.497			1.550			0.040	0.053
mean α			**2.78**									

Note: since the dry equivalent rates could not be calculated for the first replication, the rates calculated for the second replication were used as an approximation.
Source: (1st replication) fieldwork in Accra, February and March 2007; (2nd replication) G. A. Annor.

Initially, it was expected that the values of dry equivalent rates and input-output conversion rates would not vary much across the respondents; if dry equivalent rates vary, this means that the vendors' rates of wastage of ingredients (during processing) vary; and if input-output conversion rates vary, this means that the weight ratios of dry equivalent ingredients to oil and water vary, which implies that the taste of the kosei would likely vary. Such variations might be wide among less experienced vendors, but less among experienced vendors. To examine this hypothesis, the value of input-output conversion rates was calculated for 6 out of 13 kosei vendor respondents, who could provide enough information for making this calculation, assuming that the dry equivalent rates were the same as the rates obtained from the experiment across the respondents. The results are shown in Table 4.18.

The results indicated that the input-output conversion rates, estimated from data provided by the six kosei vendor respondents and the experiment, ranged from 1.78 to 4.28, with a mean of 2.54, standard deviation of 0.84, and median of 2.42. The variation among the respondents was wider than expected, and no clear relation was found between the level of the input-output conversion rates and the experience of respondents. Therefore, to estimate the weight of kosei produced by the other kosei respondents, it was decided to use the median value of 2.42. Using this value and equation (5), the weight of

Table 4.18 Input-output conversion rate across kosei vendor respondents, using the wet-milling method

Resp. number	Experience (year)	Q_k =	α	(r_c	Q_c +	r_o	Q_o +	r_p	Q_p) +	Q_s
3	15	7.59	**4.28**		2.51		0.71		0.09	0.07
4	3	3.48	**1.95**		2.51		0.71		0.03	0.08
7	0.6	2.54	**2.12**		1.67		0.57		0.06	0.04
9	9	7.42	**1.78**	0.67	6.02	0.09	0.48	0.23	0.10	0.18
10	>20	10.81	**2.42**		6.24		1.78		0.23	0.25
13	>20	1.82	**2.47**		1.04		0.20		0.04	0.04
Experiment			**2.78**							
Mean α			**2.54**							
(standard deviation)			**(0.84)**							
Median α			**2.42**							

Note: the value of Q_k was calculated as [revenue] / [price per ball] × [weight per ball]; the calculation to derive Q_c for Respondents 10 and 13 as well as Q_o, Q_p, and Q_s for Respondent 9 included assumptions due to missing information; the values of Q_o for all the respondents as well as Q_p for Respondents 7 and 13 were calculated as [price of onion/pepper for the amount used] / [representative price per kg of onion/pepper (see Appendix 3)]. Details for calculation of these values are available from the author upon request.
Source: Fieldwork in Accra, February and March 2007; Table 4.16.

kosei prepared the day before the interview was conducted was calculated[43] for those respondents who either could not or did not want to report their revenue.

Second, the input-output equation for the dry-milling method was derived based on the same logic that was followed for the wet-milling method:

In this formula, the main input is dry cowpea meal. When dry meal is used, onions and peppers have to be peeled and milled separately from cowpeas. Therefore, the dry equivalent rates are modified as follows:

[43] Using: (1) the weight of cowpea grain, onion, pepper, and salt used by each respondent (estimated using the data obtained from each respondent) and (2) the same dry equivalent rates derived from the experiment across the respondents. Then, the revenue was also calculated for each of these respondents, using the following formula: [revenue] = [price per ball of kosei] × [estimated weight (kg) of kosei prepared the day before the interview was conducted] / [average weight (kg) per ball of kosei].

$$u_m = (1 - h_m) \tag{6}$$

$$u_{oj} = (1 - d_{oj})(1 - f^*_{oj})(1 - h_o) \tag{7}$$

$$u_{pj} = (1 - d_{pj})(1 - f^*_{pj})(1 - h_p) \tag{8}$$

where,

u = dry equivalent rate for the dry-milling method,
m = dry cowpea meal,
f^* = milling waste rate: this rate can be different from f because onions and peppers are now milled separately from cowpeas, perhaps involving a different milling method (e.g., they can be ground using a blender at home)

Based on the same assumption of a constant ratio of water and oil to the dry equivalent ingredients, the kosei input-output weight equation for the dry-milling method can be expressed as:

$$Q_{kj} = \alpha_j \left(u_m Q_{mj} + u_{oj} Q_{oj} + u_{pj} Q_{pj} \right) + Q_{sj} \tag{9}$$

Note that α_j does not change, whether vendors wet-mill cowpeas or use dry cowpea meal. By moving Q_{mj} in equation (9) to the left hand side, the weight of dry cowpea meal needed to produce Q_{kj} is expressed as:

$$Q_{mj} = \frac{Q_{kj} - Q_{sj} - \alpha_j u_{oj} Q_{oj} - \alpha_j u_{pj} Q_{pj}}{\alpha_j u_m} \tag{10}$$

Finally, by dividing both sides of equation (10) by Q_{kj}, the formula to calculate the weight of dry cowpea meal needed to prepare 1 kg of kosei is expressed as follows:

$$\frac{Q_{mj}}{Q_{kj}} = \frac{Q_{kj} - Q_{sj} - \alpha_j u_{oj} Q_{oj} - \alpha_j u_{pj} Q_{pj}}{\alpha_j u_m Q_{kj}} \tag{11}$$

To use equation (11), the values of dry equivalent rate for each ingredient are needed. Representative dry equivalent rates were derived using the data obtained from the second dry-milling method replication. The results are shown in Table 4.19.

Table 4.19 Dry equivalent rates of the kosei preparation experiment (dry-milling)

u_m	=			$(1 - h_m)$
0.93				$1 - 0.075$
u_o	=	$(1 - d_o)$	$(1 - f^*_o)$	$(1 - h_o)$
0.08		$\frac{1{,}500}{1{,}700}$	$1 - 0.224$	$1 - 0.885$
u_p	=	$(1 - d_p)$	$(1 - f^*_p)$	$(1 - h_p)$
0.20		$1 - 0$	$1 - 0.224$	$1 - 0.742$

Source: (experiment) G. A. Annor; (value of h_m: 7%-8%) R. D. Phillips.

The values obtained in this section were used to calculate budgets for the kosei vendors. The model used and the results are reported in detail in the following chapter.

4.3 Summary

Interviews with street vendors of kosei revealed that there were actually two types of fried cowpea ball products: one made from wet-milled cowpeas was called kosei, and the other made from dry-milled cowpeas was called agawu. Among 20 respondents, 13 were kosei and 7 were agawu vendors. The scale of business varied across the respondents. Most respondents used custom millers to dehull cowpeas, and all of them used custom millers to mill cowpeas.

Potential benefits of dry cowpea meal included: (1) reduction in preparation time of kosei; (2) fine adjustment of the quantity of kosei to prepare depending on the sales of the day; (3) more stable price of input (i.e., meal) compared to cowpea grain; and (4) increase in consumption of cowpeas through increasing home preparation of kosei.

With regard to the reduction in preparation time, it was found that it would not be easy to accurately estimate how much kosei vendors would value the time that they could save by switching from the use of cowpea grain to dry cowpea meal. The amount of time saved would depend on: (1) how they prepare other food products that they sell along with kosei; (2) change in soaking and whipping time; and (3) how easily they can grind ingredients other than cowpeas.

The use of dry cowpea meal to make fine adjustments of the quantity of kosei to prepare seems to have two potential constraints: (1) vendors who currently fry a whole batch of cowpea paste at once would have to accept less convenient not-all-at-once preparation; and (2) they would also have to be able to accurately predict the amount of the sales of the day, because soaking dry meal takes time.

The statement of kosei vendors indicated that they would be interested in using dry cowpea meal if: (1) they are informed that the meal is not for preparing agawu but kosei; (2) they are assured that the meal is of a good quality (no contamination by other milled grains); and (3) the price is attractive.

All custom millers used 2-A type plate mills, and none of them used hammer mills. Among the respondents, there was a difference in preference for milling dry and wet cowpeas. Whether dry cowpea meal for preparation of kosei could be produced by custom millers would depend on how easily they could mill cowpeas into the correct particle sizes. Although the ways to adjust particle sizes seemed to be technically the same across the respondents, some stated that it was easy for them to mill cowpeas into different particle sizes, while others stated that it was not easy.

While potential processors of dry cowpea meal would range from individuals to large-scale multinational companies, all the processor respondents interviewed were small- to medium-scale local companies. The respondents produced different types of food products along with grain products. Most of the respondents producing cowpea/soybean flour used the same technology as custom millers (i.e., plate mill). The production of cowpea/soybean flour seemed to be just a small and relatively new part of their entire business. Housewives were the major target of cowpea flour.

There was no new major finding about the non-price-related constraints for the industrial production of dry cowpea meal. The processor respondents producing cowpea and/or soybean flour seemed to be capable of producing dry cowpea meal with their current equipment or with a small investment.

Among the retailer respondents, a wide variation was found among their retail margins. However, based on the information obtained from kosei vendor and processor respondents, it was assumed for the budgeting analysis that kosei vendors would purchase dry cowpea meal directly from processors, without paying retail margins. On the other hand, it was found that the meal would have to be sold with the Value Added

Tax/National Health Insurance Scheme, with a rate of 15%.

Also reported in this chapter were the representative prices of cowpea grain derived from the price data collected during the fieldwork, as well as the results of dry cowpea meal and kosei preparation experiments.

CHAPTER 5

DRY COWPEA MEAL FOR PREPARATION OF KOSEI

—BUDGETING AND SENSITIVITY ANALYSIS

5.1 Budgeting Analysis—Model

A budgeting analysis was conducted to assess both the profitability of: (1) industrial grain flour processors to produce dry cowpea meal; and (2) kosei vendors to use commercial cowpea meal to make kosei.

5.1.1 Returns to Meal Processors

The unit return to meal processors—returns to processors' management and investment for 1 kg of dry cowpea meal—can be expressed by the following equation:

$$\frac{\Pi^m_{jt}}{Q^m_{jt}} = P^m_{jt} - \frac{C^m_{jt}}{Q^m_{jt}} \qquad (12)$$

where,

Π = return, m = dry cowpea meal, j = meal processor,
t = time period, Q = quantity in kg, P = price per kg,
C = total cost payment

The total cost payment consists of the components noted in equation (13) below. Since the processor respondents produced cowpea/soybean flour and other products, most of the cost components were joint costs, which were not paid separately for each product. Incorporating this fact into equation (12), the cost of producing dry cowpea meal is expressed as follows:

$$C_{jt}^{m} = P_{cjt}M_{cjt} + \delta_{jt}^{m}\sum_{w}W_{wjt} + \sum_{e}\gamma_{ejt}^{m}E_{ejt} + \sum_{n}\lambda_{njt}^{m}X_{njt} \tag{13}$$

where,

c = cowpea grain, M = raw material in kg, δ = share in wage,
W = wage per worker, w = worker, e = piece of equipment,
γ = share in equipment use, E = equipment payment,
n = other cost component
(electricity, fuel [excluding fuel for vehicle], water, rent, transportation [including fuel for vehicle], printing and stationery, telecommunication, packaging material, and miscellaneous)
λ = share in other cost component, X = other cost payment

Although desirable, it is virtually impossible to accurately measure the share of cowpea meal in each cost component (i.e., cost share associated with producing cowpea meal). For example, to estimate the wage cost share would require watching all the workers to measure the time each worker spent on producing cowpea/soybean flour. To accurately estimate the transportation cost share would require measuring the amount of each product that the respondents put into their car each time they sell their products. Therefore, approximated values were used to estimate the share of cowpea meal in each cost component, unless the respondent was able to provide costs on a product-by-product basis. The values used in this case study are as follows:

(1) $\dfrac{Q_{jt}^{m}}{\sum_{g}Q_{jt}^{g}}$: share in the quantity (weight) produced

where, g = product produced by the respondent

The formula above was used to estimate the cost of wage, electricity, fuel, water, and transportation.

(2) $\dfrac{P_{jt}^{m} Q_{jt}^{m}}{\sum_{g} P_{jt}^{g} Q_{jt}^{g}}$: share in the value of products produced

The formula above was used to estimate the cost of rent and telecommunication.

(3) $\dfrac{Q_{jt}^{m} / q_{ej}^{m}}{\sum_{g \in e} Q_{jt}^{g} / q_{ej}^{g}}$: share in the equipment use time

where,

q = hourly output

(Therefore, q^{g}_{ej} denotes "hourly output of product g by equipment e for processor j")

$g \in e$ = products produced using equipment e

The formula above was supposed to be used to estimate the cost of equipment. However, information on the hourly output of each product for each piece of equipment was almost never available. Therefore, an approximated value was used most of the time (e.g., for a plate mill, the weight of each product processed using the mill during the month was multiplied by the number of milling necessary to process that product [reported by the respondent], and the proportion of cowpea/soybean flour in the total production for this variable was calculated and used as an approximation).

(4) $\dfrac{A_{jt}^{m}}{\sum_{g} A_{jt}^{g}}$: share in the number of packages

where, A = number of packages

The formula above was used to estimate the cost of printing and stationery.

Using the model described above, the cost of producing dry cowpea meal was first estimated for each respondent, using the data that they reported on the cost of producing cowpea/soybean *flour*. The potential processor price per kg of dry cowpea meal was then estimated, assuming that the respondents would set the price so they could

receive the same level of returns as they were receiving for producing cowpea/soybean flour.

5.1.2 Returns to Kosei Vendors

Unit returns to kosei vendors (i.e., return for 1 kg of kosei) can be expressed by the following equation:

$$\frac{\Pi_j}{Q_{kj}} = \frac{P_{bj}}{\beta_j} - \sum_i \frac{P_{ij} Q_{ij}}{Q_{kj}} \tag{14}$$

where,

j = kosei vendor, k = kosei, P_b = price per ball of kosei,
β = weight in kg of one ball of kosei,
i = cost component
(cowpea grain or dry cowpea meal, onion, pepper, salt, water, oil, fuel, custom dehulling and/or milling)[1]

Using this model and the data collected from 13 kosei vendor respondents, three representative budgets for preparing 1 kg of kosei were constructed as follows:

(1) the payment for each cost component (per kg of kosei) was calculated for each of the kosei vendor respondents;

(2) from the 13 observations, the median values of the following variables were selected, excluding assumed values and outliers[2]: (i) calculated payment for

[1] Note that in equation (2) (see Section 4.2.6.3) the notations of Q_{vj} (weight of water used) and Q_{lj} (weight of oil used) represented only the quantity of water and oil absorbed in kosei and did not include any waste. In equation (14), the notation $P_{ij}Q_{ij}$ was used for the convenience, but the costs of water and oil that were actually collected from the respondents and used for calculating budgets were the total payment for water and oil (i.e., including waste).

[2] Assumed values refer to those values that respondents could not provide and therefore were assumed, based on the information reported by others; outliers were defined as values outside mean ± 2 standard deviations (calculated excluding assumed values).

each cost component, (ii) weight per ball of kosei (obtained from the samples of kosei purchased during the interview), and (iii) weight of dry cowpea meal needed to prepare 1 kg of kosei (calculated using equation [11])[3];

(3) for each of the above variables, the values *plus* one standard deviation (recalculated excluding outliers found in the previous step) and the values *minus* one standard deviation were calculated, respectively;

(4) the budget using the median was defined as "median representative budget (MB)," the budget with the median plus one standard deviation was defined as "least profitable representative budget (LB)," and the budget with the median minus one standard deviation was defined as "most profitable representative budget (PB);"[4] and

(5) the total cost of each budget was calculated as the sum of the cost components in the same budget; the revenue was calculated as the price per ball (i.e., 500) divided by the weight per ball (i.e., kg/ball) of the same budget; and the return was calculated as the revenue minus the total cost of the same budget.

Then, to estimate how the returns would change if dry meal were substituted for cowpea grain, each representative budget was modified as follows: (1) the cost of cowpea grain was replaced by the estimated cost of dry cowpea meal[5]; and (2) the cost of custom dehulling and milling, which vendors would not have to pay anymore if they used dry

---

[3] Since this value is highly influenced by the value of input-output conversion rate, the values derived using the assumed input-output conversion rate were also treated as assumed values and excluded from the calculation of representative budgets.

[4] One might be suspicious about this method because a vendor could pay a higher or lower unit cost than other vendors depending on the cost components. However, a positive correlation was found between the respondents' per-kg-of-kosei payment for cowpea grain and payment for oil, which were the two major cost components. This finding supports the method used to construct the LB and PB.

[5] Calculated as the estimated price of dry meal (per kg) times the weight (kg) of dry meal needed to prepare 1 kg of kosei (calculated for each representative budget).

meal, was set to zero.

5.2 Budgeting Analysis—Results

5.2.1 Budgets for Producing Cowpea Meal

Budgets for industrially producing dry cowpea meal were constructed using the model described in the previous section. Unfortunately, not enough information for this analysis could be obtained from two out of six cowpea/soybean flour processor respondents. Also, due to many missing and apparently erroneous data values for key variables reported by the remaining four respondents, it was necessary to utilize various assumptions in the analysis[6]. The results of the analysis are presented below.

For all respondents, the cost component having the largest share in the total cost was the raw material (i.e., cowpea grain)—the ratio of the payment for cowpea grain to the revenue from cowpea meal (i.e., processor price per kg of cowpea meal) was 22% to 39%, equal to ¢6,510 to ¢9,639 per kg of cowpea meal (Table 5.1. See also Figure 5.1). However, the same representative cowpea grain price derived in Section 4.2.5 (Table 4.14) was used across the respondents except for Respondent 4, from whom the unit cost of production was obtained from the respondent's accountant. In reality, all four respondents had their own procurement systems for raw materials (see Section 4.2.3.1). Therefore, the price that the respondents actually paid for cowpea grain might have been higher or lower than the representative price. If this was the case, the actual unit cost, and therefore the share in the total cost, of cowpea grain would be higher or lower than presented in Table 5.1.

[6] Details of the problems encountered and the methods used to handle those problems are available from the author upon request. Some of them are reported in the rest of this chapter as well as in Appendix 4.

Table 5.1 Estimated processor price, cost, return per kg of cowpea meal

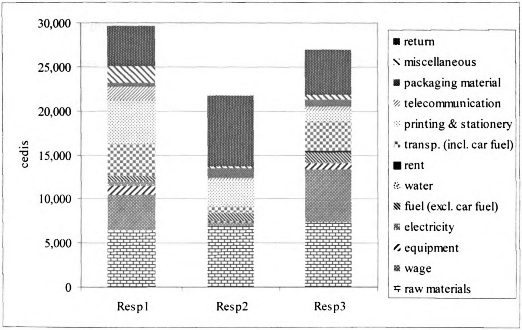
	Resp1	Resp2	Resp3	Resp4*
Processor price (¢; VAT/NHIS exclusive)	29,705	21,768	27,035	24,639
Raw material (i.e., cowpea grain)	6,510	*6,887*	7,310	9,639
Wage	3,925	431	6,044	2,921
Equipment	1,075	189	*742*	N.Av.
Electricity	491	127	204	
Fuel (excl. fuel for vehicles)	589	*736*	954	2,500
Water	0	68	51	
Rent	0	0	196	0
Transportation (incl. fuel for vehicles)	3,739	*712*	3,344	*2,599*
Printing & stationery	4,861	3,000	1,206	800
Telecommunication	1,508	239	491	N.Av.
Packaging material	*550*	1,100	*733*	1,200
Miscellaneous	1,789	260	636	N.Av.
Total cost (¢)	25,037	13,750	21,911	N.Av.
Return (¢)	4,668	8,018	5,123	N.Av.
Total revenue of the month (million ¢; approximate)	40	100	50	N.Av.
Share of cowpea/soybean flour in total revenue	0.02	0.04	0.04	N.Av.

Notes on assumed values (italicized figures): (1) raw material cost of Resp2 was calculated based on the input-output ratios obtained from other respondents; (2) cost of a sieve (included in equipment cost) of Resp3 was assumed, based on the values obtained from other respondents; (3) cost of fuel of Resp2 was assumed based on the values obtained from other respondents; (4) transportation cost of Resp2 was calculated using information obtained from other respondents; (5) transportation cost of Resp4 is the mean of the values of the other three respondents; and (6) costs of packaging material of Resps 1 and 3 were assumed, based on the values obtained from other respondents. Details of the methods used for calculation are available from the author upon request.

*Resp4: the values were not derived using the model described in Section 5.1.1 but obtained directly from the respondent's accounting record for cowpea flour that was produced *sometime in 2006* (not in February 2007. Since the information was missing for which month of 2006 the record was, the data could not be adjusted for inflation); the respondent gave a total of ¢2,500 for electricity, fuel (excluding fuel for vehicle), and water, rather than individual amounts; N.Av.: not available.

Source: Field survey in Accra, February and March 2007; secondary data used in other parts of this thesis.

Figure 5.1 Estimated processor price, cost, return per kg of cowpea meal (Resps 1, 2, and 3)



Source: Table 5.1.

The wage paid per kg of cowpea meal varied across respondents, from ¢431 to ¢6,044 in absolute values, and from 2% to 22% in terms of the ratio to the revenue. Due to a smaller number of employees and a lower wage rate with a larger scale in production, Respondent 2 paid a much lower unit wage, compared to Respondents 1 and 3.

The unit transportation cost[7] varied widely across the respondents, ranging from ¢712 (3% of the revenue) to ¢3,739 (13% of the revenue). As mentioned in Section 4.2.4, for the analysis of this study, kosei vendors were assumed to come to the processors' facility to purchase dry cowpea meal. Therefore, kosei vendors, rather than processors, were assumed to pay the transportation cost. However, it was difficult to

[7] Composed of: (1) payment for fuel; (2) estimated monthly share of purchase price of owned vehicle(s); and (3) maintenance cost of owned vehicle(s).

estimate such a cost that would potentially be paid by kosei vendors. Therefore, it was further assumed that the unit transportation cost that processors currently paid to deliver their products to their outlets were close to the unit transportation cost that kosei vendors would have to pay to visit processors for purchasing meal. Based on this assumption, the transportation costs were left in the budgets—these values represent the additional cost for kosei vendors to use dry cowpea meal[8].

Printing and stationery was another important cost component for Respondents 1 and 2 (¢4,861 per kg of cowpea meal [16% of the revenue] and ¢3,000 [14%], respectively) while not as important for Respondents 3 and 4 (¢1,206 [4%] and ¢800 [3%], respectively). It was expected that a larger scale of production would drive down the unit cost of printing and stationery. However, such a trend was not observed among the respondents.

The equipment, electricity, fuel (excluding fuel for vehicles), water, rent, telecommunication, packaging material[9], and miscellaneous costs did not contribute much to the total cost.

The estimated processor price of cowpea meal ranged from ¢21,768 to ¢29,705 per kg.

The returns to the capital, management, and perhaps labor of the respondents and

[8] Respondent 4 actually did not pay for transportation at all because the suppliers brought raw materials to the respondent's facility and the customers also came to the facility to buy outputs. However, for the same reason that kosei vendors would have to pay transportation costs, the mean unit transportation cost of the other three respondents was added to the budget of this respondent.

[9] One of the respondents stated that a high packaging cost was a constraint to introduce a new product. She most likely meant that the cost of creating a new package (e.g., designing a label) was high rather than the cost of packaging material.

their family members[10] (excluding Respondent 4 whose total cost was not available) ranged from ¢4,668 to ¢8,018 per kg of cowpea meal or from 16% to 37% of the revenue (i.e., processor price per kg of cowpea meal).

Since the sample size (i.e., 4) seemed to be too small to justify the use of mean value as a representative price of cowpea meal, the lowest and highest estimated prices were used in the following sections of this chapter to analyze the price-competitiveness of cowpea meal as an ingredient in kosei.

*5.2.2 **Budgets for Preparing Kosei from Wet-Milled Cowpeas***

Representative budgets for preparing 1 kg of kosei by the wet-milling method were constructed based on the collected data. As was the case with the budgets for producing dry cowpea meal, the calculation required modifications, estimations, and assumptions of various data values (see Appendix 5). The results are shown in Table 5.2.

Table 5.2 Representative budgets for preparing 1 kg of wet-milled kosei (¢)

	Cowpea grain	Onion	Pepper	Salt	Water	Oil	Fuel	Custom dehull/mill	Total cost	Revenue	Returns	Q_m/Q_k
LB	4,305 (32)	1,487 (11)	745 (5)	99 (1)	511 (4)	5,309 (39)	1,145 (8)	951 (7)	14,553 (107)	13,594 (100)	-959 (-7)	.53
MB	3,427 (23)	1,042 (7)	457 (3)	72 (0)	264 (2)	3,391 (22)	913 (6)	669 (4)	10,233 (68)	15,142 (100)	4,909 (32)	.42
PB	2,549 (15)	597 (3)	168 (1)	45 (0)	16 (0)	1,472 (9)	682 (4)	387 (2)	5,914 (35)	17,089 (100)	11,175 (65)	.31

Notes: LB: least profitable representative budget; MB: median representative budget; PB: most profitable representative budget; the figures in parentheses are the ratio to the value of revenue; for details of the calculation, see Appendix 5.

[10] The wage paid by Respondent 2 (and reported in Table 5.1) does not include the payment to the respondent and family members, while it is not clear whether the wage paid by the other three respondents included the payment to the respondent and family members or not.

The total costs to prepare 1 kg of kosei ranged from ¢5,914 to ¢14,553 (US$0.64 – US$1.58), while the revenue ranged from ¢13,594 to ¢17,089 (US$1.48 – US$1.86), making returns range from ¢-959 to ¢11,175 (US$-0.10 – US$1.21). Note that the return includes the return to all the labor (i.e., the labor of respondents, family members, and/or hired assistants) involved in preparing 1 kg of kosei as well as the return to management and capital. The negative return in LB is not an unrealistic result; if a vendor sells other food products such as hausa koko along with kosei, and if those products are more profitable, the overall return could be positive[11].

The most important cost components were cowpea grain (with a share of between 15% and 32% in the revenue) and oil (with a share of between 9% and 39% in the revenue).

The weight of dry cowpea meal needed to prepare 1 kg of kosei ranged from 0.31 to 0.53 kg. This value is important because it determines the change in the difference in returns between wet-milled kosei (i.e., prepared from cowpea grain) and dry-milled kosei (i.e., prepared using dry cowpea meal), when the price per kg of dry meal changes (e.g., if this value is 0.31, a ¢1 increase in the price of dry meal leads to a ¢0.31 increase in the difference in returns)[12]. Obviously, the smaller the difference in returns is, the more

[11] Vendors would continue selling kosei, even though having negative returns from kosei, only if the use of kosei as a "loss leader" to attract customers to buy more profitable products leads to a higher profit than when they sell only those profitable products (without kosei).

[12] One can see this relationship by using equation (14): subtracting the unit return for dry-milled kosei from the unit return for wet-milled kosei ends in the form:

$$\frac{\Pi^{wet}}{Q_k} - \frac{\Pi^{dry}}{Q_k} = \frac{P_m Q_m}{Q_k} - \left(\frac{P_c Q_c}{Q_k} + \frac{P_{custom\ d/m} Q_{custom\ d/m}}{Q_k}\right)$$

where, *custom d/m* = custom dehulling/milling.

Therefore, the effect of change in the price of meal on the left-hand side of the equation is derived as:

$$\Delta\left(\frac{\Pi^{wet}}{Q_k} - \frac{\Pi^{dry}}{Q_k}\right) = \frac{Q_m}{Q_k} \Delta P_m .$$

attractive to kosei vendors the meal would be.

5.2.3 Budgets for Preparing Kosei Using Dry Cowpea Meal

Finally, the weight of dry cowpea meal needed to prepare 1 kg of kosei in the three representative budgets was multiplied by the lowest and highest estimated prices per kg of dry cowpea meal, generating $3 \times 2 = 6$ case scenarios. As discussed in Section 4.2.4, it was assumed that the kosei vendors purchased cowpea meal directly from the processors. It was not clear whether the processors would collect the VAT/NHIS for such a transaction[13]. Therefore, both cases—processors do collect (and kosei vendors pay the entire 15% of tax; see discussion in Section 4.2.4) and do not collect the VAT/NHIS—were considered, making a total of 12 different case scenarios. As explained earlier in this chapter, the calculated costs of dry cowpea meal were entered in the budgets for kosei preparation, replacing the cost of cowpea grain, and the costs of custom dehulling and milling were set to zero. The results are shown in Table 5.3

The results indicate that, for all of the four potential prices of dry cowpea meal, the meal would lead to a negative return if used by a vendor operating with LB (with returns ranging from ¢-13,830 to ¢-7,254 per kg of kosei) or MB (from ¢-5,293 to ¢-106), while a positive return if used by a vendor operating with PB (from ¢3,642 to ¢7,440).

The difference in returns between wet- and dry-milled kosei ranged from ¢6,295 to ¢12,871 per kg of kosei for LB vendors, ¢5,015 to ¢10,202 for MB vendors,

[13] The guide book obtained from a VAT officer during the fieldwork indicates that the VAT/NHIS has to be collected from everybody (except the Ghanaian President and some organizations such as foreign embassies) unless the commodity is VAT/NHIS exempted. Therefore, cowpea meal processors would be supposed to collect the VAT/NHIS whether they sell products to retailers or to kosei vendors. However, considering the finding that not all the processor respondents were collecting the VAT/NHIS from retailers regardless of the regulation, it would be possible that they do not collect VAT/NHIS from kosei vendors.

Table 5.3 Budgets for preparing 1 kg of kosei using dry cowpea meal

	Price per kg of meal (¢)	Budget	Cowpea meal (¢)	Other costs (¢)	Total cost (¢)	Sales (¢)	Returns (¢)	Difference in returns* (¢)
Processors collect VAT/NHIS from kosei vendors	25,033 [21,768 × 1.15]	LB	13,283	9,297	22,580	13,594	-8,986	8,027
		MB	10,477	6,138	16,615	15,142	-1,473	6,382
		PB	7,671	2,979	10,650	17,089	6,439	4,736
	34,161 [29,705× 1.15]	LB	18,127	9,297	27,423	13,594	-13,830	12,871
		MB	14,298	6,138	20,435	15,142	-5,293	10,202
		PB	10,469	2,979	13,447	17,089	3,642	7,533
Processors do NOT collect VAT/NHIS from kosei vendors	21,768	LB	11,551	9,297	20,847	13,594	-7,254	6,295
		MB	9,111	6,138	15,248	15,142	-106	5,015
		PB	6,671	2,979	9,650	17,089	7,440	3,735
	29,705	LB	15,762	9,297	25,059	13,594	-11,465	10,506
		MB	12,433	6,138	18,570	15,142	-3,428	8,337
		PB	9,103	2,979	12,082	17,089	5,007	6,168

* Difference in returns between wet- and dry-milled kosei.
Source: Tables 5.1 and 5.2.

and ¢3,735 to ¢7,533 for PB vendors.

Whether kosei vendors would adopt dry cowpea meal would depend on whether the value of saved time and labor exceeds the increasing cost of preparation by switching from the wet-milling method to the use of dry cowpea meal (i.e., the difference in returns between wet- and dry-milled kosei). However, for the reasons discussed in Section 4.2.1.5, it would be difficult to predict from the available data the amount of time and labor that could be saved by using dry cowpea meal. As an alternative, the use of the daily minimum wage as a proxy for the opportunity cost of the vendor's time and labor can provide some insights. According to the Bank of Ghana (www.bog.gov.gh), the Ghanaian daily minimum wage (during February and March 2007) was ¢19,000. In addition, ¢10,000[14] and ¢38,000 were selected as alternative minimum wages to examine the effects of change in the opportunity cost on the profitability of dry cowpea meal. Since the difference in returns widens as the volume of production of kosei increases, the

[14] A kosei vendor respondent actually paid ¢10,000 per day to each of her two hired young assistants. (Note: this payment was removed from the budget of this respondent so that the returns in the budgets of all the 13 respondents included the return to all the labor needed to prepare kosei.)

volumes of 5, 10, and 15 kg were selected as examples[15]. The differences in returns per kg of kosei with the lowest and highest estimated prices of dry meal (see Table 5.3) were multiplied by 5, 10, and 15 for each of the three budgets to derive the total difference in returns. Then, the ratios of these figures to the three different opportunity costs of labor were calculated. The results are shown in Table 5.4.

Table 5.4 Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%) Opp. cost of labor per day (¢) 10,000	19,000	38,000
LB	21,768	5	31,473	315	166	83
		10	62,947	629	331	166
		15	94,420	944	497	248
	34,161	5	64,354	644	339	169
		10	128,707	1,287	677	339
		15	193,061	1,931	1,016	508
MB	21,768	5	25,075	251	132	66
		10	50,150	502	264	132
		15	75,226	752	396	198
	34,161	5	51,010	510	268	134
		10	102,020	1,020	537	268
		15	153,029	1,530	805	403
PB	21,768	5	18,677	187	98	49
		10	37,354	374	197	98
		15	56,031	560	295	147
	34,161	5	37,666	377	198	99
		10	75,332	753	396	198
		15	112,998	1,130	595	297

Source: Table 5.3; (opportunity cost of labor) Bank of Ghana.

Table 5.4 shows that, with the lowest estimated price of dry cowpea meal, for LB vendors preparing 5 kg of kosei per day to adopt dry meal, they would have to be able to save an amount of labor that is equivalent of 166% of the current daily minimum wage

[15] Among 13 respondents, there were 4 whose estimated volume of kosei production of the day before the interview was conducted fell between 2.5 and 7.4 kg, another 4 whose estimated volume fell between 7.5 and 12.4 kg, and 2 whose estimated volume fell between 12.5 and 17.4 kg (the estimated volume of the other 3 respondents were outside of this range).

(i.e., 1 and 2/3 person days), by switching from the wet-milling method to the use of dry meal. MB vendors would have to be able to save an amount of labor that is equivalent of 132% of the daily minimum wage, and PB vendors would have to be able to save an amount of labor that is equivalent of 98% of the daily minimum wage. With regard to the change in the volume of production, the amount of labor that vendors would have to be able to save doubles for 10kg and triples for 15kg, because of the linear relations between these variables. With regard to the change in the opportunity cost of labor per day, if the opportunity cost doubles, the amount of labor that vendors would have to be bale to save falls to one-half of the original amount, because of the inversely proportional relations between these variables.

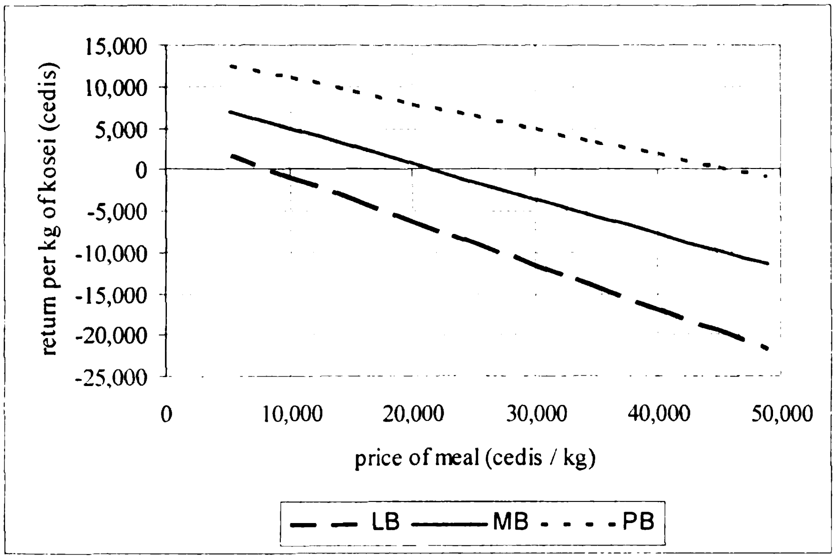
It would be unlikely that many kosei vendors could save the amount of labor derived above by switching from cowpea grain to dry meal. Therefore, under the conditions observed in Accra during February and March 2007, dry cowpea meal would not be a price-competitive ingredient in kosei for the majority of vendors.

5.3 Sensitivity Analysis

Before conducting sensitivity analyses for different scenarios, breakeven prices of dry cowpea meal were calculated for each of the three representative budgets for kosei preparation. The relationship between the purchase price of dry cowpea meal and the return for kosei vendors is plotted in Figure 5.2.

The breakeven prices of dry cowpea meal (i.e., price at which returns for kosei vendors equal zero) were ¢8,098 per kg for LB vendors, ¢21,514 per kg for MB vendors, and ¢46,045 per kg for PB vendors. The processor price of cowpea flour produced by the

Figure 5.2 Relationship between the purchase price of dry cowpea meal and the return for kosei vendors



Source: Calculated by the author.

two industrial processor respondents interviewed averaged ¢25,870 per kg (VAT/NHIS exclusive; with a standard deviation of ¢5,841). Thus, only the PB vendors could expect to break even using dry meal priced at this level.

Sensitivity analyses were then conducted for the following six scenarios that would potentially change the price-competitiveness of dry cowpea meal: (1) change in the technical efficiency of processing dry cowpea meal; (2) change in the volume of production; (3) bulk purchase of dry cowpea meal by kosei vendors; (4) change in the price of cowpeas (seasonality analysis); (5) change in the retail margin; and (6) a combination of different scenarios.

In these sensitivity analyses, except for a special assumption made for scenarios (2) and (6), the respondents were assumed to modify the price at which they would sell cowpea meal so the returns remained constant, whenever the cost of production changed.

While these assumptions were made to simplify the analysis, assuming constant returns is the equivalent of assuming a perfectly competitive market for the products analyzed. The appropriateness of this assumption is discussed in Section 8.3.

5.3.1 Change in the Technical Efficiency of Processing Dry Cowpea Meal

As reported in Section 4.2.6.2, the input-output ratio (or [1 – waste rate]) of dry cowpea meal obtained by the experiment was 0.8474, while the input-output ratio of cowpea/soybean flour obtained from the respondents ranged from 0.7488 to 0.8469. A higher ratio means a higher technical efficiency because less waste is generated from the same amount of raw material. Therefore, a higher technical efficiency leads to a lower raw material cost. The first sensitivity analysis was conducted on the technical efficiency of processing: considering the ratio obtained from the laboratory experiment as the maximum value, the input-output ratio of each respondent was set to 0.8474. The results are shown in Tables 5.5, 5.6, and 5.7.

Table 5.5 Sensitivity analysis (1): Technical efficiency—budgets for cowpea meal processors (¢ per kg of meal)

	Resp1	Resp2	Resp3	Resp4
Processor price (VAT/NHIS exclusive)	**29,655** (-50)	**21,341** (-427)	**26,184** (-850)	**24,634** (-6)
Raw material	**6,459** (-50)	**6,459** (-427)	**6,459** (-850)	**9,633** (-6)
Other costs	18,528	6,863	14,602	N.Av.
Total cost	**24,987** (-50)	**13,322** (-427)	**21,061** (-850)	N.Av. (-6)
Return	4,668	8,018	5,123	N.Av.

Note: the numbers in parentheses are the difference from the original values (in Table 5.1); N.Av.: not available.
Source: Calculated by the author.

In this scenario, the cost of raw material (i.e., cowpea grain) for cowpea meal processors declined by ¢6 to ¢850 per kg of meal, depending on the initial technical efficiency and the price of cowpea grain[16] (Table 5.5). Assuming no associated change in the costs of equipment, electricity, fuel, and water occurred[17], both the total cost and the processor price declined by the same value for each processor respondent. As a result, the estimated price of the least expensive dry cowpea meal changed from ¢21,768 to ¢21,341, and the estimated price of the most expensive meal changed from ¢29,705 to ¢29,655 per kg.

[16] As explained earlier, the same price of cowpea grain was used for Respondent 1 through 3, which resulted in the same cost of cowpea grain (¢6,459 per kg of meal) across these three respondents.
[17] Strictly speaking, these variables must change because the input amount changed.

Table 5.6 Sensitivity analysis (1): Technical efficiency—budgets for kosei vendors (per kg of kosei)

	Price per kg of meal (¢)	Budget	Cowpea meal (¢)	Total cost (¢)	Returns (¢)	Difference in returns* (¢)	
Processors collect VAT/NHIS from kosei vendors	24,542 [21,341 × 1.15]	LB	13,022	22,319	-8,726	7,767	(-261)
		MB	10,272	16,409	-1,267	6,176	(-206)
		PB	7,521	10,500	6,590	4,585	(-151)
	34,103 [29,655 × 1.15]	LB	18,096	27,393	-13,799	12,840	(-31)
		MB	14,273	20,411	-5,269	10,178	(-24)
		PB	10,451	13,430	3,660	7,515	(-18)
Processors do NOT collect VAT/NHIS from kosei vendors	21,341	LB	11,324	20,621	-7,027	6,068	(-227)
		MB	8,932	15,070	73	4,836	(-179)
		PB	6,540	9,519	7,571	3,604	(-131)
	29,655	LB	15,735	25,032	-11,439	10,480	(-27)
		MB	12,412	18,549	-3,407	8,316	(-21)
		PB	9,088	12,067	5,023	6,152	(-15)

* Difference in returns between wet- and dry-milled kosei.
Note: the numbers in parentheses are the difference from the original values (in Table 5.3).
Source: Calculated by the author.

The new lowest estimated price of cowpea meal (i.e., ¢21,341) was slightly lower than the breakeven price for MB vendors (i.e., ¢21,514). Therefore, at this price, the returns to MB vendors turned to a small positive number (i.e., ¢73) (Table 5.6).

The estimated decline in the price of cowpea meal only increased the return for kosei vendors by a minimal amount, from ¢15 (when the meal costs ¢29,655 per kg and is used by a PB vendor) to ¢261 (when the meal costs ¢24,542 per kg and is used by a LB vendor) per kg of kosei.

Table 5.7 Sensitivity analysis (1): Technical efficiency—Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%)		
				Opp. cost of labor per day (¢)		
				10,000	19,000	38,000
LB	21,341	10	60,679 (-2,267)	607 (-23)	319 (-12)	160 (-6)
MB			48,362 (-1,789)	484 (-18)	255 (-9)	127 (-5)
PB			36,044 (-1,310)	360 (-13)	190 (-7)	95 (-3)

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (in Table 5.4).
Source: Tables 5.4 and 5.6; (opportunity cost of labor) Bank of Ghana.

These increases in returns were not enough to make any major change in the results derived earlier about the profitability of using meal: with the modified lowest price of meal and for 10 kg of kosei, the ratio of the total difference in returns to the opportunity cost of labor per day (¢19,000) decreased only by 7 percentage points (when the meal is used by a PB vendor) to 12 percentage points (when the meal is used by a LB vendor) (Table 5.7).

5.3.2 Change in the Volume of Production

When processors have their own equipment, the purchase cost is a fixed cost. Therefore, the average equipment cost becomes lower as the volume of production increases up to the level of full capacity utilization. In the same way, if processors pay fixed monthly wages to their employees, the average wage becomes lower as the volume of production increases. However, if the facility is operating at its full capacity, it cannot increase production without purchasing new equipment or hiring additional workers. Therefore, whether the processor respondents operated at their full or under capacity was first examined to identify if it was viable to conduct a sensitivity analysis with regard to the change in the volume of production.

The weekly operation time of the facility obtained from Respondents 1, 2, and 3 were between 40 and 48 hours. None of them operated in shifts. Although the information is missing on the standard weekly working time in Ghana, with the current working time of 40 hours or longer per employee, it would likely be difficult for the respondents to increase the volume of production by extending their operation time.

The next question was whether their equipment and employees were constantly working throughout the facility's operation time. If not, there would be a potential for an increase in production by making them "work harder," while causing no or minimal increase in the cost of equipment and labor. Ideally, the full capacity of a facility has to be estimated from the hourly capacity and labor requirement of each piece of equipment for producing each product, and the estimated production under the full capacity has to be compared with the actual production of the facility. However, such detailed data were not available. For this study, a simple method was used to obtain a rough idea about the degree of capacity utilization of the respondents: the total weight of products produced during February was divided by the number of total working hours (sum of hours worked by each employee) during the same period. The result turned out that although all three respondents used similar processing technologies, Respondent 2 produced at least 4.3 times more per worker per hour than Respondent 1 and 4.8 times more than Respondent 3. Differences of more than four times seemed to be large enough to judge that Respondent 2 produced more intensely, or in other words, more closely to the facility's full capacity than Respondents 1 and 3, even taking into consideration the difference in the types of products produced by each respondent and the difference in the degrees of equipment and labor involvement for different products.

Based on the finding, the following assumptions were made: (1) Respondents 1 and 3 can produce 4.3 and 4.8 times more products[18], respectively, without an increase in the fixed costs[19]; (2) Respondent 2 can produce 10% more products without increase in the fixed costs; and (3) there is no change in the *average* variable costs (i.e., assumption of constant returns to scale). The 10% in the second assumption was arbitrarily selected. Respondent 2 might have been already operating at the full capacity. Therefore, this assumption was just experimental.

In addition, when processors increase their volume of production, they could possibly reduce their per-unit margin to make their products more competitive with other companies' products. By doing so, they could still increase their total returns since their total sales volume would increase, if the demand is sufficiently price-elastic. Therefore, for the budgets of Respondents 1 and 3, two alternative assumptions were made such that when the unit cost of production decreases due to the increase in the volume of

[18] 4.3 or 4.8 more of *each* product (not only cowpea meal). Thus, the share of cowpea meal in the total production (be weight) remained the same. An alternative sensitivity analysis could be conducted by increasing the share of cowpea meal while keeping the total quantity of production constant. However, as described in Section 4.3, for many of the cost variables, an accurate share of each product was impossible to obtain. Therefore, the weight share was used as an approximation. When modeled in this way, the cost per kg of cowpea meal of these variables are actually not affected by the weight share of cowpea meal; what matters is the total weight of all products (for example, wage per kg of cowpea meal is expressed as $\frac{1}{Q^m_{jt}}\frac{Q^m_{jt}}{\sum_g Q^g_{jt}}\sum_w W_{wjt} = \frac{1}{\sum_g Q^g_{jt}}\sum_w W_{wjt}$ [see equations (12) and (13); note that $Q^m{}_{jt}$ cancel out]). Therefore, the change in the share of cowpea meal in the total production (by weight), while keeping the level of total production, would not make much difference to the original budget. For this reason, this sensitivity analysis was not conducted.

[19] The following cost components were considered to be fixed costs: wage, purchase prices of equipment, rent, telecommunication, and miscellaneous; while the following cost components were considered to be variable costs: raw materials, maintenance costs of equipment, electricity, fuel, water, transportation, printing and stationery, and packaging material. In reality, Respondent 1 did not pay fixed monthly wages but paid the wages depending on the volume of work of each month. Therefore, the assumption of fixed wages for this respondent was experimental.

production, the respondents modify the selling price of cowpea meal: (1) so the per-unit returns remain constant (the same assumption made for the other scenarios); and (2) so the per-unit returns become one-half of the original value. The result of the sensitivity analysis is shown in Tables 5.8, 5.9, and 5.10.

As expected, the unit cost paid by Respondents 1 and 3 declined markedly due to the decreasing average fixed costs (Table 5.8). The 10% increase in production did not have a significant effect on the total cost paid by Respondent 2 (only ¢99 less per kg of meal). Under the assumption that the processors set the selling price so the per-unit returns remain constant, only the lowest estimated price of cowpea meal (i.e., ¢21,011, for Respondent 3) was slightly lower than the breakeven price for MB vendors (i.e., ¢21,514). Under the assumption that the processors set the selling price so the per-

Table 5.8 Sensitivity analysis (2): Increase in the volume of production—budgets for cowpea meal processors (¢ per kg of meal)

		Resp1	Resp2	Resp3
Processor price (VAT/NHIS exclusive)	With original return	**23,840** (-5,866)	**21,668** (-99)	**21,011** (-6,024)
	With 1/2 of original return	**21,506** (-8,199)		**18,449** (-8,586)
Wage		**913** (-3,013)	**391** (-39)	**1,259** (-4,785)
Equipment		**753** (-323)	**174** (-15)	**550** (-192)
Rent		**0** (0)	**0** (0)	**41** (-155)
Telecommunication		**351** (-1,157)	**218** (-22)	**102** (-389)
Miscellaneous		**416** (-1,373)	**236** (-24)	**132** (-503)
Other costs		16,740	12,631	13,802
Total cost		**19,172** (-5,866)	**13,650** (-99)	**15,887** (-6,024)
Return	Original return	4,668	8,018	5,123
	1/2 of original return	**2,334**		**2,562**

Note: the numbers in parentheses are the difference from the original values (in Table 5.1).
Source: Calculated by the author.

unit returns become one-half of the original value, the estimated prices of cowpea meal were ¢21,506 (for Respondent 1) and ¢18,449 (for Respondent 3), both of which were lower than the breakeven price for MB vendors.

Under the assumption that the processors set the selling price so the per-unit returns remain constant, the decline in the lowest estimated price of meal increased the returns to MB vendors by only ¢317 per kg of kosei (if the VAT/NHIS was not collected), which is less than the value of 1 ball of kosei (i.e., ¢500) (Table 5.9). Under the assumption that the processors set the selling price so the per-unit returns become one-half of the original values, the decline in the lowest estimated price of meal increased the returns to MB vendors by ¢1,389 per kg of kosei (if the VAT/NHIS was not collected).

Table 5.9 Sensitivity analysis (2): Increase in the volume of production—budgets for kosei vendors (per kg of kosei)

		Price per kg of meal (¢)	Budget	Cowpea meal (¢)	Total cost (¢)	Returns (¢)	Difference in returns* (¢)	
With original returns	With VAT/NHIS	24,162 [21,011 × 1.15]	LB	12,821	22,118	-8,524	7,565	(-462)
			MB	10,113	16,251	-1,108	6,017	(-365)
			PB	7,404	10,383	6,706	4,469	(-267)
	Without VAT/NHIS	21,011	LB	11,149	20,445	-6,852	5,893	(-402)
			MB	8,794	14,931	211	4,698	(-317)
			PB	6,439	9,418	7,672	3,503	(-232)
With 1/2 of original returns	With VAT/NHIS	21,216 [18,449 × 1.15]	LB	11,258	20,555	-6,961	6,002	(-2,025)
			MB	8,880	15,018	125	4,784	(-1,597)
			PB	6,502	9,481	7,609	3,566	(-1,170)
	Without VAT/NHIS	18,449	LB	9,789	19,086	-5,493	4,534	(-1,761)
			MB	7,722	13,859	1,283	3,626	(-1,389)
			PB	5,654	8,633	8,457	2,718	(-1,017)

* Difference in returns between wet- and dry-milled kosei.

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) and ¢25,033 per kg (with VAT/NHIS) (in Table 5.3).

Source: Calculated by the author.

Under the assumption that the processors set the selling price so the per-unit returns remain constant, the increases in returns were not enough to make any major change in the profitability of using meal: with the modified lowest price of meal and for 10 kg of kosei, the ratio of the difference in returns to the opportunity cost of labor per day (¢19,000) declined only by 12 percentage points (when the meal is used by PB vendors) to 21 percentage points (when used by LB vendors) (Table 5.10).

Under the assumption that the processors set the selling price so the per-unit returns become one-half of the original value, MB vendors who prepare 10 kg of kosei per day might adopt dry meal if they could save at least an amount of labor that is equivalent of 191% of the daily minimum wage, using the lowest estimated price of meal.

Table 5.10 Sensitivity analysis (2): Increase in the volume of production —Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

	Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%)		
					Opp. cost of labor per day (¢)		
					10,000	19,000	38,000
With original returns	LB	21,011	10	58,928 (-4,019)	589 (-40)	310 (-21)	155 (-11)
	MB			46,981 (-3,170)	470 (-32)	247 (-17)	124 (-8)
	PB			35,033 (-2,321)	350 (-23)	184 (-12)	92 (-6)
With 1/2 of original returns	LB	18,449	10	45,336 (-17,611)	453 (-176)	239 (-93)	119 (-46)
	MB			36,260 (-13,891)	363 (-139)	191 (-73)	95 (-37)
	PB			27,183 (-10,171)	272 (-102)	143 (-54)	72 (-27)

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) (in Table 5.4).
Source: Tables 5.4 and 5.9; (opportunity cost of labor) Bank of Ghana.

These results indicate that: (1) if the processors set the selling price of their meal so the per-unit returns remain constant, when the cost of production changes, the increase in the volume of production alone would not be enough to improve significantly the price-competitiveness of dry cowpea meal as an ingredient in kosei; and (2) if the processors set the selling price of their meal so their per-unit returns become one-half of the original value, when they increase the volume of production, the price-competitiveness of dry meal would improve greatly, compared to under the per-unit-returns-remain-constant assumption. However, it is not clear whether the dry meal would become attractive enough for MB vendors to adopt it.

Finally, it should be noted that whether the processors can sell all the increased outputs, whether holding the per-unit margin (i.e., per-unit returns) constant or cutting it to one-half of the original value (while increasing the total returns), depends on how price-elastic the demand for the product is.

5.3.3 Bulk Purchase of Dry Cowpea Meal by Kosei Vendors

It might be possible for kosei vendors to negotiate with dry cowpea meal processors and sign a contract for regular bulk purchases. For the processors, the benefits of such a contract would be a secure constant demand for the meal as well as the cost savings for printing and stationery and packaging material, as they would not need to individually package small quantities of meal in a container with a printed label. Because of these benefits, the processors might be willing to offer a discount. This scenario was examined in the following sensitivity analysis, assuming that (1) the cost of printing and stationery becomes zero for the contracted bulk purchase; and (2) the cost of packaging material becomes ¢73 per kg of meal[20]. The results are shown in Tables 5.11, 5.12, and 5.13.

The results indicated that the bulk purchase of cowpea meal would decrease the price of meal by ¢1,866 to ¢5,338 per kg (Table 5.11). As a result, the lowest price among the four processor respondents was estimated to be ¢17,741 per kg of meal (for Respondent 2), which is lower than the breakeven price for MB vendors (i.e., ¢21,514). However, the processor prices estimated for the other three respondents stayed above the breakeven price.

Table 5.11 Sensitivity analysis (3): Bulk purchase of meal by kosei vendors—budgets for cowpea meal processors (¢ per kg of meal)

	Resp1	Resp2	Resp3	Resp4
Processor price (VAT/NHIS exclusive)	**24,367** (-5,338)	**17,741** (-4,027)	**25,168** (-1,866)	**22,712** (-1,927)
Printing and stationery	**0** (-4,861)	**0** (-3,000)	**0** (-1,206)	**0** (-800)
Packaging material	**73** (-477)	**73** (-1,027)	**73** (-660)	**73** (-1,127)
Other costs	19,626	9,650	19,972	N.Av.
Total cost	**19,699** (-5,338)	**9,723** (-4,027)	**20,045** (-1,866)	N.Av. (-1,927)
Return	4,668	8,018	5,123	N.Av.

Note: the numbers in parentheses are the difference from the original values (in Table 5.1); N.Av.: not available.
Source: Calculated by the author.

[20] During the field survey, a gari processor was found selling gari in bulk. The cost of packaging material (two different types of inner and outer polyethylene bags) was ¢9,000 for 62 olonka (estimated to be 123 kg). Therefore, the unit cost was 9,000/123 = ¢73 per kg. It was assumed that the material suitable for gari can be used for dry cowpea meal as well.

With the new lowest price, the return for MB vendors would be ¢1,579 per kg of kosei, if processors did not collect the VAT/NHIS from the vendors, and ¢466 per kg of kosei, if processors collected the VAT/NHIS (Table 5.12). If processors did not collect the VAT/NHIS, the decline in the price of meal increased the returns to kosei vendors by ¢1,234 (when the meal was used by PB vendors) to ¢2,137 (when used by LB vendors).

Table 5.12 Sensitivity analysis (3): Bulk purchase of meal by kosei vendors—budgets for kosei vendors (per kg of kosei)

	Price per kg of meal (¢)	Budget	Cowpea meal (¢)	Total cost (¢)	Returns (¢)	Difference in returns* (¢)	
Processors collect VAT/NHIS from kosei vendors	20,402 [17,741 × 1.15]	LB	10,826	20,123	-6,529	5,570	(-2,457)
		MB	8,539	14,677	466	4,443	(-1,938)
		PB	6,252	9,231	7,858	3,317	(-1,419)
Processors do NOT collect VAT/NHIS from kosei vendors	17,741	LB	9,414	18,711	-5,117	4,158	(-2,137)
		MB	7,425	13,563	1,579	3,330	(-1,685)
		PB	5,437	8,416	8,674	2,501	(-1,234)

* Difference in returns between wet- and dry-milled kosei.

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) and ¢25,033 per kg (with VAT/NHIS) (in Table 5.3).

Source: Calculated by the author.

If preparing 10 kg of kosei, using the lowest priced meal (without the VAT/NHIS being charged), MB vendors would have to be able to save at least 1.75 days of one person's labor for them to adopt the meal (or 0.88 days for 5 kg of kosei), while PB vendors would have to be able to save at least 1.32 days (or 0.66 days for 5 kg of kosei) (Table 5.13).

Table 5.13 Sensitivity analysis (3): Bulk purchase of meal by kosei vendors—Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%)		
				Opp. cost of labor per day (¢)		
				10,000	19,000	38,000
LB	17,741	10	41,579 (-21,368)	416 (-214)	219 (-112)	109 (-56)
MB			33,296 (-16,854)	333 (-169)	175 (-89)	88 (-44)
PB			25,013 (-12,341)	250 (-123)	132 (-65)	66 (-32)

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) (in Table 5.4).
Source: Tables 5.4 and 5.12; (opportunity cost of labor) Bank of Ghana.

5.3.4 Change in the Price of Cowpeas

The potential benefit of dry cowpea meal for kosei vendors, in terms of input price stabilization, was examined by the following sensitivity analysis. As reported in Section 4.2.5.2 (Table 4.14), the estimated lowest price of cowpea grain in 2007 was ¢5,155 per kg, while the highest price was estimated to be 1.10 times the price in

March[21]. Using these estimates, it was assumed that cowpea meal processors purchased cowpea grain and produced meal when the price of cowpea grain was the lowest, stored the meal, and sold it when the price of grain was the highest, without changing the price of meal. Based on this assumption, the budget for kosei vendors to prepare 1 kg of kosei by the wet-milling method was also modified. However, it was assumed that the prices of all cost components to prepare kosei stayed constant, except cowpea grain. The results are shown in Tables 5.14, 5.15, and 5.16.

The lower price of cowpea grain drove down the cost of cowpea meal production, and therefore the price of meal, by ¢380 to ¢426 per kg of meal (Table 5.14). The lowest estimated price of meal was ¢21,366 per kg for Respondent 2.

Table 5.14 Sensitivity analysis (4): Change in the price of cowpea grain—budgets for cowpea meal processors (¢ per kg of meal)

	Resp1	Resp2	Resp3
Processor price (VAT/NHIS exclusive)	**29,326** (-380)	**21,366** (-402)	**26,608** (-426)
Raw material	**6,130** (-380)	**6,485** (-402)	**6,884** (-426)
Other costs	18,528	6,863	14,602
Total cost	**24,658** (-380)	**13,348** (-402)	**21,485** (-426)
Return	4,668	8,018	5,123

Note: the numbers in parentheses are the difference from the original values (in Table 5.1); Respondent 4 was excluded from this analysis because the information was missing on which month of the year 2006 the data were collected.
Source: Calculated by the author.

[21] Since the majority of kosei vendor respondents seemed to report the cost of cowpeas that they purchased during March, the highest cost of cowpea grain per kg of kosei during 2007 was estimated to be the cost of cowpeas in the original budgets (Table 5.2) times 1.10, which was derived by dividing the maximum price index of cowpea grain (i.e., 111) by the price index for March (i.e., 101) (see Section 4.2.5.2).

The increase in the price of cowpea grain drove down the returns to kosei prepared by the wet-milling method by only ¢265 to ¢447 per kg of kosei (Table 5.15). In contrast, the decrease in the estimated price of the least expensive cowpea meal slightly drove up the returns to the kosei prepared from dry meal. As a result, the difference in returns between wet- and dry-milled kosei declined by only ¢388 (when the meal was used by PB vendors) to ¢660 (when used by LB vendors) per kg of kosei, if the processor did not collect the VAT/NHIS.

Table 5.15 Sensitivity analysis (4): Change in the price of cowpea grain—budgets for kosei vendors (per kg of kosei)

	Price per kg of meal (¢)	Budget	Cowpea meal/ grain (¢)	Total cost (¢)	Returns (¢)	Difference in returns* (¢)
Processors collect VAT/NHIS from kosei vendors	24,571 [21,366 × 1.15]	LB	13,038	22,335	-8,741	7,335 (-692)
		MB	10,284	16,422	-1,279	5,832 (-549)
		PB	7,530	10,509	6,581	4,330 (-406)
Processors do NOT collect VAT/NHIS from kosei vendors	21,366	LB	11,337	20,634	-7,041	5,634 (-660)
		MB	8,943	15,080	62	4,491 (-524)
		PB	6,548	9,527	7,563	3,348 (-388)
Budget for kosei vendors by the wet-milling method with 1.10 times higher price of cowpea grain than the price in the original budget**		LB	4,752 (447)	15,000 (447)	-1,406 (-447)	
		MB	3,783 (356)	10,589 (356)	4,553 (-356)	
		PB	2,814 (265)	6,179 (265)	10,910 (-265)	

* Difference in returns between wet- and dry-milled kosei; the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) and ¢25,033 per kg (with VAT/NHIS) (in Table 5.3)

** The numbers in parentheses are the difference from the original values (in Tables 5.2).

Source: Calculated by the author.

Since the changes in the price of cowpea grain resulted in only minor changes in the difference in returns between wet- and dry-milled kosei, the ratio of the difference in returns to the opportunity cost of labor per day did not improve much (Table 5.16).

Table 5.16 Sensitivity analysis (4): Change in the price of cowpea grain—Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%) Opp. cost of labor per day (¢) 10,000	19,000	38,000
LB	21,366	10	56,344 (-6,603)	563 (-66)	297 (-35)	148 (-17)
MB			44,910 (-5,241)	449 (-52)	236 (-28)	118 (-14)
PB			33,475 (-3,878)	335 (-39)	176 (-20)	88 (-10)

Note: the numbers in parentheses are the difference from the original values, calculated for the lowest meal price of ¢21,768 per kg (without VAT/NHIS) (in Table 5.4).
Source: Tables 5.4 and 5.15; (opportunity cost of labor) Bank of Ghana.

To conclude, the analysis showed that a reasonable range of seasonal fluctuation in the price of cowpea grain alone would not make dry cowpea meal much more attractive to kosei vendors.

5.3.5 Change in the Retail Margin

It has been assumed so far that the kosei vendors buy cowpea meal directly from meal processors. If vendors have to buy meal from retailers, the price will be higher because of the retail margin. Also, for most housewives, retailers would be the major outlet if dry cowpea meal becomes available. The retail prices of cowpea meal were estimated for the different retail margins combined with the VAT/NHIS, derived in Section 4.2.4. The result is presented in Table 5.17.

The estimated price of dry cowpea meal ranged from ¢26,121 to ¢47,528 per kg. This range almost falls between the breakeven price for MB vendors (¢21,514) and the breakeven prices for LB vendors (¢46,045).

Table 5.17 Sensitivity analysis (5): Change in the retail margin—estimated retail price of dry cowpea meal

Retail margin + VAT/NHIS (%)	Lowest price (¢)	Highest price (¢)
20	26,121	35,646
30	28,298	38,617
40	30,475	41,587
50	32,652	44,558
60	34,829	47,528

Source: Calculated by the author.

5.3.6 Combination of Different Scenarios

Finally, the most favorable scenario for a higher price-competitiveness of dry cowpea meal was analyzed. It was assumed that the scenarios 1 through 4 analyzed above happened at the same time (i.e., technical efficiency improved, volume of production increased, while the processors set the selling price of meal so their per-unit returns become one-half of the original value, discount was offered for bulk purchase, and cowpea price fluctuated in favor of dry meal), while keeping the assumption of direct purchase of meal by kosei vendors from meal processors (i.e., no retail margin was added to the processor price). The results of this sensitivity analysis are shown in Tables 5.18, 5.19, and 5.20.

As expected, the estimated prices of meal declined sharply (Table 5.18). The difference, compared to the originally estimated prices, ranged from ¢4,933 to ¢13,964 per kg, which led to the lowest meal price of ¢15,354 per kg and highest price of ¢16,835 per kg.

Table 5.18 Sensitivity analysis (6): combination of different scenarios—budgets for cowpea meal processors (¢ per kg of meal)

	Resp1	Resp2	Resp3
Processor price (VAT/NHIS exclusive)	**15,741**	**16,835**	**15,354**
	(-13,964)	(-4,933)	(-11,681)
Raw material	**6,082**	**6,082**	**6,082**
	(-428)	(-805)	(-1,228)
Wage	**913**	**391**	**1,259**
	(-3,012)	(-40)	(-4,785)
Equipment	**753**	**174**	**550**
	(-322)	(-15)	(-192)
Rent	**0**	**0**	**41**
	(0)	(0)	(-155)
Printing & stationery	**0**	**0**	**0**
	(-4,861)	(-3,000)	(-1,206)
Telecommunication	**351**	**218**	**102**
	(-1,157)	(-21)	(-389)
Packaging material	**73**	**73**	**73**
	(-477)	(-1027)	(-660)
Miscellaneous	**416**	**236**	**132**
	(-1,373)	(-24)	(-504)
Other costs	4,819	1,643	4,553
Total cost	**13,407**	**8,817**	**12,792**
	(-11,630)	(-4,933)	(-9,119)
Return	**2,334**	8,018	**2,562**
	(-2,334)	(0)	(-2,562)

Note: the numbers in parentheses are the difference from the original values (in Table 5.1).
Source: Calculated by the author.

The large decline in the prices of dry cowpea meal reduced the difference in returns between wet- and dry-milled kosei to between ¢1,505 (minimum difference) and ¢4,570 (maximum difference) per kg of kosei (Table 5.19). Nonetheless, even with the lowest estimated price of dry meal (¢15,354 per kg), wet-milling still yielded a higher net margin than use of the dry meal.

Table 5.19 Sensitivity analysis (6): combination of different scenarios—budgets for kosei vendors (per kg of kosei)

	Price per kg of meal (¢)	Budget	Cowpea meal/ grain (¢)	Total cost (¢)	Returns (¢)	Difference in returns* (¢)	
Processors collect VAT/NHIS from kosei vendors	17,657 [15,354 × 1.15]	LB	9,369	18,666	-5,072	3,666	(-4,361)
		MB	7,390	13,528	1,614	2,939	(-3,443)
		PB	5,411	8,390	8,699	2,211	(-2,525)
	19,360 [16,835 × 1.15]	LB	10,273	19,570	-5,976	4,570	(-8,301)
		MB	8,103	14,241	902	3,651	(-6,551)
		PB	5,933	8,912	8,178	2,733	(-4,800)
Processors do NOT collect VAT/NHIS from kosei vendors	15,354	LB	8,147	17,444	-3,850	2,444	(-3,851)
		MB	6,426	12,564	2,578	1,975	(-3,040)
		PB	4,705	7,684	9,405	1,505	(-2,230)
	16,835	LB	8,933	18,230	-4,636	3,230	(-7,276)
		MB	7,046	13,184	1,958	2,594	(-5,743)
		PB	5,159	8,138	8,951	1,959	(-4,209)
Budget for wet-milled kosei with 1.10 times higher price of cowpea grain than the original budget		LB	4,752	15,000	-1,406		
		MB	3,783	10,589	4,553		
		PB	2,814	6,179	10,910		

* Difference in returns between wet- and dry-milled kosei.
Note: the numbers in parentheses are the difference from the original values (in Table 5.3).
Source: Calculated by the author.

With the lowest estimated price of meal without the VAT/NHIS being charged (¢15,354 per kg), PB vendors preparing 10 kg of kosei per day would have to be able to save at least 0.79 days of one person's labor by using meal for them to adopt the meal (based on the opportunity cost of labor per day of ¢19,000) (Table 5.20). MB vendors would have to be able to save 1.04 days of one person's labor under the same conditions.

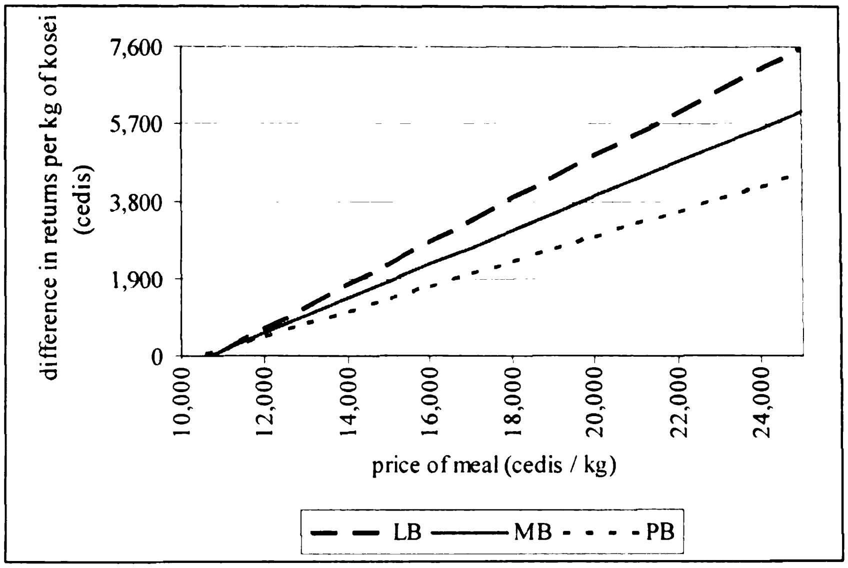
Table 5.20 Sensitivity analysis (6): combination of different scenarios—Ratio of the total difference in returns between wet- and dry-milled kosei to the opportunity cost of labor per day

Budget	Price of dry meal per kg (¢)	Volume of production of kosei (kg)	Total difference in returns (¢)	Ratio of total difference in returns to opportunity cost of labor per day (%)		
				Opp. cost of labor per day (¢)		
				10,000	19,000	38,000
LB	15,354	10	24,441 (-38,506)	244 (-385)	129 (-203)	64 (-101)
	19,360		45,699 (-83,008)	457 (-830)	241 (-437)	120 (-218)
MB	15,354		19,746 (-30,405)	197 (-304)	104 (-160)	52 (-80)
	19,360		36,513 (-65,506)	365 (-655)	192 (-345)	96 (-172)
PB	15,354		15,051 (-22,303)	151 (-223)	79 (-117)	40 (-59)
	19,360		27,328 (-48,004)	273 (-480)	144 (-253)	72 (-126)

Note: the numbers in parentheses are the difference from the original values (in Table 5.4).
Source: Tables 5.4 and 5.19; (opportunity cost of labor) Bank of Ghana.

The relationship between the price of dry cowpea meal and the difference in returns between wet- and dry-milled kosei is linear, as shown in Footnote 12. The slope and y-intercept, calculated using the highest estimated costs of cowpea grain for kosei vendors during 2007 (i.e., the values used in the sensitivity analyses [4] and [6]), are 0.53 and -5,703 for LB vendors, 0.42 and -4,452 for MB vendors, and 0.31 and -3,200 for PB vendors. These relations are plotted in Figure 5.3.

Figure 5.3 Relationship between the price of dry cowpea meal and the difference in returns between wet- and dry-milled kosei



Source: Calculated by the author.

The difference in returns between wet- and dry-milled kosei reaches ¢1,900 per kg of kosei (i.e., ¢19,000—the minimum daily wage—per 10 kg of kosei) when the price of meal is about ¢14,300 per kg for LB vendors, ¢15,200 for MB vendors, and ¢16,600 for PB vendors. At these prices, vendors would be interested in adopting the meal if the use of meal allows them to save 1 day of one person's labor, or ¢19,000 in monetary term, for 10 kg of kosei (or 1/2 day of one person's labor for 5 kg of kosei). If the opportunity cost of labor doubles, or if the use of dry meal saves 2 days of one person's labor for 10 kg of kosei (or 1 day of one person's labor for 5 kg of kosei), the acceptable price of meal would become about ¢17,900 for LB vendors, ¢19,700 for MB vendors, and ¢22,800 for PB vendors.

Even under the most favorable scenario, the estimated price of meal did not decline below ¢15,200. On the other hand, the estimated price of meal declined below ¢19,700 only when: (1) Respondent 3 increased the volume of production while setting the price of meal so the per-unit return becomes one-half of the original value and without collecting the VAT/NHIS (sensitivity analysis [2]); (2) Respondent 2 offered a discount for bulk purchase of meal, without collecting the VAT/NHIS (sensitivity analysis [3]); and (3) Respondents 1 through 3 produced and sold the meal under the most favorable scenario's conditions, whether or not collecting the VAT/NHIS (sensitivity analysis [6]). Thus, these results suggest that, for the majority of kosei vendors, dry cowpea meal could only be a price-competitive ingredient in kosei under a combination of very favorable conditions.

5.4 Summary

In this chapter, enterprise budgets were constructed for: (1) industrially-processed dry cowpea meal; (2) kosei prepared by the wet-milling method (i.e., using cowpea grain); and (3) kosei prepared by the dry-milling method (i.e., using dry cowpea meal).

Of the six processor respondents producing cowpea/soybean flour, four provided enough information for constructing the budgets. The raw material (i.e., cowpea grain) was estimated to be the cost component that accounted for the largest share of total cost. For cost variables such as wage, transportation, and printing and stationery, the estimated payment (per kg of output) varied widely across the respondents. The estimated price of cowpea meal ranged from about ¢21,800 to ¢29,700 per kg, while the estimated returns to the processors ranged from about ¢4,700 to ¢8,000 per kg.

With regard to the budgets for the wet-milled kosei, the total cost ranged from about ¢5,900 to ¢14,600 per kg of kosei, while the revenue ranged from about ¢13,600 to ¢17,100 per kg, making returns range from about ¢-1,000 to ¢11,200 per kg. The most important cost components were cowpea grain and oil.

The budget constructed for the dry-milled kosei found that, under the conditions observed in Accra during February and March 2007, dry cowpea meal would not be price-competitive with cowpea grain for the majority of kosei vendors. The difference in returns between wet- and dry-milled kosei was estimated to range from about ¢3,700 to ¢12,900 per kg of kosei. This means that the meal would only be attractive to those vendors who could save an amount of labor that is equivalent of 197% to 677% of the minimum daily wage (¢19,000) for every 10 kg of kosei they prepare (or 98% to 339% of the daily minimum wage for 5 kg of kosei), by switching from the wet-milling method to the dry-milling method (i.e., meal), which is a very unlikely condition.

The sensitivity analysis showed that none of the suggested scenarios to improve the price-competitiveness of meal—improvement in the technical efficiency, increase in the volume of production (with or without reduction in the processing margin), bulk purchase of meal, and fluctuation in cowpea price—would greatly change the results of the original analysis, if these scenarios occurred individually. If all of these scenarios occurred simultaneously, the price of dry cowpea meal would decline significantly. However, to adopt the meal, kosei vendors would still have to be able to save an amount of labor that is equivalent of 79% to 241% of the current minimum daily wage for every 10 kg of kosei they prepare (or 40% to 120% of the daily minimum wage for 5 kg of kosei). The results suggest that, for the majority of kosei vendors, dry cowpea meal could only be a price-competitive ingredient in kosei under a combination of very favorable conditions.

CHAPTER 6

WEANIMIX—DESCRIPTIVE ANALYSIS

6.1 Overview of Ghanaian Weaning Foods

As described in Chapters 1 and 2, traditional Ghanaian maize-based weaning foods are porridges made from fermented maize, called koko, and from roasted maize, called Tom Brown. Since they are maize-based, both koko and Tom Brown are inexpensive to prepare but low in protein. At home, they can be either prepared from the raw material—maize grain—using custom millers for milling maize or from ready-to-use semi-processed products: fermented maize dough (for koko) and roasted maize flour (for Tom Brown; the flour is also called Tom Brown). During the fieldwork in Accra, grain/flour-type product vendors in the market were found to be the major sellers of these semi-processed products. They often prepared these products by themselves (using custom millers). Industrially produced and individually packaged Tom Brown was also available and mostly sold in supermarkets.

As mentioned in Section 2.2.2, Weanimix was developed to enhance the nutrients of Tom Brown by fortifying it with cowpeas or soybeans and groundnuts. However, home preparation of Weanimix has not been widely adopted by women who were taught how to prepare it—possibly due to the higher cost and longer time required to prepare Weanimix, compared to Tom Brown (G. A. Annor, personal communication, March 26, 2007). Preparation of Weanimix is indeed more costly than preparation of Tom Brown because the additional ingredients are more expensive than maize (see Section 6.2.6); and it is more tedious because each ingredient has to be roasted separately. Plahar et al.

Figure 6.1 Fermented maize dough sold in a market

Source: Author.

Figure 6.2 Tom Brown sold in a market

(2003) also pointed out the inconvenience and possible cost ineffectiveness of small-scale production at the household level, and suggested small-scale enterprise production as a solution. During the fieldwork in Accra, such Weanimixes/quasi-Weanimixes produced by small- to medium-scale local companies were observed in supermarkets.

In addition to the above-mentioned traditional and fortified traditional weaning foods, several brands of weaning foods produced by large-scale multinational companies were also observed in supermarkets. Among them was Cerelac, produced by Nestlé, and sold in various forms such as "Maize & Milk," "Rice & Milk," and "Wheat & Milk." In addition, the company launched "Nestlé Wheat & Beans" in 2003 (http://www.nestleghana.com), a product containing cowpeas as a protein source (cowpeas are called beans in Ghana). Cerelac was found to be widely sold in small shops as well. Also observed were a variety of formula produced for weaning-age infants such as Lactogen (produced by Nestlé), Nursie (Blédina), and SMA (SMA Nutrition). These multinational companies' weaning foods and formula were in general much more expensive than traditional weaning foods (see Section 6.2.1).

This and next chapters analyze the competitiveness of cowpeas as an ingredient in Weanimix.

6.2 Description and Implication of Data

This section reports descriptive analyses of the data collected during the fieldwork, examines non-price-related factors affecting the competitiveness of cowpea-Weanimix, and processes these data to prepare for the budgeting analysis.

6.2.1 Prices of Different Weaning Foods

A wide range of prices was observed among different weaning foods described above (Table 6.1).

Fermented maize dough, the ingredient of koko, was the cheapest among the identified commercial weaning foods, with a mean price ranging from ¢3,211 to ¢5,976 per kg, depending on the season of the year. Tom Brown sold in the market was more expensive than fermented maize dough, with a mean price ranging from ¢12,295 to ¢15,390 per kg. However, the difference in prices between fermented maize dough and the other products (in Table 6.1) should be interpreted with caution. Fermented maize dough sold in the market is moist (see Figure 6.1), while the other products are sold in a dried form. Therefore, the price per kg of dry-equivalent fermented maize dough would not be as low as presented in Table 6.1.

Tom Brown produced by small- to medium-scale local companies was more expensive than Tom Brown sold at the traditional market, costing ¢17,000 per kg.

Table 6.1 Mean prices of different types of weaning foods observed in Accra during February and March 2007

Weaning foods	Low price during the year* (¢/kg)	Price in Feb/Mar 2007 (¢/kg)	High price during the year* (¢/kg)	Main outlet
Fermented maize dough (produced by grain/flour-type product vendors)	3,211 (361) n = 4	4,483 (609) n = 4	5,976 (1,111) n = 3	Markets
Tom Brown (produced by grain/flour-type product vendors)	12,295 (4,394) n = 7	14,295 (3,630) n = 6	15,390 (4,668) n = 7	Markets
Tom Brown (produced by small- to medium-scale local companies)		17,000 (0) n = 2		Supermarkets
Weanimix and quasi-Weanimix** (produced by small- to medium-scale local companies)		23,854 (7,719) n = 10		Supermarkets
Cerelac		69,167 (6,221) n = 6		Small shops Supermarkets
Multinational companies' weaning foods/infant formula (other than Cerelac)		147,183 (34,610) n = 7		Supermarkets

Note: numbers in parentheses are standard deviation; "n" denotes the number of respondents for fermented maize dough and Tom Brown produced by grain/flour-type product vendors and the number of the variety of products for the other categories.

* Low/High prices during the year are not prices observed during the fieldwork but prices reported by the vendors.

** Include products that were named Tom Brown but included ingredients other than maize and therefore seemed to be appropriate to be called Weanimix.

Source: Fieldwork in Accra, February and March 2007.

Weanimix produced by those companies cost ¢23,854 per kg on average. Weaning foods/infant formula produced by multinational companies were far more expensive than weaning foods produced by local companies. Cerelac, the cheapest among them, still cost ¢69,167 per kg on average, while the mean price of the other brands observed during the fieldwork was ¢147,183 per kg.

These observations clarified a question that needs to be explored. Weanimixes that were industrially produced by local companies were more expensive than Tom Brown produced by local companies, and much more expensive than Tom Brown produced by grain/flour-type product vendors. In addition to the price difference, industrially-processed Weanimixes were mostly sold in supermarkets. This implied that those products were not targeted at mothers in low-income families because supermarkets in Ghana appeared to be frequented by higher-income consumers [1]. Thus, while Weanimixes were already commercialized in Accra, they were not yet available to mothers whose children would most benefit from Weanimix. The question is whether it is possible to lower the price of Weanimix to a level where low-income families can afford to buy it, while processors still earn enough returns to motivate them to produce it.

6.2.2 Weaning Mothers

This sub-section summarizes the data collected from 30 weaning mothers. As described in Section 3.2.4, all the respondents were selected from mothers who visited a clinic or hospital on a "weighing day."

6.2.2.1 Weaning habits

The age of the respondents' weaned children ranged from 6 to 20 months, with a mean of 9.6 months. The majority of the respondents gave weaning foods to their child three or more times a day (Table 6.2).

Among the 30 respondents, 3 always prepared weaning foods by themselves.

---

[1] Reardon and Timmer (2007) reported that although a rapid increase in the demand for and supply of supermarket services, beyond high-income consumers in the capital cities, has been observed since 1990s in developing countries, "sub-Saharan Africa presents a very diverse picture, ... (p. 2831)" Ghana seems to be a part of "the great majority of Africa, ... [that] can be classified as not yet entering a substantial 'takeoff' of supermarket diffusion. (p. 2831)"

Table 6.2 Weaning habits of the respondents

Weaning habits		weaning mother (n = 30)
How many times per day give weaning foods to the child	1	1
	2*	8
	3 or more	21
Self-prepare or buy weaning foods	Always self-prepare	3
	Self-prepare more often than buy	12
	Self-prepare as often as buy	4
	Self-prepare less often than buy	4
	Always buy	6
	Both self-prepare and buy but don't know which is more often	1

* Includes two respondents who answered "twice or three times a day."
Source: Field survey in Accra, February and March 2007.

Their reasons for not buying commercial weaning foods[2] were: (1) her child did not like the commercial weaning food that she fed the child; (2) her child likes self-prepared weaning foods very much (but she is thinking of starting to use commercial ones); and (3) she has never fed her child a commercial weaning food, but she thinks her child might not like their taste.

A total of 21 respondents fed their child both self-prepared and commercial weaning foods. The majority of them prepared weaning foods by themselves more often than they used commercial ones.

Six respondents always purchased weaning foods. Their reasons for not preparing weaning foods by themselves were[3]: (1) self-preparing weaning foods is time consuming (mentioned by 2 respondents); (2) her child prefers the taste of commercial weaning foods (2 respondents); (3) commercial weaning foods are more nutritious (2

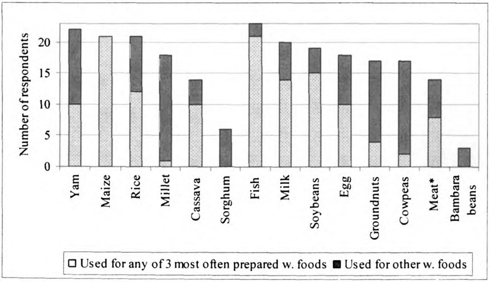
[2] In this section (6.2.2), "self-prepared" weaning foods refer to those weaning foods that are prepared from raw materials (e.g., grains), while "commercial" weaning foods refer to those weaning foods that are sold in a semi-processed form and purchased by weaning mothers. Therefore, koko, for example, was considered to be self-prepared if respondents prepared it from maize grain, while it was considered to be commercial if respondents prepared it from fermented maize dough that they purchased.
[3] Asked as a multiple choice question.

respondents); and (4) her child is still too young to eat self-prepared weaning foods (1 respondent).

6.2.2.2 Self-prepared weaning foods

Information was collected on: (1) whether the respondents used any of the 14 selected ingredients (see Figure 6.3) to prepare weaning foods by themselves; and (2) three kinds of weaning foods that the respondents prepared most often[4], as well as the ingredients of each of those weaning foods. Data were obtained from 23 respondents—excluded were 6 respondents who always purchased weaning foods and 1 respondent who had just started giving weaning foods to her child and had not yet tried different types.

Figure 6.3 Ingredients that respondents use to make self-prepared weaning foods



* Excluding two respondents who mentioned that they tried but their child could not chew.
Source: Field survey in Accra, February and March 2007.

[4] At most three kinds: five respondents mentioned only one kind and another five respondents only two kinds of weaning foods that they prepared most often.

Among the six staples selected, the largest number of respondents used yam (*Dioscorea rotundata*) (22 out of 23 respondents), followed by maize (21), rice (21), millet (18), cassava (14), and sorghum (6). This order and the associated number of respondents change significantly when the criterion is limited to the ingredients used for the three most-often-prepared weaning foods: maize becomes the most commonly used (21 respondents), followed by rice (12), yam (10), cassava (10), millet (1), and sorghum (0).

Among the eight non-staples selected, fish was used by the largest number of respondents (all 23 respondents), followed by milk (20), soybeans (19), egg (18), groundnuts (17), cowpeas (17), meat (14), and bambara beans (3). Cowpeas and soybeans were used by about the same number of respondents. However, when the criterion was limited to the ingredients used for the three most-often-prepared weaning foods, cowpeas were used by only 2 respondents, while soybeans were used by 15 respondents. It is also noteworthy that such a high proportion of respondents used nutritious but relatively expensive food materials such as fish and meat as ingredients in their weaning foods.

The weaning foods that were frequently self-prepared by the largest number of respondents were koko and/or *banku*. Banku is prepared from fermented maize dough like koko, but with less water added so it becomes a solid, which can be formed into balls[5]. A total of 20 of 23 respondents mentioned either koko or banku as one of their three most-often-prepared weaning foods. Koko was always prepared with different combinations of additional food materials such as milk, fish, and egg, depending on the respondents. Among the 13 respondents for whom koko was one of the three most-often-

[5] Fermented cassava flour is often added to fermented maize dough when banku is prepared. Banku is enjoyed with stew or soup by all Ghanaians (i.e., adults as well as children) in their daily meals, rather than only used as a weaning food.

prepared weaning foods, 10 added soybeans, while only 1 added cowpeas.

Only two respondents mentioned Tom Brown as one of their three most-often-prepared weaning foods, while no respondents mentioned Weanimix. However, one of these two respondents fortified Tom Brown with soybeans, and the other fortified it with soybeans and groundnuts. Therefore, their "Tom Brown" would probably have to be called Weanimix. In any case, Tom Brown/Weanimix were clearly less popular than koko/banku among the respondents.

The other three most-often-prepared weaning foods mentioned by the respondents included rice cooked in different ways such as rice porridge and rice balls (12 respondents), mashed yam (9), and *Tuo Zafi* (or commonly called T-Z: a food similar to banku, but made from non-fermented maize and fermented cassava) (6).

6.2.2.3 *Commercial weaning foods*

Respondents were asked to name up to three weaning foods that they purchased most often. Data were collected from 26 respondents—excluding 3 respondents who always prepared weaning foods by themselves and 1 respondent who had just started giving weaning foods to her child and had not tried different varieties yet.

The overwhelmingly preferred commercial weaning food was Cerelac, which was used by 23 respondents. Ten respondents mentioned Lactogen and/or SMA, both of which were mainly used by those respondents to fortify traditional weaning foods that they prepared by themselves. Eight respondents mentioned maize dough, which they used to prepare koko or banku[6]. Only three respondents mentioned Tom Brown and/or Weanimix (Table 6.3).

[6] Some of them both self-prepared and bought maize dough.

Table 6.3 Most often purchased weaning foods selected up to three by the respondents

Purchased weaning foods	weaning mother who purchases weaning foods (n = 26)
Cerelac	23
Lactogen and/or SMA*	10
Maize dough	8
Tom Brown and/or Weanimix	3
Other	3

* Mainly used for fortification.
Source: Field survey in Accra, February and March 2007.

Among the 26 respondents who purchased weaning foods, 21 were asked whether they had ever bought Weanimix (i.e., information is missing for 5 respondents). Besides two respondents who mentioned Weanimix as one of their three most-often-purchased weaning foods, three had bought Weanimix: one bought it from the hospital once a week when she came to weigh her child; one bought it from the hospital, but her child did not like it, and therefore, she discontinued to use it; and one mentioned she once bought Tom Brown fortified with soybean and groundnut, which most likely was soybean-Weanimix, but her child did not eat it. The remaining 16 respondents had never bought Weanimix. Except for the three respondents who had never bought it because they prepared it by themselves, most of them had never seen it or they did not know what it was. It was unexpected that such a high proportion of the respondents were not aware of Weanimix, because weaning mothers visiting a clinic/hospital for weighing their child would most likely have more opportunities to learn about nutritious weaning foods than weaning mothers in general.

While most respondents purchased weaning foods produced by multinational large-scale companies (i.e., Cerelac, Lactogen, and SMA) at small shops, a few respondents purchased at supermarkets. Most respondents purchased maize dough either at the market or from maize dough vendors. Tom Brown was purchased at the market, and Weanimix at either the market or the hospital.

One of the clinics where the interviews were conducted sold: (1) soybean flour; (2) soybean-Weanimix; (3) cowpea-Weanimix; (4) rice & soybean flour; and (5) dry fish powder, packaged in small polyethylene bags[7]. A nurse said soybeans had been promoted more than cowpeas.

6.2.2.4 Cowpeas versus soybeans as a fortifier

The respondents were asked if they would be willing to buy cowpea- and soybean-fortified gari[8] if they found such products on the shelf in the store. Although the products for which the question was asked are different from Weanimix, the respondents' answers were expected to reflect their perception about cowpeas and soybeans as fortifiers of traditional foods in general, and thereby provide insights on their willingness to pay for cowpea- and soybean-Weanimix. The results are shown in Table 6.4.

Table 6.4 Willingness to pay for cowpea- and soybean-fortified gari among the respondents

Willingness to pay	(n = 28)*
Would pay more for cowpea- than soybean-fortified gari	3
Would pay more for soybean- than cowpea-fortified gari**	13
Would pay equally more for cowpea- and soybean-fortified gari	9
Would not buy either c- or s-fortified gari if prices are higher than normal gari	3

* weaning mother respondents who would buy either cowpea- or soybean-fortified gari
** Includes two respondents who would buy only soybean-fortified gari.
Source: Field survey in Accra, February and March 2007.

[7] Each of them was for ¢2,000. On the day when the interview was conducted, only soybean flour, soybean-Weanimix, and rice & soybean flour were available for purchase. We bought and weighed one of each formulation. The weight was between 60 and 80 g.

[8] As mentioned in Chapter 1, cowpea-fortified gari (grated, fermented, and roasted cassava) was initially among the target products for this case study. The questionnaire for weaning mothers was designed to examine the difference in their willingness to pay for cowpea- and soybean-fortified gari rather than cowpea- and soybean-Weanimix.

Among the 28 respondents who showed their interest in buying either cowpea- or soybean-fortified gari, 3 were willing to pay more for cowpea- than soybean-fortified gari, while 13 were willing to pay more for soybean- than for cowpea-fortified gari.

The result showed a higher willingness among the respondents to pay more for soybean- than for cowpea-fortified gari. While no generalization can be made from these data because of the limited sample size, this result suggests a need to conduct a comprehensive consumer survey. Interviewed mothers preferred soybean- over cowpea-fortified gari, which suggest that consumers may prefer soybean- over cowpea-Weanimix. If such a preference is commonly held by weaning mothers in Accra, it implies that cowpeas face a significant challenge as an ingredient in Weanimix—especially because soybeans are less expensive than cowpeas (see Section 6.2.6).

6.2.2.5 Comparison with findings of another study

The descriptive analysis reported above suggests a different picture about weaning mothers in Accra, compared to the results of a study conducted by Mensa-Wilmot et al. (2001b). In their study, 133 weaning mothers were randomly selected and interviewed at "residential areas, open-air markets and Maternal and Child Health (MCH) centers in the city suburbs and rural areas in the Greater Accra Region" (pp. 84-85). Their findings, among others, were that: (1) 50% of the respondents had never bought "proprietary food" (the term seems to refer to multinational companies' weaning foods); and (2) 87% used cowpeas in the preparation of weaning foods, while 65% used soybeans.

Mensa-Wilmot et al. (2001b) stated cost constraints as a reason why one-half of the respondents chose cereal-based traditional porridges over multinational companies' weaning foods. In contrast, in this study, 26 out of 30 respondents (87%) indicated that they had bought multinational companies' weaning foods at least once. Moreover, for most of the remaining four respondents, cost did not seem to be the reason why they did not buy those weaning foods. It is not clear whether this discrepancy in results is caused by an increase in the wealth of weaning mothers in Accra since the previous study was conducted or due to a potential bias in our data because of: (1) the limited sample size; or (2) the population from which the sample was drawn—i.e., weaning mothers visiting a clinic/hospital to weigh their child. This population would most likely include a higher proportion of mothers who are aware of, or concerned about, child nutritional issues than exists in the general population. However, it should be noted that our sample of weaning mothers, who were rich enough to purchase expensive multinational companies' weaning foods, were most likely not representative of mothers whose children were malnourished and therefore would benefit from Weanimix[9]. Therefore, it would most likely be inappropriate to extrapolate the answers from our respondents to the low-income weaning mothers for whom Weanimix was originally targeted.

The data collected by Mensa-Wilmot et al. (2001b) indicated that cowpeas were more popular than soybeans for the ingredients in weaning foods. However, Mensa-Wilmot et al. (2001a, p. 850) also observed that soybeans were "gaining popularity as a nutritious ingredient for infant food supplementation due to the efforts of public health workers for the Ministry of Health." In our study, the respondents preferred soybeans to

[9] As far as the author could observe during the interview, all the weaned child of the respondents looked healthy, and no apparently malnourished children were observed.

cowpeas (see Figure 6.3). Again, it is not clear whether the discrepancy is caused by the actual change in the popularity of soybeans among weaning mothers in Accra over time or by a potential bias in our data. Another interesting finding by Mensa-Wilmot et al. (2001b) was that 23 focus group interviews conducted in traditional villages in the Central Region revealed that the respondents were not familiar with aroma of soybeans used in the sample of weaning foods that they prepared—as mentioned in Section 2.2.3, the researchers could not determine if the respondents were familiar with soybeans because there was no word for soybean in the local language. The implication of these findings is that the popularity of soybeans would most likely vary across time and regions in Ghana. If so, it would be important to accurately assess soybean popularity among the target population of Weanimix, because the knowledge and acceptance of soybeans among the target population would greatly affect the competitiveness of cowpea-Weanimix with soybean-Weanimix.

6.2.3 Industrial Weaning Food Processors

Including the 6 cowpea/soybean flour processors analyzed in Chapter 4, a total of 10 industrial grain flour/weaning food processors were interviewed to collect information on their production of weaning foods. This section presents a descriptive analysis of the data collected from them.

6.2.3.1 Characteristics of weaning food processors

The characteristics of 10 respondents are summarized in Table 6.5.

Table 6.5 Characteristics of weaning food processor respondents

Characteristics		processor (n = 10)
Sex of the manager	Female	6
	Male	3
	Missing information	1
Number of years the company has been in business	Less than 5	3
	5-10	2
	11-20	4
	More than 20	1
Total number of workers (including family members)	1-5	2
	6-10	4
	11-15	2
	More than 15	1
	Missing information	1
Monthly revenue from all products* (¢; 1 US$ ≈ ¢9,200)	Less than 50 million	6
	50-100 million	1
	More than 100 million	2
	Missing information	1
Number of products (including weaning foods)	1-5	2
	6-10	2
	11-15	4
	More than 15	2
Weanimix or quasi-Weanimix includes as an ingredient:	Cowpeas (not soybeans)	1
	Soybeans (not cowpeas)**	7
	Both cowpeas and soybeans	1
	N.A. (do not produce Weanimix but Tom Brown)	1
Number of years the company is producing Weanimix or quasi-Weanimix	Less than 2	2
	2-5	4
	6-10	0
	10-15	2
	Missing information & N.A.	2
Share of Weanimix or quasi-Weanimix in the total revenue*	Less than 10%	3
	10-20%	1
	More than 20%	2
	Missing information & N.A.	4
Major source of raw materials	Vendor in the market	5
	Wholesalers	1
	Owned farm	1
	Middlemen/Suppliers	3

* Revenue of the month for which the data were collected (mostly January or February 2007); approximate values were used for those respondents who reported, instead of the monthly revenue from all products, (1) the quantity and price of each product produced—the value of products was used as the approximate revenue, assuming that all the products were sold out in the month they were produced; and (2) the annual revenue in the past year—the figures were divided by 12 and used as approximate monthly revenue.

** Includes one respondent who was using soybeans at the time the interview was conducted, but reported also using cowpeas instead of soybeans depending on their availability.

Source: Field survey in Accra, February and March 2007.

The majority of the companies interviewed (6 out of 10) were managed by a woman. The number of years that the companies had been in business varied across the respondents; all except 1 respondent had been in business for fewer than 20 years. The total number of workers (including family members) also varied; most respondents had fewer than 15 workers. Monthly revenue from all products was obtained from nine respondents, including assumed values (see notes for Table 6.5): the revenues were less than ¢50 million (US$5,435) for the majority of respondents. The number of products produced by the company also varied across the respondents; the majority produced more than 10 products.

Among the nine respondents[10] who produced Weanimix or quasi-Weanimix[11], six used soybeans rather than cowpeas as an ingredient in their Weanimix; only one used cowpeas rather than soybeans; one used either cowpeas or soybeans, depending on the availability at the owned farm and was using soybeans when the interview was conducted; and one used both cowpeas and soybeans. The majority of the respondents had produced Weanimix for fewer than five years. There was variation across the respondents in the share of Weanimix in the total revenue.

The major sources of raw materials were vendors in the market for five respondents, wholesalers for one respondent, owned farm for one respondent, and middlemen or suppliers for three respondents.

[10] Among the 10 respondents, 1 did not produce Weanimix/quasi-Weanimix but produced Tom Brown.

[11] In this study, quasi-Weanimix refers to a product that (1) is composed of three roasted ingredients of standard Weanimix—maize, either cowpeas or soybeans, and groundnuts—but the share of each ingredient is very different from that of standard Weanimix (i.e., 7.5 or 8 : 1.5 or 1 : 1) or (2) contains roasted ingredient(s) in addition to the three standard ingredients. Hereafter, when it is unnecessary to distinguish between these different formulations, the term Weanimix is used to refer to both Weanimix and quasi-Weanimix.

6.2.3.2 Tom Brown and Weanimix

Among the nine respondents who produced Weanimix, four also produced Tom Brown, while the remaining five did not. The majority of Weanimixes produced by the respondents, as well as other local processors who were not interviewed but identified during the fieldwork, were actually named Tom Brown. Most of the few respondents who "correctly" named their product Weanimix also produced Tom Brown, and perhaps needed to use the term Weanimix to differentiate the product from Tom Brown.

The reason the respondents called their product Tom Brown, rather than Weanimix, was not asked during the interview. A hypothesis is that Weanimix was not well known among consumers—which was the case with weaning mother respondents, and therefore the products sold better by being marketed under the name of well-known Tom Brown. However, a disadvantage of this naming practice is that their Weanimix, which was more nutritious and more costly to produce, was recognized by consumers as the same product as Tom Brown, unless they carefully read the label and found the difference in ingredients.

Among the four respondents who produced both Weanimix and Tom Brown, one stated that if the price of Weanimix was higher than Tom Brown, people would not buy it. So, this respondent actually set the price of Weanimix the same as Tom Brown, while three other respondents set the price of Weanimix 1.2 to 1.9 times the price of their Tom Brown.

Respondents' Weanimix and quasi-Weanimix, whether they called it Weanimix or Tom Brown, were mostly composed of the same ingredients as standard Weanimix. However, the share of each ingredient varied across the respondents' formulations. The only ingredient other than the standard three was millet used by two respondents. Among the nine Weanimixes/quasi-Weanimixes produced by the respondents, six had a higher share of cowpeas and/or soybeans than the standard share of 10-15% (used in the original formula for Weanimix), two had the standard share, and one had a lower share. In terms of groundnuts, four had a higher share than the standard share of 10%, while five had a lower share.

6.2.3.3 Processing procedure and equipment use

There were no major differences between the model processing procedure to prepare Weanimix (see Figure 2.3) and the processing procedures that the respondents used to make their Weanimix. The only difference worth noting is that some respondents stated that they sieved their product. To analyze the cost of producing the same quality of Weanimix across the respondents, in the budgeting analysis reported in the next chapter, all the respondents were assumed to use a sieve, and the purchase price of a sieve was added to the cost of equipment.

Major equipment needed to produce and sell Weanimix on a commercial basis are: (1) a roaster (or other equipment that can serve as a roaster, such as oven); (2) a mill; and (3) a packaging machine. However, a processor would not necessarily have to own a roaster or mill because custom roasters and custom millers were available. Also, a roaster could be just a roasting pan (see Figure 6.4). Therefore, the capital seemed to be a minimal constraint to enter the business of producing and selling Weanimix. The equipment ownership among the respondents is shown in Table 6.6.

Figure 6.4 Roasting pans

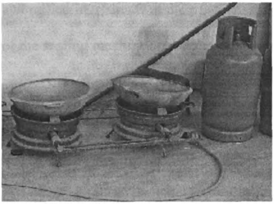
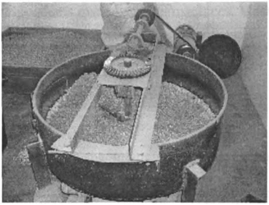


Figure 6.5 Roaster



Source: Author

Table 6.6 Equipment for producing Weanimix and possession by the respondents

Equipment inventory		weaning food processor (n = 10)
Own equipment and roast ingredients at the facility	No	2
	Yes	8
Own a mill	No	4
	Yes	6
Own a sealing machine	No	0
	Yes	10

Source: Field survey in Accra, February and March 2007.

Two respondents custom-roasted ingredients, while eight respondents roasted ingredients at their facility using equipment such as roasting pan, roaster, or gas oven. The type of roaster shown in Figure 6.5 was fueled by gas for heat and electricity for the motor (to stir), and was the most expensive equipment among those three types: about ¢11 million (US$1,196) in 2007 cedis (mean of 3 observations, with a standard deviation of ¢1.5 million). The cost of a gas oven, the second most expensive piece of equipment, varied widely across the respondents, ranging from about ¢1.4 million (US$153) to about ¢7.1 million (US$768) (sample size of 3). A roasting pan, the cheapest piece of equipment, cost about ¢90,000 (US$10) per pan.

Four respondents custom-milled ingredients, while six respondents owned a mill and milled ingredients at their facility. All the respondents owned sealing machines. Most of the sealing machines observed during the interview were hand sealers.

6.2.3.4 Demand for Weanimix and its shelf life

For most respondents, retailers were the only or the major customer of their Weanimix. None of them mentioned selling their products to hospitals or schools. For one respondent, export was the major outlet.

No respondent produced the same amount of Weanimix throughout the year. Rather, the majority changed the amount produced depending on the demand. The majority of the respondents sold their Weanimix at the same price throughout the year. One respondent reported increasing the price when it was impossible to keep it constant, taking different factors into consideration such as changes in raw material and labor costs.

Among the five respondents who had been in business for more than three years and had regularly sold Weanimix mainly to domestic customers, four mentioned that their production of Weanimix increased over the past three years. Among these processors, three (1 processor of cowpea-Weanimix [named Tom Brown] and 2 processors of soybean-Weanimix [both named Weanimix]) mentioned they increased production because customers became more aware of or patronized their product, while another soybean-Weanimix processor attributed the production increase to his business expansion in general. Another respondent stated that the amount of production fluctuated over the past three years.

Among the nine respondents who produced Weanimix, eight stored their product at their facility. The maximum storage time ranged from 6 to 36 months[12]. Based on this information, it was assumed in the sensitivity analysis that the respondents could produce Weanimix when the price of raw materials was the lowest during the year and sell outputs for up to one year, avoiding the price fluctuation of inputs.

6.2.3.5 Cowpeas versus soybeans as an ingredient in weaning foods

While the respondent who produced cowpea-Weanimix had never used soybeans as an ingredient in weaning foods, this respondent had no special reason for using cowpeas rather than soybeans.

Among the seven respondents who produced soybean-Weanimix and the one respondent who produced Tom Brown and another kind of weaning food, five had never used cowpeas as an ingredient in their weaning foods. Of these five processors, three mentioned that soybeans were more nutritious; one mentioned that she might try cowpeas later but was used to using soybeans; and the other one mentioned that cowpeas would cause gas in the stomach and therefore would not be good for weaning foods. Another respondent used to produce a maize-based weaning food containing both cowpeas and soybeans as ingredients, but dropped cowpeas and added groundnuts. The reason given for staying with soybeans was that the respondent heard that people were getting to know about soybeans. Another respondent used to produce cowpea-Weanimix, but switched to soybean-Weanimix because cowpeas became too expensive. As mentioned earlier, one respondent used either cowpeas or soybeans, depending on the availability at his own farm.

[12] It was not clear whether the respondents answered the actual storage time or shelf life of their product. The latter can be longer than the former.

One respondent preferred the taste of soybeans over that of cowpeas, and another respondent mentioned that soybeans had a nice aroma. Easier storage of soybeans compared to cowpeas, which easily gets weevil infestation, was mentioned by one respondent as an advantage of soybeans. As for the advantage of cowpeas, two respondents mentioned that cowpeas were nutritious, and another respondent mentioned that cowpeas were better known than soybeans. However, one respondent mentioned that the difficulty of obtaining a constant supply of some varieties of cowpeas as a constraint to using cowpeas as an ingredient in weaning foods. Another respondent was concerned that some people might not like the taste of weaning foods containing cowpeas[13].

An unexpected result was that only one respondent mentioned the higher price of cowpeas, compared to the price of soybeans, as a constraint to using cowpeas.

6.2.4 Cost of Custom Milling

The information on the charge for custom-milling roasted maize (to prepare Tom Brown) and a mixture of roasted maize, cowpeas/soybeans, and groundnuts (to prepare Weanimix) was collected from the 15 custom miller respondents, 7 retailer respondents who self-prepared Tom Brown, and 4 weaning food processor respondents.

Among the custom miller respondents, groundnuts were an unpopular crop to mill because, according to them, it is tedious to clean the machine after milling groundnuts.

[13] There was also one respondent who mentioned as a disadvantage of cowpeas, that cowpeas had to be dehulled because people did not like to have black-eyes in foods, which would add an extra step in the processing procedures. However, this respondent had never used cowpeas as an ingredient in weaning foods, and this statement might not reflect reality. Among the respondents who had experience using both cowpeas and soybeans as an ingredient in their Weanimix, one mentioned that black-eyes were removed while sieving (all the respondents who stated they sieved their Weanimix were processors of soybean-Weanimix. Therefore, it would not be a task only for cowpea-Weanimix), and another respondent said that there was no difference between the processing procedures for cowpea- and soybean-Weanimix. Therefore, in this study, the processing procedures for cowpea- and soybean-Weanimix were assumed to be identical, and no difference in the cost of production associated with processing procedures was considered.

However, most custom miller respondents answered that they would charge the same price for milling roasted maize and a mixture of roasted maize, cowpeas/soybeans, and groundnuts, as long as the mixture was maize-based[14]. Also, all the respondents indicated that the charge would not change whether cowpeas or soybeans were added to the maize. These answers imply that there is little or no difference in the labor needed to mill the grains for preparing Tom Brown, cowpea-Weanimix, and soybean-Weanimix.

A representative charge for custom-milling to prepare Tom Brown/Weanimix was derived from a total of eight retailer and weaning food processor respondents who custom-milled the ingredients in bulk (i.e., mill 10 olonka or more at once). The charge was ¢1,857 per olonka of raw materials (with a standard deviation of ¢764). This derived value was used in the budgeting analysis to estimate the cost of custom-milling that grain/flour-type product vendors paid to self-prepare Tom Brown/Weanimix.

*6.2.5 **Retailers***

6.2.5.1 Retail margins

To estimate representative retail prices of industrially-processed Tom Brown, cowpea-Weanimix, and soybean-Weanimix, the mean retail margin of 29% for small shops (potential outlets, as opposed to the current outlet, which is supermarkets), which was derived in Section 4.2.4, was used as the representative retail margin in the budgeting analysis[15].

Although industrially produced Tom Brown and Weanimix are subject to the

[14] Since it was expected that not all custom millers had previously milled a mixture of roasted maize, cowpeas/soybeans, and groundnuts, the question was asked "How much would you charge if a customer brings a mixture of...?"
[15] Since industrially-processed Tom Brown and Weanimix are subject to the VAT/NHIS (see discussion in Section 4.2.4), the representative margin used included the VAT/NHIS.

VAT/NHIS, some processor respondents did not collect the VAT/NHIS, and as mentioned in Appendix 6, it was not clear whether small shops collected the VAT/NHIS. Therefore, in the sensitivity analysis, three different ranges in retail margins were assumed, based on the data reported in Tables 4.12 and 4.13: (1) small shops without VAT/NHIS: 3%-31%; (2) small shops with VAT/NHIS: 19%-50%; and (3) supermarkets with VAT/NHIS: 38%-57%.

6.2.5.2 Grain/flour-type product vendors as processors of Tom Brown/Weanimix

Interviews were conducted with seven grain/flour-type product vendors who self-prepared Tom Brown and sold it in the market. One of them also self-prepared soybean-Weanimix. Only two of them bought maize from markets in Accra, while the remaining five bought maize from different regions. Among these five respondents, two bought maize from farmers, while another two from wholesalers (information is missing for 1 respondent). There were two respondents who custom-roasted maize, while the other five roasted maize by themselves using their own pan(s).

Among the seven respondents, four changed the selling price of Tom Brown depending on the season of the year, while three did not change the price (for the range in price change, see Table 6.1). However, as discussed in Section 4.2.5.3, the actual amount of commodities sold as "1 olonka" can vary because of the vendors' subjective measuring practices. Therefore, unit prices of Tom Brown might actually fluctuate more than reported in Table 6.1.

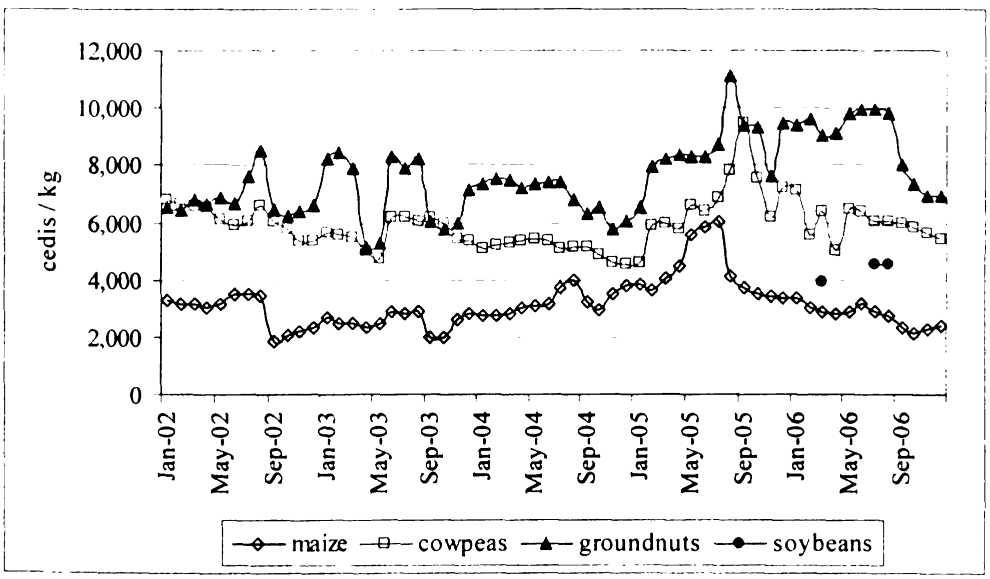
Although many respondents mentioned that their customers could be anybody, their main customers seemed to be weaning mothers and students.

6.2.6 *Representative Prices of Maize, Cowpeas, Groundnuts, and Soybeans*

As was done for cowpeas in Chapter 4, representative prices of maize, groundnuts, and soybeans to be used in the budgeting and sensitivity analyses were derived from the secondary data.

To obtain a general picture of the differences in prices of these crops, historical wholesale real prices (base month = Feb. 2007) of maize, cowpeas, and groundnuts at urban markets of the Greater Accra Region, obtained from the MoFA, were plotted in Figure 6.6, along with prices of soybeans reported by a wholesaler in Nima market (as mentioned in Section 3.3, the MoFA does not collect soybean prices).

Figure 6.6 Real maize, cowpea, and groundnut monthly wholesale prices at urban markets of the Greater Accra Region, Ghana (average of Accra, Ga, & Tema Districts) (2002-2006) and prices of soybeans reported by a wholesaler in Nima market (inflation adjusted)



Note: base month = Feb. 2007.
Source: (maize, cowpeas, groundnuts) SRID, MoFA; (soybeans) a wholesaler in Nima market; (CPI) IMF.

As shown in Figure 6.6, the prices of maize, cowpeas, and groundnuts have followed a similar trend during the last five years[16]. Maize has always been cheaper than cowpeas, and groundnuts were almost always more expensive than cowpeas. The soybean prices plotted in the figure were derived from the soybean prices recalled by a wholesaler in the Nima market. The lowest adjusted price[17] was ¢3,889 per kg, and the highest price was ¢4,548 per kg. Assuming that the price of soybeans fluctuated within this range during recent years, soybeans have been a cheaper ingredient in Weanimix than cowpeas.

To obtain representative prices of maize and groundnuts in February 2007, data sets were collected from Tradenet (http://www.tradenet.biz). For both maize and groundnuts, the price series in Makola market (Accra Metropolis) and Tema (Tema Municipal) were very close to the price series of the MoFA until December 2006 (when the MoFA data ended). Therefore, it was decided to use the mean price in the Makola market and Tema in February 2007 as representative prices. The mean price of maize was ¢3,000 per kg, while the mean price of groundnuts was ¢7,650 per kg.

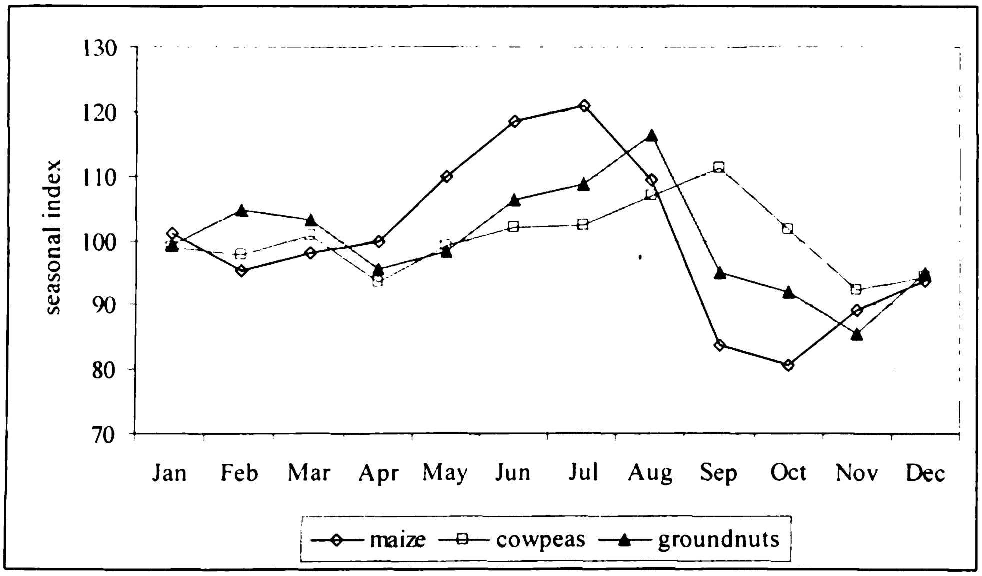
The representative price of cowpeas that was derived for the analysis of dry cowpea meal (¢5,474 per kg; see Section 4.2.5.2) was also used in the analysis of Weanimix.

Since no data on prices of soybeans could be obtained from either the MoFA or Tradenet, the representative price in February 2007 was approximated by the mean of the four wholesale prices observed by the author at the Nima market in March 2007. The derived price was ¢4,069 per kg (with a standard deviation of ¢298).

[16] The price of cowpeas in Figure 6.6 is the same as reported in Figure 4.7.
[17] The prices provided by the wholesaler were converted to real prices per kg (base month = Feb. 2007), using the olonka-kg conversion rate for soybeans (see Appendix 2) and the CPI.

Then, the seasonal fluctuation in the prices of maize and groundnuts was examined to derive the lowest and highest representative price estimates during the year 2007. As done in Chapter 4, seasonal indices were constructed for maize and groundnuts, using the data presented in Figure 6.6. The result is shown in Figure 6.7.

Figure 6.7 Seasonal index of maize, cowpea, and groundnut wholesale prices at urban markets of the Greater Accra Region, Ghana (average of Accra, Ga, & Tema Districts) (2002-2006)



Note: the indices for cowpeas are the same as reported in Figure 4.8.
Source: (for the price series) SRID, MoFA; (for the CPI) IMF.

Figure 6.7 shows that among the three crops, maize has had the widest price fluctuation over the last five years, followed by groundnuts. Cowpea prices have been the most stable. Using the lowest and highest seasonal index, the seasonal index for February, and the representative prices derived above for maize and groundnuts, the lowest and highest representative prices for these two crops were estimated. The lowest price of maize was ¢2,541 per kg; the highest price of maize was ¢3,809 per kg; the lowest price of groundnuts was ¢6,240 per kg; and the highest price of groundnuts was ¢8,486 per kg.

To summarize, the representative prices of maize, cowpeas, groundnuts, and soybeans are presented in Table 6.7.

Table 6.7 Representative maize, cowpea, groundnut, and soybean prices paid by processor respondents in February 2007 and estimated range in price fluctuation during the year

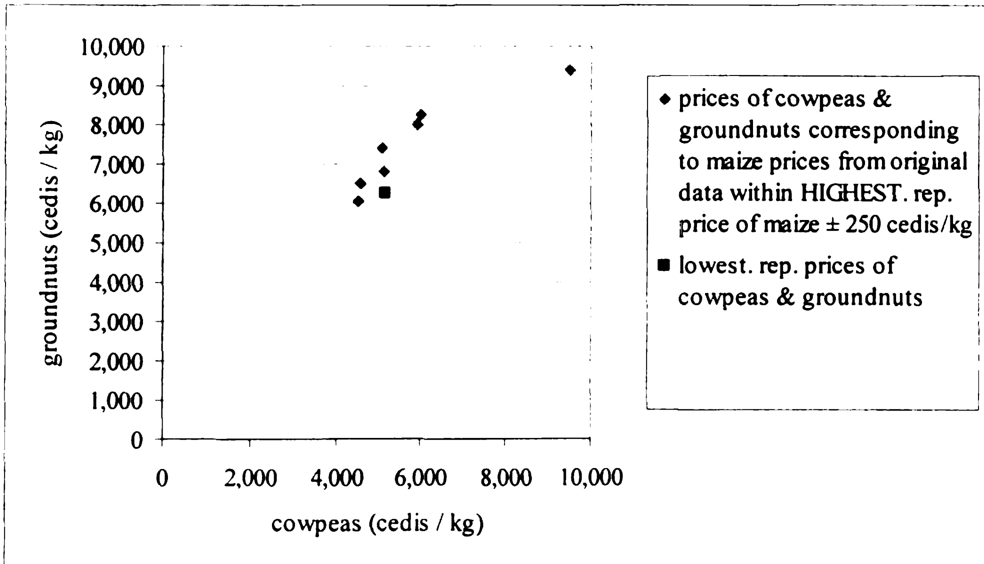
Crop	Lowest (¢ / kg)	February (¢ / kg)	Highest (¢ / kg)
Maize	2,541	3,000	3,809
Cowpeas	5,155	5,474	6,221
Groundnuts	6,240	7,650	8,486
Soybeans	3,889	4,069	4,548

Source: Calculated by the author based on the data collected from: (maize and groundnuts) Tradenet (http://www.tradenet.biz) and SRID, MoFA; (cowpeas) Table 4.14; (soybeans) wholesalers in Nima market.

In the sensitivity analysis, the effects of changes in the price of raw materials on the price-competitiveness of cowpea-Weanimix will be examined. As will be shown later, cowpea-Weanimix becomes more competitive with Tom Brown as the price of maize increases and the prices of cowpeas and groundnuts decrease. However, the combination of the above-derived highest representative price of maize and the lowest representative prices of cowpeas and groundnuts could be an unrealistic assumption. As shown in Figure 6.7, the prices of maize, cowpeas, and groundnuts have followed a similar seasonal trend, although the peak month seemed to slightly differ across the crops. This implies that when the price of maize is high, the prices of cowpeas and groundnuts are also expected to be high, rather than low.

Whether the combination of the highest representative price of maize and the lowest representative price of cowpeas and groundnuts is reasonable was examined as follows: (1) from the MoFA data, the maize prices that fell within the lowest representative price of maize ± ¢250 per kg were selected; (2) the relationship between the price of cowpeas and groundnuts in the same month from when the prices of maize were selected was plotted in a graph; and (3) the relationship between the lowest representative price of cowpeas and groundnuts was plotted in the same graph. If the assumption was unrealistic, the combination of the lowest representative price of cowpeas and groundnuts has to be found as an outlier in the graph. The result is shown in Figure 6.8.

Figure 6.8 Relationship between the high price of maize and the prices of cowpeas and groundnuts in the same month

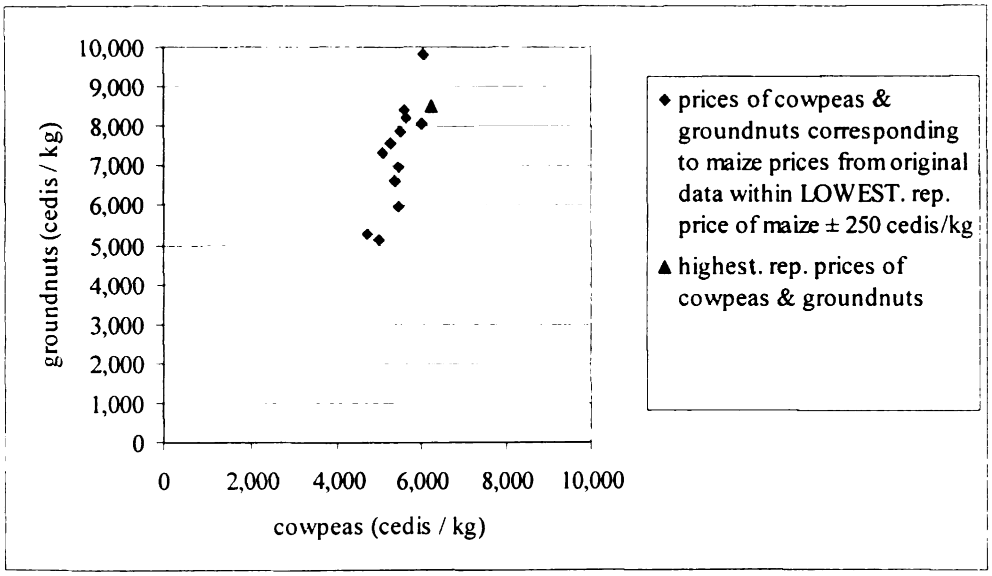


Source: Derived by the author based on the data collected from: (for the price series) Tradenet (http://www.tradenet.biz) and SRID, MoFA. ; (for the CPI) IMF.

The position of the combination of the lowest representative price of cowpeas and groundnuts in Figure 6.8, relative to the other points, suggests that the assumption is viable.

In the same way, the viability of using the combination of the lowest representative price of maize and the highest representative price of cowpeas and groundnuts was examined as the most unfavorable price sets for cowpea-Weanimix. The result is shown in Figure 6.9.

Figure 6.9 Relationship between the low price of maize and the prices of cowpeas and groundnuts in the same month



Source: Derived by the author based on the data collected from: (for the price series) Tradenet (http://www.tradenet.biz) and SRID, MoFA. ; (for the CPI) IMF.

Again, the position of the combination of the highest representative price of cowpeas and groundnuts in Figure 6.9, relative to the other points, suggests that the assumption is viable.

Based on these results, the sensitivity analysis (with respect to the price change in raw materials) was conducted using the combination of the representative price of maize, cowpeas, and groundnuts as described above.

6.3 Summary

A wide difference was found among the prices of existing weaning foods available in Accra. Industrially produced Weanimix/quasi-Weanimix were mainly sold at supermarkets and therefore seemed to target high-income families.

All the 10 processor respondents interviewed managed small- to medium-scale local companies, most of which had fewer than 15 workers (including family members). The majority of these companies produced more than 10 different products, and had produced Weanimix/quasi-Weanimix for fewer than five years. The share of Weanimix in total revenue varied across the respondents. Demand for Weanimix was not constant throughout the year. For most respondents, retailers were the only or major customers for their Weanimix.

These companies' Weanimixes were mostly composed of the same ingredients as standard Weanimix (i.e., maize, cowpeas/soybeans, and groundnuts). However, the shares of each ingredient differed across the respondents. Many of these products were actually named Tom Brown. While the processor respondents indicated that consumers' awareness and the demand for Weanimix had increased in recent years, answers from weaning mother respondents suggested that the term Weanimix was not yet widely known among consumers.

Among the processor respondents, soybeans were more popular than cowpeas as an ingredient in industrially-processed weaning foods. The advantages of soybeans mentioned included higher nutritional value, better taste, lower price, and easier storage of grain. However, the lower price of soybeans did not seem to be the major reason for most of the respondents to choose soybeans over cowpeas.

With regard to processing procedures, there were few differences between the procedures used by the respondents to make Weanimix and the model procedure (presented in Section 2.2.2). Most of the 15 custom miller respondents answered that they would charge customers the same price for milling roasted maize and a mixture of roasted maize, cowpeas/soybeans, and groundnuts, as long as the mixture was maize-based. Their answers imply that there is little or no difference in the labor needed to mill the grains for preparing Tom Brown, cowpea-Weanimix, and soybean-Weanimix.

Of the seven grain/flour-type product vendors who self-prepared Tom Brown, two custom-roasted maize, while the other five roasted maize by themselves using their own pan(s). The main customers for their Tom Brown seemed to be weaning mothers and students.

Of the 30 weaning mother respondents, all of the 23 who were asked about their self-prepared weaning foods could afford to use fish as an ingredient; and 23 out of the 26 respondents who were asked about their purchased weaning foods could afford to buy Cerelac. These facts indicated that our sample of weaning mothers did not include weaning mothers from low-income families whose children were malnourished and therefore would benefit most from Weanimix.

Also, this chapter discussed how representative prices of maize, cowpeas, soybeans, and groundnuts were derived from prices observed during the fieldwork and secondary data.

CHAPTER 7

WEANIMIX—BUDGETING AND SENSITIVITY ANALYSIS

7.1 Budgeting Analysis—Model

A model similar to the one used to construct the budgets for industrially-processed dry cowpea meal (in Chapter 5) was used in this chapter to estimate retail prices of Tom Brown, cowpea-Weanimix, and soybean-Weanimix. The prices were estimated for each of these weaning foods that are: (1) produced by industrial processors and sold at small shops (potential outlets, as opposed to the current outlet of supermarkets); and (2) self-prepared and sold by grain/flour-type product vendors in the market. During the fieldwork, no grain/flour-type product vendors were found selling cowpea-Weanimix and only one vendor was selling soybean-Weanimix. Therefore, Weanimix self-prepared by grain/flour-type product vendors is considered to be a potential new product.

7.1.1 Estimated Prices of Industrially-Processed Tom Brown and Weanimix

Processor prices of industrially-processed Tom Brown, cowpea-Weanimix, and soybean-Weanimix were estimated for each processor respondent using the following equation:

$$P_{jt}^{z} = \frac{\Pi_{jt}^{y}}{Q_{jt}^{y}} + \frac{C_{jt}^{z}}{Q_{jt}^{y}} \tag{15}$$

where,

P = price per kg,
z = target weaning food
(Tom Brown, cowpea-Weanimix, and soybean-Weanimix)
j = weaning food processor, t = time period, Π = return,
y = currently produced weaning food product
(Tom Brown or cowpea- or soybean-Weanimix/quasi-Weanimix)
Q = quantity in kg, C = total cost payment

As described in Section 3.6.2, a budget for each respondent was first constructed for the weaning food product that the respondent currently produced. When respondents produced different weaning foods, the same product or one closest in characteristics to our target weaning foods was selected (denoted as "y" in equation [15]). Then, holding the returns to the processor and quantity of production constant, processor prices of our target weaning foods were estimated by replacing the cost of production of the selected currently-produced weaning food with the estimated cost of production of each of our target weaning foods (i.e., Tom Brown, cowpea-Weanimix, and soybean-Weanimix; denoted as "z" in equation [15]).

The cost of production was calculated in the same way as the cost of production of dry cowpea meal was calculated, using the following equation:

$$C_{jt}^{z} = \sum_{a} P_{ajt} M_{ajt}^{z} + \delta_{jt}^{z} \sum_{w} W_{wjt} + \sum_{e} \gamma_{ejt}^{z} E_{ejt} + \sum_{n} \lambda_{njt}^{z} X_{njt} \tag{16}$$

where,

a = type of raw material
(maize, cowpeas, soybeans, and groundnuts)
M = raw material in kg, δ = share in wage, W = wage per worker,
w = worker, e = piece of equipment, γ = share in equipment use,
E = equipment payment,
n = other cost component
(electricity, fuel [excluding fuel for vehicle], water, rent, transportation [including fuel for vehicle], printing and stationery, telecommunication, packaging material, and miscellaneous)
λ = share in other cost component, X = other cost payment

The shares of the target weaning food in different cost variables were approximated in the same way as the shares of dry cowpea meal were calculated in Chapter 5. In making these calculations, the following shares of raw materials were used for Weanimix: maize 75%, cowpeas/soybeans 15%, and groundnuts 10%. Also, due to the lack of information, the waste rate during processing (in terms of weight) was assumed to be the same across maize, cowpeas, soybeans, and groundnuts. In other words, input-output ratio was assumed to be the same across these four raw materials.

Finally, retail prices were estimated by adding representative retail margins reported in Section 6.2.5.1 to the estimated processor price of each of the target weaning foods.

7.1.2 Estimated Prices of Self-Prepared Tom Brown and Weanimix

Compared to industrial processors, grain/flour-type product vendors most likely pay for a smaller number of cost components to produce Tom Brown or Weanimix. Their major cost components would be: (1) raw materials; (2) fuel for roasting; and (3) charge for custom milling. Returns to the vendors are equal to the difference between the selling price and the sum of these costs, and include the returns to: (1) their labor; (2) investment in buying roasting pans, which were most likely a small amount (see Section 6.2.3.3); (3) transportation, if they carried the product from the place of production to the market; (4) polyethylene bags to contain the product; and (5) the pro-rata share of the product in the membership fee required to do business in the market, if they pay such a fee.

Since data on the quantity of Tom Brown produced were not collected from the vendor respondents [1], budgets for producing Tom Brown were constructed using representative values for each cost variable, as follows:

(1) cost of maize grain to produce 1 kg of output was estimated by dividing the representative price per kg of maize (derived in Section 6.2.6) by the representative input-output ratio (mean of input-output ratios obtained from two industrial processor respondents);

(2) cost of fuel for roasting maize to produce 1 kg of output was estimated by dividing the average payment for fuel for roasting 1 kg of maize (calculated using data reported by five grain/flour-type product vendor respondents who roasted maize by themselves) by the representative input-output ratio; and

(3) cost of custom milling to produce 1 kg of output was estimated by dividing the representative charge for custom-milling 1 kg of maize[2] by the representative input-output ratio.

[1] Although it was found during the pre-testing of the questionnaire that grain/flour-type product vendors self-prepared Tom Brown, it would have been too time-consuming to ask them both the original questions designed for them (as sellers of the product) and a similar set of questions asked to industrial processor respondents (as processors of the product). Therefore, as processors of Tom Brown, grain/flour-type product vendors were only asked about the costs of raw material (i.e., maize), roasting, and milling.

[2] Calculated using the representative charge for custom-milling 1 olonka of maize (derived in Section 6.2.4) and representative olonka-kg conversion rate of maize (see Appendix 2).

The representative return was calculated by subtracting the sum of these costs from the mean price (per kg) of Tom Brown reported by the vendor respondents.

Finally, representative prices of cowpea- and soybean-Weanimix were estimated by replacing the cost of maize in the budget for producing Tom Brown with the cost of maize, cowpeas/soybeans, and groundnuts[3], holding the values of other variables (i.e., cost of fuel, custom milling, and returns) constant.

7.2 Budgeting Analysis—Results

7.2.1 Processor Price Estimates of Tom Brown, Cowpea-Weanimix, and Soybean-Weanimix

Derived budgets for industrially producing 1 kg of Tom Brown, cowpea-Weanimix, and soybean-Weanimix and estimated processor prices of these products are summarized in Table 7.1. Note that not all of the 10 respondents could provide enough information to estimate their payment for every cost component. As a result, the number of observations for each cost component varied from two to eight.

There were only two respondents for whom the cost of raw materials could be calculated. This is because the other respondents could not recall the information required to estimate input-output ratio or the information that they provided was apparently erroneous[4]. Raw materials were a major cost component for all three products, with a mean of ¢3,876 per kg of Tom Brown, ¢4,956 per kg of cowpea-Weanimix, and ¢4,683 per kg of soybean-Weanimix. Note that the prices of raw materials were not collected

[3] Cost of maize, cowpeas/soybeans, and groundnuts to produce 1 kg of Weanimix were estimated by {0.75 × [representative price per kg of maize] + 0.15 × [representative price per kg of cowpeas/soybeans] + 0.10 × [representative price per kg of groundnuts]} divided by [representative input-output ratio].

[4] Several respondents reported the weight of output that was higher than the weight of inputs. This does not make sense because there should be waste during the processing. Inputs other than the main ingredients, such as spices, were not included in the calculation. However, such ingredients would not have contributed much to the weight of the output.

Table 7.1 Budgets by cost component for industrially produced 1 kg of Tom Brown, cowpea-Weanimix, and soybean-Weanimix

		Number of observations	Min. (¢)	Mean* (¢)	Max. (¢)	Standard deviation (¢)
Processor price	TB	5	10,878	14,295	16,332	2,631
	c-WM	5	11,957	15,375	17,436	2,632
	s-WM	5	11,685	15,102	17,158	2,631
Raw material	TB	2	3,789	3,876	3,962	123
	c-WM	2	4,845	4,956	5,067	157
	s-WM	2	4,578	4,683	4,788	149
Wage		6	0	2,644	6,044	2,273
Equipment		5	84	637	1,338	457
Electricity		7	0	73	491	176
Fuel (excl. fuel for vehicle)		5	514	736	1,080	261
Water		8	0	25	78	35
Rent		8	0	13	413	145
Transportation (incl. fuel for vehicle)		3	712	2,599	3,739	1,646
Printing & Stationery		6	487	1,706	3,889	1,413
Telecommunication		4	144	383	855	321
Packaging material		7	367	767	4,737	1,535
Miscellaneous		5	135	438	1,036	362
Total cost	TB	5	10,411	14,645	19,656	4,031
	c-WM	5	11,491	15,724	20,761	4,045
	s-WM	5	11,219	15,452	20,482	4,041
Return		5	-4,461	-350	5,522	3,907

* Mean values were calculated excluding outliers (defined as values outside of the mean of all observations ± 2 standard deviations). The maximum value of the following cost variables were found to be outliers, and therefore excluded from the mean calculation: electricity, rent, and packaging materials.

Notes: TB: Tom Brown; c-WM: cowpea-Weanimix; s-WM: soybean-Weanimix; the sum of cost components in each column does not equal the total cost in the same column because the figures for each cost component, as well as total cost in the table, were based on data obtained from a different number of respondents.

Source: Fieldwork in Accra, February and March 2007.

from each respondent, but the representative prices (derived in Section 6.2.6) were used across the respondents.

Wage was a cost component whose value varied widely across the respondents, ranging from ¢0 to ¢6,044 per kg of output, with a mean of ¢2,644 per kg. The respondent who reported zero wage was the smallest processor who did not have any employees.

Transportation cost also varied across the respondents, ranging from ¢712 to ¢3,739 per kg of output. In fact, there were respondents who reported zero transportation costs. These respondents had intermediaries who came to their facility to sell raw materials and to buy outputs. Since we did not have an opportunity to interview intermediaries, for those respondents paying zero transportation costs, the mean value for transportation cost (¢2,599) was added to their processor price, so that the estimated processor prices became prices at the outlet level across the respondents.

The importance of printing and stationery also varied across the respondents, ranging from ¢487 to ¢3,889 per kg of output, with a mean of ¢1,706 per kg.

Finally, packaging material costs also varied across the respondents, ranging from ¢367 to ¢4,737 per kg of output. However, the maximum payment of ¢4,737 was an outlier. The respondent used both a polyethylene bag and paper box to package the product, while many other respondents used only a polyethylene bag. The mean cost of packaging material (excluding this outlier) was ¢767 per kg.

Equipment, electricity, fuel for processing, water, rent, telecommunication, and miscellaneous costs were minor cost components.

Due to missing information, the total cost of production could be estimated for only 5 of the 10 respondents. Because of the wide variation in the payment for each cost component across the respondents, total cost also varied widely, ranging from ¢10,411 to ¢19,656 per kg of Tom Brown, ¢11,491 to ¢20,761 per kg of cowpea-Weanimix, and ¢11,219 to ¢20,482 per kg of soybean-Weanimix. Since it was expected that raw material cost would be the only cost component that would change depending on the choice of output (i.e., Tom Brown, cowpea-Weanimix, or soybean-Weanimix), the difference in total cost was due to differences in raw material costs. The results indicate that 1 kg of cowpea-Weanimix would be about ¢1,100 more expensive to produce than Tom Brown and ¢300 more expensive to produce than soybean-Weanimix.

Returns ranged from ¢-4,461 to ¢5,522 per kg of output. As explained in Section 7.1.1, these are estimated returns to the processors for their current products, which are similar to or the same as our target products. Therefore, the result indicates that some of the respondents earned negative returns for their currently-produced weaning foods—two of the five respondents had negative returns. There could be at least three potential explanations for this outcome: (1) the respondents were actually losing money by producing those weaning foods, but the returns of other products were large enough to cover the loss. The respondents either continued producing those weaning foods without noticing that the products were not profitable, or knew that the products were not profitable but did not stop production for some reasons (for example, those non-profitable weaning foods might be a "loss-leader," promoting customers to buy other more profitable products of the company); (2) the respondents were actually earning positive returns. However, the approximated shares of those weaning foods in each cost component in the budget calculation were not close enough to the real values, which led to inaccurate results; and (3) due to seasonal variations in costs, the respondents were losing money during the month for which the data were collected, but the respondents earned positive returns in other months. Since the analysis of this study was conducted using monthly data (collected for only one month of the year, rather than a series), it could not capture the seasonal variations in costs.

Processor prices were estimated to be ¢10,878 to ¢16,332 per kg of Tom Brown, ¢11,957 to ¢17,436 per kg of cowpea-Weanimix, and ¢11,685 to ¢17,158 per kg of soybean-Weanimix. From the structure of the model used (i.e., assumption of fixed returns, rather than returns based on a relative [percentage] processing margin to the cost of production), the difference in estimated processor prices among the three products equals the difference in total costs among the products. Therefore, the processor price of cowpea-Weanimix was estimated to be about ¢1,100 higher than the processor price of Tom Brown and ¢300 higher than the processor price of soybean-Weanimix.

7.2.2 Representative Budgets and Retail Price Estimates of Tom Brown, Cowpea-Weanimix, and Soybean-Weanimix

Of the 10 industrial processor respondents, 5 could provide information with a relatively few number of missing and apparently erroneous values across the cost components[5]. Using the data obtained from these five respondents, two representative budgets for producing 1 kg of Tom Brown, cowpea-Weanimix, and soybean-Weanimix were constructed as follows: first, two out of the five respondents with the lowest values of returns were selected, and the mean value was calculated for each component of their budgets (this new budget is hereafter called the "low profit representative budget" [LB])[6]. Second, the two respondents with the highest values of returns were selected, and the mean values were calculated in the same way (this budget is hereafter called the "high

[5] Details of the problems encountered analyzing the data collected from these five respondents and the methods used to handle those problems are available from the author upon request. Some of them are reported in the rest of this chapter as well as in Appendix 4.
[6] When there were missing values for one of the two respondents, the value from the other respondent's budget was used in the representative budget.

profit representative budget" [HB])[7].

Assuming that industrially-processed Tom Brown and Weanimix were sold in small shops rather than supermarkets, a retail margin of 29% (VAT/NHIS included) was added to the estimated processor price in the LB and HB. The results are shown in Table 7.2, along with the representative budget for grain/flour-type product vendors to prepare Tom Brown, cowpea-Weanimix, and soybean-Weanimix, which were prepared as described in Section 7.1.2.

The estimated retail prices of weaning foods self-prepared by grain/flour-type product vendors were ¢14,295 per kg of Tom Brown, ¢15,375 per kg of cowpea-Weanimix, and ¢15,103 per kg of soybean-Weanimix. These prices were derived as the sum of raw material costs, cost of custom milling (¢946 per kg of output), fuel for roasting (¢370 per kg of output), and returns to labor and other costs not included elsewhere (¢9,106 per kg of output).

On the other hand, the retail prices of industrially-processed weaning foods sold at small shops were estimated to be ¢17,488 to ¢18,341 per kg of Tom Brown, ¢18,870 to ¢19,753 per kg of cowpea-Weanimix, and ¢18,521 to ¢19,397 per kg of soybean-Weanimix.

[7] One might be skeptical about this method of constructing representative budgets, considering that the value of returns would not be directly related to the level of each cost component. For example, a processor paying a higher total cost than the others can set a very high processor price. Then, if the value of this processor's returns is among the top two, she will be considered as a HB processor. If the other processor selected for the HB pays a lower total cost than the others, could the mean values of each cost component of these two processors be called "representative?" Therefore, to examine the viability of the method used, the values of each cost component were compared across the respondents. The result showed that the values of wage and transportation costs of the two processors selected for the LB were relatively close to each other, compared to the values of these costs of the other three respondents. In the same way, the values of these cost variables of the two processors selected for the HB were relatively close to each other compared to the values of the other three respondents. Therefore, the method used developed two reasonable representative budgets by taking account of the widely varying wage and transportation costs, which were major determinants of the variation among the total budgets.

Table 7.2 Representative budgets to produce 1 kg of Tom Brown, cowpea-Weanimix, and soybean-Weanimix and estimated retail prices

Processor (type of budget)		Grain/flour-type product vendors (¢)	Industrial processors – LB (¢)	Industrial processors – HB (¢)
Retail price	TB	14,295	18,341	17,488
	c-WM	15,375	19,753	18,870
	s-WM	15,103	19,397	18,521
Retail margin (29%)	TB		4,165	3,971
	c-WM		4,486	4,285
	s-WM		4,405	4,206
Processor price	TB		14,176	13,517
	c-WM		15,268	14,585
	s-WM		14,992	14,315
Raw material	TB	3,874	3,918	3,831
	c-WM	4,953	5,010	4,899
	s-WM	4,681	4,735	4,630
Wage		0	4,985	1,281
Equipment*		946	904	402
Electricity		0	347	116
Fuel (excl. fuel for vehicle)		370	772	545
Water		0	25	73
Rent		0	47	206
Transportation (incl. fuel for vehicle)		0	3,542	712
Printing & Stationery		0	2,188	1,815
Telecommunication		0	545	220
Packaging material**		0	368	733
Miscellaneous		0	426	586
Total cost	TB	5,190	18,068	10,522
	c-WM	6,269	19,160	11,590
	s-WM	5,997	18,885	11,321
Return		9,106	-3,892	2,995

Note: LB: low profit representative budget; HB: high profit representative budget; TB: Tom Brown; c-WM: cowpea-Weanimix; s-WM; soybean-Weanimix.

* Equipment cost for grain/flour-type product vendors is the cost of custom milling.

** The cost of packaging material was missing for both of the LB respondents. An assumed value of ¢368 was derived using the data provided by other respondents.

Source: Fieldwork in Accra, February and March 2007.

The difference between the estimated retail prices of industrially-processed cowpea-Weanimix and soybean-Weanimix was only about ¢350 per kg. This result suggests that, with the current difference between prices of cowpea and soybean grains, cowpeas are price-competitive with soybeans as an ingredient in Weanimix. Since ¢350 per kg is a minor difference, the two products could easily be sold at the same price, depending on the pricing practice used by processors and/or retailers. Then, the choice by customers would entirely depend on their preference between cowpeas and soybeans.

The difference between the estimated retail prices of industrially-processed cowpea-Weanimix and Tom Brown was about ¢1,400 per kg[8]—cowpea-Weanimix was estimated to be about 8% more expensive than Tom Brown. Whether a weaning mother would be willing to pay this premium would depend on both her budget for weaning foods and her awareness of the difference in nutritional value of these two products, as well as how much more she would be willing to pay for the difference in nutrients that she is aware of.

The difference between the retail prices of industrially-processed weaning foods and those self-prepared by grain/flour-type product vendors were estimated to be about ¢3,200 to ¢4,400 per kg. In other words, the industrially-processed products were estimated to be about 22% to 28% more expensive than the self-prepared ones. The sources of the difference in these prices are, as shown in Table 7.2, the difference in the cost of production and the retail margin that applied only to industrially-processed weaning foods.

The estimated returns to grain/flour-type product vendors were much higher than the estimated returns to industrial processors. From the data available, it is not clear

[8] This difference is much smaller than the difference observed during the fieldwork between the prices of Tom Brown and Weanimix/quasi-Weanimix sold at supermarkets (about ¢6,900; see Table 6.1). The possible reasons for this discrepancy include: (1) retail margins at supermarkets were generally higher than the retail margins at small shops. Therefore, the difference in retail prices of two products becomes larger at supermarkets than at small shops, if retailers charge proportional margins to the purchase prices, as assumed in this study; (2) many industrial processors used a higher share of fortifier ingredients (i.e., cowpeas/soybeans and groundnuts) in their weaning food products than the standard share (see Section 6.2.3.2). Therefore, the difference in the costs of raw materials between Tom Brown and their Weanimix/quasi-Weanimix was larger than between Tom Brown and standard Weanimix; and (3) industrial processors might set the price of Tom Brown and Weanimix in a way that the price difference is larger than the difference in the cost of production. This would make sense if industrial processors assume that the customers for Weanimix are higher income and willing to pay more for a more nutritionally rich food for their children (i.e., the sellers would be practicing price discrimination based on relative elasticities of demand for closely related products).

whether there are other major cost components that vendors actually paid but were omitted from the budget, or if vendors in fact charged a much higher processing margin than industrial processors.

In terms of product quality, the difference between industrially-processed weaning foods and those self-prepared by grain/flour-type product vendors would likely be negligible, because no major difference in processing procedures was found. The only major difference, other than prices, between these weaning foods would be that the industrially-processed products are sold in a sealed polyethylene bag, with a label displaying the Ghana Standards Board certified logo[9], while the self-prepared products are sold under open-air conditions, without a GSB logo. Because the sealed bag and the label serve as a signal to consumers about cleanliness and consistency/quality of the product, some consumers may prefer to pay more for the industrially-processed weaning foods to get these implicit quality guarantees. Therefore, if a mother who currently buys Tom Brown in the market values a better package with quality certification more than the difference in prices, she is expected to buy industrially-processed weaning foods at small shops.

Masters and Sanogo (2002) studied weaning mothers' willingness-to-pay a premium in a similar setting in Bamako, Mali. Their experiments found that respondents were willing to pay about US$1.75 per kg more (on average) for a sealed-and-authority-certified locally-produced weaning food sample than for an open-bagged-and-non-labeled

[9] Note that not all the weaning foods produced by the respondents were GSB certified. However, the fees for the GSB certification and the Food and Drugs Board's registration were included in miscellaneous costs for all the respondents, whether or not the respondents mentioned these costs during the interview (see Appendix 4). Therefore, the estimated prices of industrially-processed weaning foods derived in this study reflect these costs, and all the products are assumed to be GSB certified and FDB registered. (Note that miscellaneous costs, which included the fees for the GSB certification and the FDB registration, were a minor cost component in the budget [Tables 7.1 and 7.2]. Therefore, the assumption made here did not affect the results of budgeting analysis very much.)

locally-produced weaning food sample. The value of US$1.75 in 1999 (when the experiment seems to have been conducted) is equivalent to about ¢24,000 in February 2007[10]. This value is more than five times the difference in the estimated prices of industrially-processed and self-prepared weaning foods in our budgets (i.e., ¢3,200 to ¢4,400 per kg). While the results of Masters and Sanogo's study are not directly comparable to our study, their findings suggest the need to conduct a similar consumer survey in Ghana. If a similarly high willingness-to-pay for a better package and quality certification is found among Ghanaian mothers, it would indicate that there is a high potential for industrial processors to expand their sales of weaning foods through small shop channels, which they currently do not use extensively.

Table 7.2 also shows that grain/flour-type product vendors could produce Tom Brown, cowpea-Weanimix, and soybean-Weanimix for costs relatively similar to each other. Since vendors prepare a large amount of these products, compared to households, separate roasting of three major ingredients to prepare Weanimix would cause little extra work compared to the preparation of Tom Brown. Therefore, vendors could likely sell these three products at prices similar to each other, as shown in Table 7.2. However, during the fieldwork, almost no vendors could be found who sold either self-prepared cowpea- or soybean-Weanimix. Since no major constraints were found on the supply side, the reason for the lack of Weanimix in the market is suspected to be found on the demand side. A hypothesis is that the majority of weaning mothers who purchase Tom Brown in the market either do not know about Weanimix or cannot tell from its appearance whether

---

[10] The original figure in the Malian currency was FCFA455.24/400g (Masters and Sanogo [2002], Table 2). This value was first converted to the value per kg, and then inflation-adjusted by using the CPI (obtained from the IMF website). Finally, it was converted to cedis by using the average exchange rate between FCFA and cedis in February 2007 (obtained from the website of OANDA at http://www.oanda.com/convert/fxhistory).

the product is truly Weanimix (i.e., fortified Tom Brown), rather than plain Tom Brown. Therefore, they would not pay a higher price for Weanimix, compared to Tom Brown, which discourages vendors to prepare and sell Weanimix.

7.3 Sensitivity Analysis

Sensitivity analyses were conducted for different scenarios that would potentially change the price-competitiveness of industrially-processed cowpea-Weanimix with: (1) industrially-processed soybean-Weanimix; (2) industrially-processed Tom Brown; and (3) cowpea-Weanimix self-prepared by grain/flour-type product vendors. The analyzed scenarios are: (1) change in the technical efficiency of industrial processing; (2) change in the volume of industrial production; (3) change in the price of raw materials (seasonality analysis); (4) change in the retail margin; and (5) a combination of different scenarios.

Throughout these sensitivity analyses, different assumptions were made for processors with HB (i.e., high profit representative budgets) and those with LB (i.e., low profit representative budgets) about their ways to modify the prices of their products. Whenever the cost of production changed, HB processors were assumed to modify the price so the returns remained constant, except for a special assumption made for scenarios (2) and (5). On the other hand, for LB processors, it was assumed that: (1) when the modified total cost is larger than the total cost in the original budget, they increase the price so the value of returns remains unchanged; and (2) when the modified total cost is smaller than the total cost in the original budget, they do not change the price until the returns reach zero, and change the price only when the returns would potentially turn positive, by subtracting the value of potential returns from the price so the returns remains zero. While these assumptions were made to simplify the analysis, assuming constant returns is the equivalent of assuming a perfectly competitive market for the products analyzed. The appropriateness of this assumption is discussed in Section 8.3.

7.3.1 Change in the Technical Efficiency of Industrial Processing

The input-output ratio of HB processors (calculated from the original data) was 0.78, while that of LB processors was 0.77. The first sensitivity analysis was conducted on the effects of a change in the input-output ratio of industrial processing on the estimated retail prices[11].

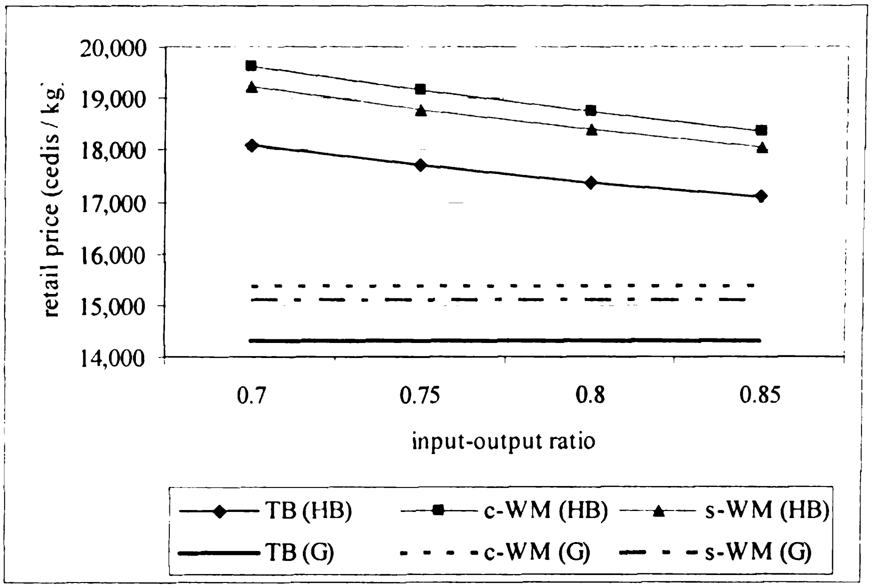
First, the estimated prices of weaning foods produced by LB processors did not decrease because the returns did not reach zero, even with the input-output ratio of 1.00. The relationship between different input-output ratios and the estimated retail prices of weaning foods produced by HB processors are plotted in Figure 7.1. For comparison, Figure 7.1 also plots the estimated retail prices of weaning foods self-prepared by grain/flour-type product vendors, for whom the input-output ratios were assumed not to change.

The difference in the prices between industrially-processed cowpea-Weanimix and industrially-processed Tom Brown or soybean-Weanimix slightly decreased as the input-output ratio improved.

The difference in the prices between industrially-processed and self-prepared cowpea-Weanimix decreased from about ¢3,500 per kg in the original budgets to about ¢3,400 per kg, assuming an input-output ratio of 0.80; and about ¢3,000 per kg,

[11] Note that due to the lack of information, the waste rate (or [1 – input-output ratio]) was assumed to be the same across different raw materials (i.e., maize, cowpeas/soybeans, and groundnuts).

Figure 7.1 Estimated retail prices of industrially-processed (with HB budget) and self-prepared weaning foods for different levels of input-output ratio



Note: TB: Tom Brown; c-WM: cowpea-Weanimix; s-WM: soybean-Weanimix; HB: high profit representative budget; G: grain/flour-type product vendors
Source: Calculated by the author.

assuming an input-output ratio of 0.85. As reported in Section 4.2.6.2, the input-output ratio of dry cowpea meal prepared in the laboratory was 0.847. Assuming that a ratio of similar magnitude is the maximum value for industrially-processed cowpea-Weanimix, it could be concluded that the increase in the technical efficiency of industrial processing would certainly improve the price-competitiveness of the product, but not dramatically.

7.3.2 Change in the Volume of Industrial Production

The second sensitivity analysis was conducted with regard to the change in the volume of production of industrial processors. First, the same method used in Section 5.3.2 was used to estimate how much each of the LB and HB processors could increase their volume of production without requiring an increase in fixed costs[12]. Second, the budget of each respondent was recalculated using the derived multipliers. As done in Section 5.3.2, it was assumed that there is no change in the average variable costs (i.e., assumption of constant returns to scale). Finally, the LB and HB were reconstructed with the same combinations of respondents that were selected to construct the original LB and HB.

To estimate the processor prices for HB, the two alternative assumptions made in Section 5.3.2 were applied. When the unit cost of production declined, HB processors were assumed to modify the selling price of their products: (1) so the per-unit returns remain constant; or (2) so the per-unit returns become one-half of the original value (to make their products more competitive with other companies' products, while increasing their total returns due to the increase in the volume of production). It was assumed that the demand for the products is price-elastic enough for the increased outputs to be sold out, whether the processors kept the same per-unit processing margin (i.e., per-unit returns) or cut it to one-half of the original value (while increasing the total returns). The results are shown in Table 7.3.

As a result of increased production, it was estimated that LB processors could save a total of ¢4,905 per kg of output, due to the decline in fixed costs per unit of output. Under the assumption noted previously about the way that LB processors modify the price of their products, ¢3,892 were deducted to make the returns zero, and the processor

[12] Based on the highest volume of production per worker per hour estimated for one of the HB processors, each LB processor was estimated to be able to produce at least 4.3 and 4.8 times more outputs, while the other HB processor was estimated to be able to produce at least 2.5 times more outputs. In Section 5.3.2, the respondent with the highest estimated volume of production per worker per hour was assumed to be able to produce 10% more outputs. In this section, this assumption was not made (i.e., the budget of the HB processor with the highest volume of production per worker per hour remained unchanged).

Table 7.3 Increase in the volume of production and change in the budgets of industrially-processed weaning foods

Processor (type of budget)		Grain/flour-type product vendors (¢/kg)	Industrial processors – LB (¢/kg)	Industrial processors – HB (¢/kg)	
				With original returns	With 1/2 of original returns
Retail price	TB	14,295	**17,031**	**15,912**	**13,974**
(retail margin for	c-WM	15,375	**18,444**	**17,293**	**15,356**
industrially-processed	s-WM	15,103	**18,088**	**16,945**	**15,008**
products: 29%)			(-1,310)	(-1,577)	(-3,514)
Processor price	TB		**13,163**	**12,298**	**10,801**
	c-WM		**14,255**	**13,366**	**11,869**
	s-WM		**13,980**	**13,097**	**11,600**
			(-1,012)	(-1,219)	(-2,716)
Wage			**1,086**	**642**	
			(-3,899)	(-640)	
Equipment			**689**	**347**	
			(-215)	(-55)	
Rent			**10**	**83**	
			(-37)	(-124)	
Telecommunication			**124**	**131**	
			(-421)	(-89)	
Miscellaneous			**94**	**275**	
			(-332)	(-311)	
Other costs	TB		11,160	7,826	
	c-WM		12,252	8,894	
	s-WM		11,977	8,625	
Total cost	TB	5,190	**13,163**	**9,304**	
	c-WM	6,269	**14,255**	**10,371**	
	s-WM	5,997	**13,980**	**10,102**	
			(-4,905)	(-1,219)	
Return		9,106	**0**	2,995	**1,497**
			(3,892)	(0)	(-1,497)

Note: the numbers in parentheses are the difference between the original values (in Table 7.2) and the values reported in Table 7.3; LB: low profit representative budget; HB: high profit representative budget; TB: Tom Brown; c-WM: cowpea-Weanimix; s-WM: soybean-Weanimix.
Source: Calculated by the author.

price decreased by the remaining ¢1,012. As a result, the retail price was estimated to decrease by ¢1,310 per kg for all three products.

It was estimated that HB processors could save a total of ¢1,219 per kg of output. Under the assumption that the processors set the price so the per-unit returns remain constant, the processor price was estimated to decrease by the same amount, and the retail price was estimated to decrease by ¢1,577 per kg for all three products. Under the assumption that the processors set the price so the per-unit returns become one-half of the original value, the processor price was estimated to decrease by ¢2,716 per kg, and the retail price was estimated to decrease by ¢3,514 per kg for all three products.

The difference between the estimated retail prices of industrially-processed and self-prepared cowpea-Weanimix shrank from about ¢4,400 to ¢3,100 per kg for the LB. Under the assumption that HB processors set the price so the per-unit returns remain constant, the difference shrank from about ¢3,500 to ¢1,900 per kg. Again, whether these new prices would be accepted by customers would depend on the premium that weaning mothers would be willing to pay for the better package and quality certification that come with industrially-processed products. Under the assumption that HB processors set the price so the per-unit returns become one-half of the original value, the retail price of their cowpea-Weanimix was estimated to be slightly lower (by ¢19) than the retail price of self-prepared cowpea-Weanimix. This result indicates that the increase in the volume of production by industrial processors, associated with a decrease in the processing margin, could make the price of their cowpea-Weanimix low enough to be competitive with self-prepared cowpea-Weanimix.

7.3.3 Change in the Prices of Raw Materials

Third, sensitivity analysis with regard to the change in the prices of raw materials was conducted to examine the change in the price-competitiveness of industrially-processed cowpea-Weanimix, compared to industrially-processed soybean-Weanimix, industrially-processed Tom Brown, and cowpea-Weanimix self-prepared by grain/flour-type product vendors.

7.3.3.1 Industrially-processed cowpea-Weanimix vs. industrially-processed soybean-Weanimix

Using equations (15) and (16), as well as the relationship between processor and retail prices, the difference between the retail price of industrially-processed cowpea-Weanimix and that of soybean-Weanimix can be expressed as follows:

$$P_{retail}^{c-WM} - P_{retail}^{s-WM} = (1 + \text{retail margin})(\text{share of cowpeas/soybeans in raw materials})$$
$$(\frac{1}{\text{input - output ratio}})(P_{cowpea} - P_{soybean}) \qquad (17)^{13}$$

Substituting each term by the figures used in the budget calculation[14], the equation becomes:

$$\begin{aligned} P_{retail}^{c-WM} - P_{retail}^{s-WM} &= (1 + 0.29)(0.15)(\frac{1}{0.77})(P_{cowpea} - P_{soybean}) \\ &= 0.25(P_{cowpea} - P_{soybean}) \end{aligned}$$

---

[13] Mathematical note: starting from the equation:

$$P_{retail}^{c-WM} - P_{retail}^{s-WM} = (1 + \text{retail margin})(P_{processor}^{c-WM} - P_{processor}^{s-WM}),$$

canceling out the same terms in the right hand side of the equation leads to the following expression:

$$P_{retail}^{c-WM} - P_{retail}^{s-WM} = (1 + \text{retail margin})(P_{cowpea\ jt} - P_{soybean\ jt})\frac{M_{cowpea/soybean\ jt}^{c-WM/s-WM}}{Q_{jt}^{y}}$$

where,

$\frac{M_{cowpea/soybean\ jt}^{c-WM/s-WM}}{Q_{jt}^{y}}$ (i.e., quantity of cowpea/soybean needed to produce 1 kg of c-WM/s-WM)

= [share of cowpeas/soybeans in raw materials] × 1 / [input-output ratio].

As noted in Section 7.1.1, the input-output ratio was assumed to be the same for maize, cowpeas, soybeans, and groundnuts.

[14] For the input-output ratio, the mean of the ratio of LB and HB was used.

The equation shows that the difference between the retail price of cowpea-Weanimix and soybean-Weanimix is equal to the difference between the price of cowpea and soybean grains multiplied by 0.25. Therefore, for example, if cowpeas are more expensive than soybeans by ¢1,000 per kg, the retail price of cowpea-Weanimix would be ¢250 higher than that of soybean-Weanimix. Even if cowpeas were more expensive by ¢4,000 (an unrealistic assumption, because at that point, soybeans would be cheaper than maize [see Section 6.2.6]), cowpea-Weanimix would only be ¢1,000 more expensive than soybean-Weanimix. This indicates that cowpeas could be price-competitive with soybeans, as an ingredient in Weanimix, as long as the price of cowpeas and soybeans fluctuate within a reasonable range.

7.3.3.2 Industrially-processed cowpea-Weanimix vs. industrially-processed Tom Brown

Applying the same mathematical procedure used in the previous section, the difference between the retail prices of industrially-processed cowpea-Weanimix and industrially-processed Tom Brown can be expressed as follows:

$$
\begin{aligned}
P^{c-WM}_{retail} - P^{TB}_{retail} = {} & (1 + \text{retail margin})\left(\frac{1}{\text{input - output ratio}}\right) \\
& \{(\text{share of maize in raw materials of c - WM} - 1)\, P_{maize} \\
& + (\text{share of cowpeas in raw materials of c - WM}) P_{cowpea} \\
& + (\text{share of groundnuts in raw materials of c - WM}) P_{groundnut}\}
\end{aligned} \tag{18}
$$

Substituting each term by the figures used in the budget calculation[15], the equation becomes as follows:

[15] For the input-output ratio, the mean of the ratio of LB and HB was used.

$$P^{c-WM}_{retail} - P^{TB}_{retail} = (1+0.29)(\frac{1}{0.77})(-0.25P_{maize} + 0.15P_{cowpea} + 0.1P_{groundnut})$$
$$= -0.42P_{maize} + 0.25P_{cowpea} + 0.17P_{groundnut}$$

The equation shows that the price-competitiveness of cowpea-Weanimix increases as the price of maize increases, while its competitiveness decreases as the prices of cowpeas and groundnuts increase.

Using the above equation and the estimated range in the price fluctuation of maize, cowpeas, and groundnuts derived in Section 6.2.6 (Table 6.7), the difference in the retail prices of industrially-processed cowpea-Weanimix and Tom Brown were estimated for the most favorable and unfavorable cases for cowpea-Weanimix. The result is shown in Table 7.4.

Table 7.4 Price fluctuations of raw materials and estimated difference in retail prices of industrially-processed cowpea-Weanimix and Tom Brown

Combination of prices of raw materials	Price of maize (¢/kg)	Price of cowpeas (¢/kg)	Price of g-nuts (¢/kg)	Difference in retail prices betw. c-WM and TB (¢/kg)
Most favorable for cowpea-Weanimix	3,809	5,155	6,240	743
Current	3,000	5,474	7,650	1,397
Most unfavorable for cowpea-Weanimix	2,541	6,221	8,486	1,915

Source: Calculated by the author.

The difference in the retail prices of industrially-processed cowpea-Weanimix and Tom Brown was estimated to range from ¢743 to ¢1,915 per kg. This result indicates that as long as the price of raw materials fluctuate within a reasonable range, the difference in the cost of production between cowpea-Weanimix and Tom Brown does not change dramatically, and therefore, their retail prices do not change significantly.

7.3.3.3 Industrially-processed vs. self-prepared cowpea-Weanimix

As reported in Section 6.2.1 (Table 6.1), the price of Tom Brown self-prepared by grain/flour-type product vendors varied over the year due to the seasonal change in the cost of raw materials. In this section, the range of the seasonal change in the price of self-prepared cowpea-Weanimix was estimated by modifying the original budget to reflect the estimated changes in the cost of raw materials and returns[16]. Also, the retail price of industrially-processed cowpea-Weanimix was re-estimated assuming that production occurred when the prices of raw materials were the lowest during the year (i.e., using the lowest estimated prices of maize, cowpeas, and groundnuts in Table 6.7). Then, the derived retail prices of industrially-processed and self-prepared cowpea-Weanimix were compared. The result is shown in Table 7.5.

The price of cowpea-Weanimix self-prepared by grain/flour-type product vendors was estimated to range from ¢13,279 to ¢16,461 per kg during the year. On the other hand, the price of industrially-processed cowpea-Weanimix was estimated to potentially decline to ¢17,989 per kg, if produced by HB processors when the raw materials were the cheapest (the estimated price for the LB did not change because the decrease in the cost was not enough to offset the negative returns). This result means that even if industrial processors could produce a large volume of cowpea-Weanimix during the season when the prices of raw materials are the lowest and sell outputs throughout the year without changing the price, that price still could not fall below the highest price of cowpea-Weanimix sold in the market.

[16] The mathematical procedure used is available from the author upon request.

Table 7.5 Estimated changes in the price of cowpea-Weanimix self-prepared by grain/flour-type product vendors and the estimated price of cowpea-Weanimix industrially-processed when the cost of raw materials are the lowest

Processor (type of budget)	Grain/flour-type product vendors – Cheapest season (¢/kg)	Grain/flour-type product vendors – Most expensive season (¢/kg)	Industrial processors – HB (¢/kg)
Retail price	**13,279** (-2,096)	**16,461** (1,086)	**17,989** (-881)
Processor price			**13,904** (-681)
Raw material	**4,265** (-688)	**5,989** (1,036)	**4,218** (-681)
Other costs	1,316	1,316	6,691
Total cost	**5,581** (-688)	**7,305** (1,036)	**10,909** (-681)
Return	**7,698** (-1,408)	**9,155** (49)	2,995 (0)

Note: the numbers in parentheses are the difference from the original values (in Table 7.2); HB: high profit representative budget.
Source: Calculated by the author.

7.3.4 Change in the Retail Margin

For all the analyses conducted so far, the retail margin has been fixed to 29%, assuming that industrially-processed weaning foods were sold at small shops and the VAT/NHIS was collected. The fourth sensitivity analysis was conducted with regard to the effects of change in retail margins on the price-competitiveness of industrially-processed cowpea-Weanimix.

As described in Section 6.2.5.1, the following three different scenarios with different ranges in retail margins were examined: (1) products sold at small shops that did not collect the VAT/NHIS—with estimated retail margins of 3%-31%; (2) products sold at small shops that collected the VAT/NHIS—with retail margins of 19%-50%; and (3) products sold at supermarkets that collected the VAT/NHIS—with retail margins of 38%-

57%.

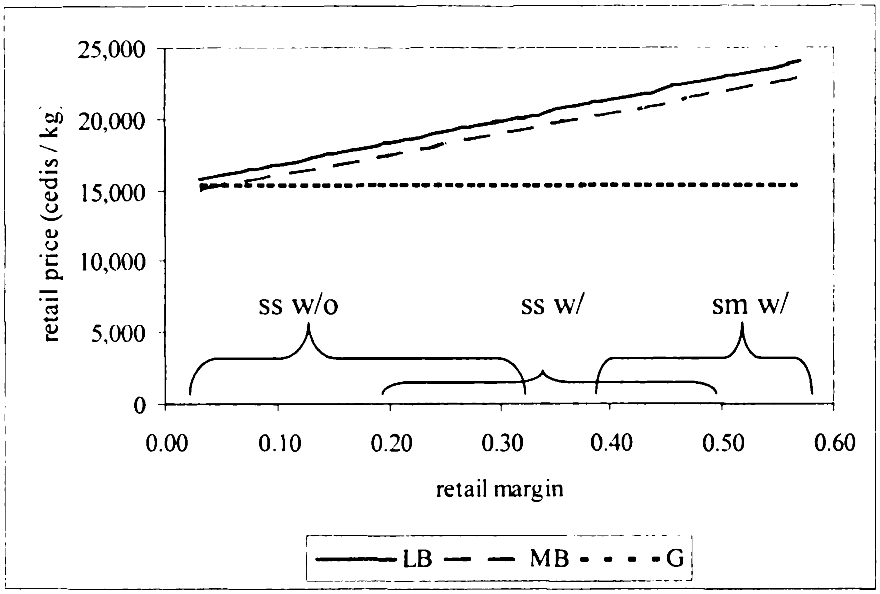
A preliminary analysis found that the difference in the retail prices between industrially-processed cowpea-Weanimix and industrially-processed Tom Brown or soybean-Weanimix does not change much when retail margins change. With a retail margin of 3%, the difference between cowpea-Weanimix and Tom Brown was about ¢1,100 per kg (whether for LB or HB processors), while with a retail margin of 57%, the difference was about ¢1,700 per kg. Between cowpea- and soybean-Weanimix, the difference was about ¢300 per kg with a retail margin of 3% and about ¢400 per kg with a margin of 57%. This finding indicates that the level of retail margin has little effects on the price-competitiveness *among* industrially-processed weaning foods. In other words, the price-competitiveness of cowpea-Weanimix with Tom Brown or soybean-Weanimix would not be greatly affected by the type of retailers where the products are sold or whether or not the VAT/NHIS are collected[17].

The analysis then focused on the price-competitiveness of industrially-processed cowpea-Weanimix with cowpea-Weanimix self-prepared by grain/flour-type product vendors. The relationship between the level of retail margins and estimated retail prices were plotted in Figure 7.2 for each of cowpea-Weanimix produced by LB processors, HB processors, and grain/flour-type product vendors.

The estimated retail price of cowpea-Weanimix processed by HB processors was lower than the estimated price of self-prepared cowpea-Weanimix until the retail margin reached 6%. In contrast, the estimated retail price of cowpea-Weanimix processed by LB

[17] Holding the assumption that the same percentage mark-up would be charged across Tom Brown, cowpea-Weanimix, and soybean-Weanimix. At least, two out of four supermarket respondents (i.e., current outlet of industrially-processed weaning foods) indicated that they charged the same percentage mark-up for all flour-type products.

Figure 7.2 Estimated retail prices of cowpea-Weanimix produced by LB processors, HB processors, and grain/flour-type product vendors for different levels of retail margins



Note: LB: low profit representative budget; HB: high profit representative budget; G: grain/flour-type product vendors; ss w/o: small shops without collection of the VAT/NHIS; ss w/: small shops with collection of the VAT/NHIS; sm w/: supermarkets with collection of the VAT/NHIS.
Source: Calculated by the author.

processors was always higher than the estimated price of the self-prepared product. The difference in prices between cowpea-Weanimix processed by HB processors and the self-prepared product was estimated to be about ¢3,700 per kg for a retail margin of 31% (upper bound for small shops without the VAT/NHIS); about ¢6,500 per kg for a retail margin of 50% (upper bound for small shops with the VAT/NHIS); and about ¢7,500 per kg for a retail margin of 57% (upper bound for supermarkets with the VAT/NHIS).

The results indicate that the level of the retail margin greatly affects the price-competitiveness of industrially-processed cowpea-Weanimix with self-prepared cowpea-Weanimix. This implies that the outlet for industrially-processed cowpea-Weanimix would need to be expanded to small shops, rather than continuing to be sold almost exclusively at supermarkets, if the products are to be patronized by weaning mothers from lower-income families.

7.3.5 Combination of Different Scenarios

Finally, sensitivity analysis was conducted with regard to the combinations of four different scenarios that were examined above (i.e., change in technical efficiency, volume of production, price of raw materials, and retail margin).

7.3.5.1 Industrially-processed cowpea-Weanimix vs. industrially-processed soybean-Weanimix

As equation (17) indicates, the difference in retail prices between industrially-processed cowpea-Weanimix and industrially-processed soybean-Weanimix becomes smaller when: (1) technical efficiency improves (i.e., input-output ratio becomes larger); (2) the difference in prices of cowpea and soybean grains becomes smaller; and (3) retail margin becomes smaller[18]. For each of these variables, the minimum and maximum values were selected from the data presented in the previous sections. Using these values, the smallest and largest differences in retail prices of cowpea- and soybean-Weanimix were estimated. The result is shown in Table 7.6.

[18] As equation (17) indicates, the volume of production does not affect the price-competitiveness of industrially-processed cowpea-Weanimix with industrially-processed soybean-Weanimix.

Table 7.6 Estimated smallest and largest differences in retail prices of industrially-processed cowpea- and soybean-Weanimix

Price-competitiveness of c-WM with s-WM	Input-output ratio*	Price of raw materials (¢/kg)**		Retail margin***	Difference in prices of c-WM and s-WM (¢/kg)
		Cowpeas	Soybeans		
Highest	0.85	5,155	4,548	0.13	120
Lowest	0.70	6,221	3,889	0.47	737

* For the reason to select 0.85 as the maximum value, see Section 7.3.1. The minimum value of 0.70 was experimentally selected (as opposed to 0.77 [the mean input-output ratio of the processor respondents]).

** From Table 6.7. These combinations assume that the price of cowpeas could become the highest when the price of soybeans is the lowest, and vice-versa.

*** The minimum value of 0.13 is the mean retail margin of small shop respondents without collection of the VAT/NHIS (see Table 4.12); the maximum value of 0.47 is the mean retail margin of supermarket respondents with collection of the VAT/NHIS (see Table 4.13).

Source: Calculated by the author.

Under the most unfavorable scenario for cowpea-Weanimix, the difference in retail prices of industrially-processed cowpea- and soybean-Weanimix was estimated to be only ¢737 per kg. This result indicates that cowpea-Weanimix could probably always be price-competitive with soybean-Weanimix, unless customers prefer soybeans and are willing to pay a high premium for soybean-Weanimix.

A key factor that affects customers' willingness to pay a premium for cowpea- or soybean-Weanimix would be the difference in the nutritional value between these two products [19]. If soybean-Weanimix is nutritionally superior to cowpea-Weanimix, customers might be willing to pay a premium for soybean-Weanimix.

[19] As long as the same ratio of ingredients are used (e.g., maize 75%, cowpeas/soybeans 15%, and groundnuts 10%), the nutritional value of cowpea- and soybean-Weanimix are different, due to the difference in the nutritional value of cowpeas and soybeans (as mentioned in Section 2.2.3, soybeans are higher in protein and fat, but lower in carbohydrates than cowpeas). On the other hand, if cowpeas and soybeans are used to produce Weanimixes that have the same protein content (e.g., the minimum protein requirement for weaned children), the proportion of soybeans in soybean-Weanimix would be lower than the proportion of cowpeas in cowpea-Weanimix, due to the higher protein content of soybeans than cowpeas. In this case, soybean-Weanimix would be more price-competitive with cowpea-Weanimix than in the results of the analysis reported in this chapter.

7.3.5.2 Industrially-processed cowpea-Weanimix vs. industrially-processed Tom Brown

Using equation (18), a similar analysis was conducted to estimate the difference in retail prices of industrially-processed cowpea-Weanimix and industrially-processed Tom Brown. The result is shown in Table 7.7.

Table 7.7 Estimated smallest and largest differences in retail prices of industrially-processed cowpea-Weanimix and Tom Brown

Price-competitiveness of c-WM with TB	Input-output ratio	Price of raw materials (¢/kg)			Retail margin	Difference in prices of c-WM and TB (¢/kg)
		Maize	Cowpeas	Groundnuts		
Highest	0.85	3,809	5,155	6,240	0.13	589
Lowest	0.70	2,541	6,221	8,486	0.47	2,415

Source: Calculated by the author.

Under the most favorable scenario, the difference in the retail prices between industrially-processed cowpea-Weanimix and Tom Brown was estimated to be ¢589 per kg. Under the most unfavorable scenario, the difference was estimated to be ¢2,415 per kg. As mentioned in Section 6.2.3.2, the relative price of Weanimix and Tom Brown varied among the processor respondents (the price of Weanimix was 1.2 to 1.9 times the price of Tom Brown, except for one respondent who set the price of these products the same). However, the result of the sensitivity analysis indicates that the relative price between these two products could potentially be smaller than their relative prices set by the majority of the processor respondents (if the price of Tom Brown is ¢17,488 per kg as estimated for HB processors [Table 7.2], the difference of ¢2,415 means that cowpea-Weanimix is 1.14 times more expensive than Tom Brown).

7.5.3.3 Industrially-processed vs. self-prepared cowpea-Weanimix

Finally, using the combinations of most favorable and unfavorable scenarios for cowpea-Weanimix[20], the lowest and highest retail prices of industrially-processed cowpea-Weanimix were estimated. Then, the derived prices were compared with the estimated lowest and highest prices of cowpea-Weanimix self-prepared by grain/flour-type product vendors. The result is discussed below.

Table 7.8 Estimated lowest and highest retail prices of industrially-processed cowpea-Weanimix

Retail price estimate	Bud-get	Input-output ratio	Price of raw materials (¢/kg)			Volume of production	Retail margin	Retail price (¢/kg)
			Maize	Cowpeas	Ground-nuts			
Lowest estimate	LB	0.85	2,541	5,155	6,240	Increased volume	0.13	14,773
	HB							12,213
Highest estimate	LB	0.70	3,809	6,221	8,486	Current volume	0.47	24,895
	HB							24,052

Source: Calculated by the author.

As Table 7.8 shows, the lowest retail price of industrially-processed cowpea-Weanimix was estimated to be around ¢12,000 per kg, while the highest price was estimated to be around ¢25,000 per kg. On the other hand, as shown in Table 7.5, the price of self-prepared cowpea-Weanimix was estimated to range from about ¢13,000 to ¢16,000, depending on the season of the year. Therefore, the result indicates that, under very favorable conditions, industrially-processed cowpea-Weanimix could become cheaper than its self-prepared counterpart.

[20] The combination of the most favorable scenarios consists of: (1) highest technical efficiency (i.e., highest input-output ratio); (2) increased volume of production (for the HB, with the reduction of the processing margin to one-half of the original value); (3) lowest prices of all ingredients (i.e., maize, cowpeas, and groundnuts); and (4) lowest retail margin. Opposite is the combination of the most unfavorable scenarios.

7.4 Summary

In this chapter, enterprise budgets were constructed to estimate the retail prices of Tom Brown, cowpea-Weanimix, and soybean-Weanimix, for two different categories of processors and the corresponding outlet—(1) industrial processors whose products are sold in small shops (potential outlet, as opposed to the current outlet of supermarkets); and (2) grain/flour-type product vendors in the market.

Raw materials were estimated to be a major cost component of all three of the products produced by industrial processors. For cost variables such as wage, transportation, and printing and stationery, the estimated payment (per kg of output) varied greatly across the respondents. Among 10 respondents, only one-half could provide enough information for calculating the total cost of production and returns. Due to the variation in the payment for each cost component, their returns also varied. For the top two processors (in terms of the value of returns), the average retail price of their products was estimated to be about ¢17,500 per kg of Tom Brown, about ¢18,900 per kg of cowpea-Weanimix, and about ¢18,500 per kg of soybean-Weanimix, with an average return to processors of about ¢3,000 per kg. On the other hand, for the bottom two processors, the average retail price of their products was estimated to be about ¢18,300 per kg of Tom Brown, about ¢19,800 per kg of cowpea-Weanimix, and about ¢19,400 per kg of soybean-Weanimix, with an average return to processors of about ¢-3,900 per kg.

Thus, the difference in retail prices of industrially-processed cowpea-Weanimix and soybean-Weanimix was estimated to be only about ¢400 per kg. This is a minor difference, which indicates that, under the conditions observed in Accra during February and March 2007, cowpeas were competitive with soybeans as an ingredient in Weanimix, if consumers valued the two products equally.

Also, the retail price of cowpea-Weanimix was estimated to be ¢1,400 per kg higher than the retail price of Tom Brown. This finding indicates that the relative price between industrially-processed cowpea-Weanimix and industrially-processed Tom Brown could potentially be smaller than their relative prices set by the majority of the processor respondents.

Estimated retail prices of weaning foods self-prepared by grain/flour-type product vendors were about ¢14,300 per kg of Tom Brown, about ¢15,400 per kg of cowpea-Weanimix, and about ¢15,100 per kg of soybean-Weanimix. Returns to vendors were estimated to be about ¢9,100 per kg of output.

Thus, the difference in prices between industrially-processed and self-prepared weaning foods was estimated to be from about ¢3,200 to ¢4,400 per kg. The only major difference between industrially-processed and self-prepared weaning foods would likely be that industrially-processed ones are sold in a sealed bag with a label containing an authority certification logo, while self-prepared ones are sold in an open-air condition without quality certification. It would be informative to conduct a consumer survey to assess the willingness of Ghanaian mothers to pay a higher price for a better package and quality certification, to find out whether the estimated higher price of industrially-processed weaning foods would be accepted by customers.

Sensitivity analyses were conducted for different scenarios to examine the change in the price-competitiveness of industrially-processed cowpea-Weanimix with: (1) industrially-processed soybean-Weanimix; (2) industrially-processed Tom Brown; and (3) cowpea-Weanimix self-prepared by grain/flour-type product vendors.

The results of the analysis showed that it is likely that cowpeas would always be price-competitive with soybeans as an ingredient in industrially-processed Weanimix, unless customers prefer soybeans over cowpeas.

The difference in the retail prices between industrially-processed cowpea-Weanimix and Tom Brown was estimated to be about ¢600 per kg under the most favorable scenarios for cowpea-Weanimix and ¢2,400 per kg under the most unfavorable scenarios. Change in the price of raw materials was the main contributor to create these differences.

The price-competitiveness of industrially-processed cowpea-Weanimix with Weanimix self-prepared by grain/flour-type product vendors was affected by the change in: (1) the technical efficiency of processing; (2) the volume of industrial production and the processing margin; (3) the price of raw materials; and (4) the retail margin. Among these examined scenarios, the level of processing and retail margins were found to be the most important factors that determine the competitiveness of industrially-processed cowpea-Weanimix, compared to self-prepared Weanimix.

CHAPTER 8

CONCLUSIONS

8.1 Summary

Cowpeas, a protein-rich and drought-tolerant indigenous African legume, are popularly consumed at home and also as street foods in West Africa. However, industrial processing of cowpeas is still negligible. For the goals of enhancing cowpea consumption, utilization, and food security, many studies have been conducted by food scientists associated with the Bean/Cowpea Collaborative Research Support Program to develop nutritious and affordable cowpea-based processed products.

Cowpea-based processed products seem to have high potential because of the popularity of cowpeas as an ingredient of various traditional dishes in the region, as well as the growing urbanization and the increase in the opportunity cost of women's time, which will increase the demand for processed products. However, previous studies have identified various constraints to creating and promoting such processed cowpea products, including higher prices of cowpeas (compared to its substitutes), lower protein content than soybeans (which are substitutes for cowpeas in the production of some of the processed products), fluctuations in price and quality, lack of stable availability, and possibly poor functionality of processed products.

This case study was conducted to examine the competitiveness of selected cowpea-based processed products in Ghana, analyzing both price-related and non-price-related factors. One of the two selected target products was ready-to-use dry cowpea meal developed by the B/C CRSP for preparation of *kosei* (cowpea fritters, a popular street food in Africa). If commercialized, the meal would save the time of street vendors of kosei, who currently prepare it from cowpea grain using labor-intensive methods. The other selected target product was *Weanimix*, a traditional roasted-maize-based weaning food (called *Tom Brown*) fortified with cowpeas or soybeans (10-15% of the output) and groundnuts (10%), which was introduced in Ghana in 1987 by the Ministry of Health Nutrition Division and the United Nations Children's Fund.

Fieldwork was conducted in the Greater Accra Region of Ghana during February and March 2007. Using structured questionnaires, interviews were conducted with 20 kosei vendors, 15 custom millers, 18 retailers (including grain/flour-type product vendors in the market [outlet for everybody], small shops [outlet for everybody], and supermarkets [outlet for wealthier families]), 30 weaning mothers, and 10 small- to medium-scale local food-processing companies. Price data were collected from different sources such as observations/personal communication in the market during the fieldwork, secondary data obtained from the Ghanaian Ministry of Food and Agriculture, and an online database. Using the qualitative data collected, descriptive analysis was carried out to assess non-price related factors affecting the competitiveness of dry cowpea meal and cowpea-Weanimix (i.e., Weanimix in which cowpeas are used rather than soybeans). Quantitative data were used to prepare enterprise budgets and analyze the price-competitiveness of the target products. Finally, sensitivity analysis was conducted to examine the change in the price-competitiveness of these products under different scenarios.

With regard to dry cowpea meal for preparation of kosei, descriptive analysis found no new major non-price-related constraints to industrially producing dry cowpea meal. The processor respondents, who were currently producing cowpea/soybean flour, seemed to be capable of producing dry cowpea meal with their current equipment or with a small additional investment. Most respondents used plate mills to grind grain—the same technology used by custom millers.

Budgets for preparing kosei using dry cowpea meal were constructed using data obtained from 4 industrial processor and 13 kosei vendor respondents. The analysis indicated that, under the conditions observed in Accra during February and March 2007, dry cowpea meal would not be price-competitive with cowpea grain for the majority of kosei vendors. The difference in returns between wet-milled kosei (i.e., kosei prepared from cowpea paste wet-milled by a custom miller; current method used by kosei vendors) and dry-milled kosei (i.e., kosei prepared using dry cowpea meal) was estimated to range from about ¢3,700 to ¢12,900 per kg of kosei (approximately US$0.41 to US$1.40; US$1 ≈ ¢9,200 [Ghanaian cedis] during February and March 2007). This means that the meal would only be attractive to vendors who, by switching from the wet-milling method to the meal, could save an amount of labor that is equivalent of about 100% to 340% of the minimum daily wage (¢19,000 [US$2.07]) for every 5 kg of kosei they prepare.

The sensitivity analysis showed that none of the four scenarios to improve the price-competitiveness of meal—improvement in the technical efficiency, increase in the volume of production (with or without reduction in the processing margin), bulk purchase of meal by kosei vendors, and fluctuation in cowpea price—would greatly change the results of the original analysis, if these scenarios occurred individually. If all of these scenarios occurred simultaneously, the price of dry cowpea meal would decline sharply. However, to adopt the meal, kosei vendors would still have to be able to save an amount of labor that is equivalent of about 40% to 120% of the current minimum daily wage for every 5 kg of kosei they prepare. The results suggest that, for the majority of kosei vendors, dry cowpea meal could only be a price-competitive ingredient in kosei under a combination of very favorable conditions.

With regard to the competitiveness of cowpea-Weanimix, a wide difference was found among the prices of existing weaning foods available in Accra. Currently, Weanimix is produced by small- to medium-scale local food processing companies and is mainly sold at supermarkets, which are frequented by higher-income consumers. While some of these companies also produced Tom Brown, grain/flour-type product vendors also self-prepared Tom Brown (using custom millers) and sold it along with other products.

Descriptive analysis of the data collected found two non-price-related constraints to the commercialization of industrially-processed cowpea-Weanimix: (1) apparently low awareness of Weanimix among consumers; and (2) preference for soybeans over cowpeas among processor respondents (for reasons other than the lower price of soybeans).

Budgets were constructed, using data collected from five processor respondents and seven grain/flour-type product vendors. The retail price of industrially-processed cowpea-Weanimix (assumed to be sold at small shops) was estimated to be about ¢400 (approximately US$0.04) per kg higher than the price of industrially-processed soybean-Weanimix, about ¢1,400 (US$0.15) per kg higher than the price of industrially-processed Tom Brown, and about ¢3,500 to ¢4,400 (US$0.38 to US$0.48) per kg higher than the price of a potential product—cowpea-Weanimix self-prepared by grain/flour-type product vendors. These results indicated that, under the conditions observed in Accra during

February and March 2007: (1) cowpeas were price-competitive with soybeans as an ingredient in Weanimix, if consumers saw these products as equally desirable; (2) the relative price between industrially-processed cowpea-Weanimix and industrially-processed Tom Brown could potentially be smaller than their relative prices currently set by the majority of the processor respondents; and (3) whether industrially-processed cowpea-Weanimix would be price-competitive with Weanimix self-prepared by grain/flour-type vendors would depend on the willingness-to-pay among consumers for a better package and quality certification—attributes that could be obtained only from industrially-processed products.

Sensitivity analysis was conducted for five scenarios: change in (1) technical efficiency of industrial processing; (2) volume of industrial production; (3) price of raw materials; and (4) retail margins, as well as (5) combinations of different scenarios. The results indicated that: (1) it is likely that cowpeas would always be price-competitive with soybeans as an ingredient in Weanimix, unless customers prefer soybeans and are willing to pay a high premium for soybean-Weanimix; (2) the difference in the retail prices between industrially-processed cowpea-Weanimix and Tom Brown would range from about ¢600 to ¢2,400 per kg depending on the conditions; and (3) the level of processing and retail margins would significantly affect the price-competitiveness of industrially-processed cowpea-Weanimix with self-prepared cowpea-Weanimix.

8.2 Policy Implications

8.2.1 Dry Cowpea Meal for Preparation of Kosei

The results of the study indicated that it would not be profitable for the majority of kosei vendors to use dry cowpea meal processed by small- to medium-scale local industrial companies, under the conditions observed in Accra during February and March 2007. Unless subsidized, processors could not sell dry cowpea meal at a price that is attractive to kosei vendors, while maintaining the same level of returns that the processors earned from similar products that they currently produced (i.e., cowpea/soybean flour). As reported in Section 4.2.3.3, the currently limited market for dry cowpea flour seemed to mainly serve high-income consumers who prepare kosei at home (high opportunity cost of their labor makes ready-to-use dry flour attractive), while a smaller amount is sold to expatriate Ghanaians.

This finding indicates that, although the technology to industrially produce dry cowpea meal is available in Accra, it is unlikely that at this time kosei vendors would switch from the wet-milling method to the use of dry cowpea meal. As the study showed, the higher the opportunity cost of vendor's time becomes, the more attractive dry cowpea meal would be to kosei vendors. Therefore, as Ghana's economy grows, there will be a point in the future when the value of time and labor saved by using dry meal would exceed the cost of purchasing meal. Therefore, it would be best to wait to promote dry cowpea meal to most kosei vendors until the economy reaches this point, unless the policy makers are willing to support kosei vendors today by subsidizing the meal.

8.2.2 Cowpea-Weanimix

The study found that, although several types of industrially-processed Weanimix were already available in Accra, the products were mainly sold in supermarkets which targeted wealthier families. Also, the sensitivity analysis found that the level of the retail margin would greatly affect the price-competitiveness of industrially-processed weaning foods with those self-prepared by grain/flour-type product vendors. Therefore, it is recommended that industrial processors of weaning foods expand their outlets from supermarkets to small shops to make their products more available to weaning mothers from lower-income families.

Also, collaboration between the government-run health clinics/hospitals and weaning food processors could help to make Weanimix more available to weaning mothers from lower-income families. Although a health clinic, which was visited for conducting the weaning mothers' interviews, sold Weanimix in small portions, the unit price seemed to be more expensive than the average unit price of industrially-processed Weanimix sold in supermarkets. This difference in unit prices appeared to be larger than the cost of repackaging, which the health clinic would have to pay (assuming that the health clinic purchased Weanimix and repackaged it to smaller portions at the clinic). Therefore, health clinics/hospitals should seek ways to sell Weanimix to weaning mothers for a lower price, such as bulk purchase of Weanimix from industrial processors.

The lack of availability of commercial Weanimix for lower-income families was suspected to be found on the demand side, rather than the supply side. Interviews with weaning mothers and industrial processors suggested that although consumer awareness of Weanimix was increasing, the product was not yet widely known. Since it is unlikely that small- to medium-scale local processors could afford to advertise on a large scale, the government could initiate campaigns as a strategy to further increase consumer awareness of Weanimix. Similarly, NGOs with a child survival mandate could assist in promoting these nutritious weaning foods. Finally, if there exists a professional organization that represents local processors of weaning foods, joint promotion programs could be carried out in partnership with the government and such an organization.

Finally, among the weaning mother respondents, koko or banku, both of which are made from fermented maize dough, was found to be a much more popular weaning food than Tom Brown or Weanimix. If this is a general trend among Ghanaian weaning mothers, the research on and the promotion of cowpea/soybean-fortified fermented maize dough would need to be paid further attention.

8.3 Limitations

An important limitation of this study is uncertainty about the accuracy in the cost calculation of industrially-processed products. In this regard, the following three issues should be noted.

First, the shares of the target products in the total production of the industrial processor respondents could be inaccurate, due to the assumptions used to derive these values (i.e., approximated by the shares in weight, value of products, estimated equipment use time, and number of packages). This problem would be most serious when respondents processed products with very different characteristics than those of flour-type products. For example, the model used for estimating the unit cost assumed that the same amount of labor was needed to produce 1 kg of cowpea flour and 1 kg of honey, which is most likely not true.

Cost variables that are subject to this type of inaccuracy problem include wage, equipment, electricity, fuel, water, and printing and stationery. For instance, wages accounted for 2% to 22% of the processors' selling price in the representative budgets for industrially-processed dry cowpea meal, and 9% to 35% in the processors' selling price in the representative budgets for industrially-processed weaning foods. If the actual wage share of the target product in the total production was twice as large as the estimated share, the unit wage should have been twice as large as the derived unit wage, which could have changed the results reported in the derived budgets.

Second, since the budgets were constructed using monthly data collected in early 2007, seasonality in production was not taken into account. However, the volume of total production of industrial processors' facility may fluctuate from month-to-month (the respondents indicated that their production of cowpea/soybean flour and Weanimix/quasi-Weanimix was not constant throughout the year). Thus, if fluctuations in total production occur overtime, the denominator of each share estimate (i.e., $\frac{Q_{jt}^{m}}{\sum_{g} Q_{jt}^{g}}$, $\frac{P_{jt}^{m} Q_{jt}^{m}}{\sum_{g} P_{jt}^{g} Q_{jt}^{g}}$, $\frac{Q_{jt}^{m} / q_{ej}^{m}}{\sum_{g \in e} Q_{jt}^{g} / q_{ej}^{g}}$, $\frac{A_{jt}^{m}}{\sum_{g} A_{jt}^{g}}$; see Section 5.1.1) fluctuates. Then, the estimated unit cost of the components for which respondents paid a fixed amount of money every month (e.g., wage and rent) or for which respondents paid once in a longer period than a month (e.g., printing and stationery) also fluctuates. For instance, if the volume of total production doubles, the share estimate becomes one-half of the value used in the budgeting analysis, and therefore, the unit cost of the affected components falls by 50%. Therefore, if the volume of total production in the month for which the data were collected was unusually high or low, the estimated unit cost of these components would be unusually low or high.

Third, information on the processors' volume of inventory was not collected and therefore not included in the analysis. The payment for cost components such as transportation depends on the volume of sales, rather than the volume of production during a month. However, due to the lack of information, the cost calculations assumed that there was no storage from the previous month, and also that all the products produced during the month were sold in the same month.

The small sample sizes are another limitation of this study. The number of industrial processor respondents who could provide enough information to construct budgets was limited to four for dry cowpea meal and five for cowpea-Weanimix. Also, due to time and budget limitations, the number of kosei vendors interviewed was limited to 13. Since the derived budgets had components whose values varied widely across the respondents, a larger number of budgets (i.e., larger sample of respondents) would have increased the reliability of the analysis.

With regard to the estimation of processor prices, to simplify the analysis, it was assumed that processors would modify the processor prices so that the values of returns remain unchanged. This assumption is the equivalent of assuming that the market for the products analyzed is perfectly competitive (i.e., price levels are determined solely by costs, including a "normal" return on capital). However, the processor price of cowpea/soybean flour varied widely across the respondents. Also, as shown in Table 6.1, there was a wide difference in prices among weaning foods produced by the respondents. Moreover, as reported in Section 6.2.3.2, the share of each ingredient in weaning foods varied across the respondents, implying that the taste of those weaning foods also differed from product-to-product. Therefore, it would be more appropriate to describe the current market for cowpea/soybean flour and weaning foods processed by local companies as a market of monopolistic competition, in which similar (i.e., not identical but differentiated) products are sold. Since each processor faces a downward-sloping demand curve (rather than a flat demand curve in a perfectly competitive market), they own some market power to change the selling price without losing all customers (Varian, 2003, p. 454). In such a market, processor prices might not increase as much as the increase in the cost of production, if processors absorb a part of increasing costs by decreasing returns. Similarly, processors might take advantage of an increase in the cost of production by increasing the processor price more than the increase in the cost. However, information on the pricing practices of processor respondents was not collected and therefore not included in the analysis.

Finally, the use of the same representative prices of raw materials across the processor respondents may have led to inaccurate estimates of unit costs of raw materials. Since the respondents had different sources of raw materials, it is indeed expected that they paid different unit prices for raw materials. This is a concern because the share of raw materials in the total cost was estimated to be large. Also, the potential problem related to the use of representative olonka-kg conversion rates was discussed in detail in Section 4.2.5.3.

8.4 Future Research

8.4.1 Dry Cowpea Meal for Preparation of Kosei

If dry cowpea meal for kosei preparation is produced by custom millers, the price of their meal is expected to be lower than the price of meal processed by industrial processors. However, this assumes that custom millers can produce the type of meal required to make kosei. Thus, it would be useful to survey custom millers to find out whether they could successfully mill cowpeas into the right particle size range for dry cowpea meal (with or without a sieve) and whether they would be willing to do it, when asked by customers.

Further research to determine the optimal soaking and whipping time necessary to prepare a good quality kosei using dry cowpea meal is needed to accurately assess: (1) the time that would be saved by the use of dry cowpea meal; and (2) the potential for using meal to make fine adjustments of the quantity of kosei to prepare depending on the sales of the day.

To better understand demand factors, a consumer survey needs to be conducted to find out the potential incremental increase in cowpea consumption through: (1) increasing home preparation of kosei using dry cowpea meal; and (2) the use of dry cowpea flour/meal for daily cooking. With regard to home preparation of kosei, dry cowpea meal has the advantage that customers could tailor kosei to meet their taste preferences. However, it has the disadvantage that home preparation of a small amount of kosei would require more labor and oil per unit of kosei than purchasing street-vended kosei, which is prepared in a large amount. A preliminary analysis on the potential of home preparation of kosei was conducted using the data collected from weaning mother respondents. The results are reported in Appendix 7.

Finally, a higher proportion of *agawu* (fritter made from dry-milled cowpeas) vendors interviewed had another source of income, compared to kosei vendor respondents (although the sample size is very small). Since the processing procedure for agawu is similar to the processing procedure to prepare kosei using dry meal, a survey of agawu vendors could provide useful information to assess how much labor kosei vendors could save by switching from the wet-milling method to the use of dry meal. Also, the potential for creating commercial dry cowpea flour suitable for preparation of agawu (rather than kosei), as well as its benefits and economic profitability, could be explored in a future study.

8.4.2 Cowpea-Weanimix

This study did not collect any information regarding how much weaning mothers in low-income families could afford to pay for Weanimix or weaning foods in general. Thus, it is not clear whether weaning mothers with malnourished children can even afford to purchase Tom Brown sold in the local market, which is among the cheapest commercial weaning foods. These mothers' willingness-to-pay for weaning foods should be examined through a survey, if locally produced commercial weaning foods are to target these weaning mothers.

Also, the difference in the nutritional value of Tom Brown, cowpea-Weanimix, and soybean-Weanimix was not incorporated in the analysis of this study. The willingness-to-pay for higher nutritional values among weaning mothers would be a key factor that determines the price-competitiveness of different weaning food products. Therefore, a study in this regard would be worth conducting.

The study found that grain/flour-type product vendors could sell Weanimix at a lower price than Weanimix produced by industrial processors. No major constraints were found for those vendors currently self-preparing and selling Tom Brown to produce Weanimix. However, almost no vendors were observed selling Weanimix. Therefore, a further research to assess the potential for grain/flour-type product vendors to produce and sell Weanimix is needed. If such a Weanimix becomes available, weaning mothers from low-income families currently using only Tom Brown, due to a budget constraint, might be able to afford Weanimix.

The difference between industrially-processed and self-prepared weaning foods was whether or not the products were sold in an air-tight package with a label containing authority certification. A study could be conducted to find out if it is feasible and economic to set up an independent testing/certification and packaging service that would serve grain/flour-type product vendors. If such a service could be established, and if the cost of service is lower than the difference between the estimated retail prices of industrially-processed and self-prepared weaning foods, it might be possible to make available to weaning mothers in low-income families a lower-price Weanimix with greater quality assurance. Also, to accurately estimate the price-competitiveness of industrially-processed Weanimix with Weanimix potentially self-prepared by grain/flour-type product vendors, there is a need to conduct a consumer survey to assess their willingness-to-pay for air-tight packages and quality certification.

The sensitivity analysis found that the level of processing margin would greatly affect the price-competitiveness of industrially-processed weaning foods with self-prepared counterparts. A study could be conducted to examine how low the processors could set their processing margins, while gaining returns greater than the opportunity cost of capital.

Finally, the study also found that because the cost of industrially producing cowpea-Weanimix and soybean-Weanimix would not differ much, these products could be sold for almost the same price. Thus, the competitiveness of cowpea-Weanimix would depend on the consumers' preference between cowpeas and soybeans. As reported, the awareness and popularity of soybeans seem to differ across regions in Ghana. Therefore, a consumer survey needs to be conducted among the target population of Weanimix to assess which type of Weanimix would have the greatest potential among that population. Also, there is a need to further investigate why the majority of the industrial processor respondents used soybeans, rather than cowpeas, as an ingredient in their Weanimix (e.g., among the advantages/disadvantages of cowpeas/soybeans reported by the respondents, which one was more influential than others?)

APPENDIX 1

Questionnaires

A.1.1 Questionnaire for Street Vendors of Kosei

Competitiveness of Cowpea-Based Processed Products: A Case Study in Ghana

- Questionnaire for Street Vendors of Kosei–

Enumerator:______________________________ **Respondent Number:**_____

Date:__________________**/2007** **Area in Accra**_______________________

Time Interview Began:_____**:**______ **Time Interview Ended:**_____**:**______

INSTRUCTIONS:

1. Bring a **kitchen scale** to the interview site.
2. Visit vendors while they are doing business.
3. **Buy** kosei balls (**at least 5 balls**) (keep them to measure the weight after the interview.)
4. Explain who you are and what you are doing.
5. Read the consent statement to the respondent. If she/he agrees, begin the interview.

(Revised Feb. 20, 2007, final version)

1. EXPERIENCE AND PRODUCTS

1.1. How many years have you been selling kosei? ....______

1.2. Do you sell kosei throughout the year, or are there seasons during which you don't sell kosei? (1 = Year around, 2 = Seasonal)......___

If "Seasonal",

1.2.1. In what months don't you sell kosei, and why?

Months: ____

Why? ____

____

1.2.2. What do you do during the period you don't sell kosei?____________

____

____

1.3. In the **past year**, have you sold any food products **at the same time** you sell kosei? (0 = No, 1 = Yes) ......___

If "Yes",

1.3.1. What products? **Enter all that apply.**.........................___ ___ ___

1 = Koko, 2 = Hausa koko, 3 = Other (specify):____________

1.4. How many days per week do you sell kosei?..____

If the respondent doesn't sell kosei everyday,

1.4.1. Which day of the week is your day off?......____________________

2. COST OF PRODUCTION

2.1. What ingredients do you use to make kosei?

Check the box of the cost components in the table below.
If the respondent doesn't mention any item listed, ask if she/he uses that item.
Ask about the varieties or traits of cowpeas, reasons to choose that variety or traits, and types of seasoning.

2.2. From whom do you usually buy these ingredients? **Enter the code.**

2.3. How often do you buy each of these ingredients? **Enter the answer.**

2.1.		2.2.	2.3.
Cost components		**From whom** Codes: 1 = vendor in the market 2 = retail store 3 = wholesaler 4 = farmer 5 = other (specify)	**Frequency of purchase**
☐	Cowpea grains*		
☐	Onion		
☐	Pepper		
☐	Ginger		
☐	Garlic		
☐	Salt		
☐	Seasoning**		
☐	Water		
☐	Oil_______________		
☐	Fuel_______________		
☐			
☐			
☐			

* Varieties or traits (e.g., color, size)________________________________

Why that variety or traits________________________________

** Types of seasoning________________________________

2.4. Do you use the same ingredients throughout the year, or do you change the ingredients for different seasons? (1 = Same, 2 = Change)........___

If "Change",

2.4.1. What ingredients change and when?

Change: ____________________ Months: ____________

Change: ____________________ Months: ____________

2.5. How much of each ingredient do you buy **each time**, and how much does each cost?
Enter the answers in the table below.

2.6. If you were to buy the ingredients you used **yesterday**, how much would you have paid?
Enter the answers in the table below.

		2.5				2.6
Cost components		**Quantity and payment (each purchase)**				**Cost of ingredients and fuel used yesterday (Cedis)**
		Amount	**Unit**	**g, kg or litter / unit**	**Payment (Cedis)**	
☐	Cowpea grains					
☐	Onion					
☐	Pepper					
☐	Ginger					
☐	Garlic					
☐	Salt					
☐	Seasoning					
☐	Water					
☐	Oil					
☐	Fuel					
☐						
☐						
☐						

2.7. Do you make the same amount of kosei **everyday**, or does the amount change in different days of the **week**? (1 = Same, 2 = Change)..............................____

If "Change",

2.7.1. By how much does the amount of kosei you make change, and why?

By how much: ________________________________
Why: ________________________________

2.8. Depending on the availability of cowpeas, do you change the amount of kosei you make at different times of the **year**? (0 = No, 1 = Yes)..........................____

If "Yes",

2.8.1. By how much does the amount of kosei you make change?

By how much: ________________________________

3. PROCESSING PROCEDURE

3.1. Do you prepare kosei by yourself? (0 = No, 1 = Yes)..............................____

If "Yes",

3.1.1. Do you usually prepare kosei alone or does somebody assist you?
(1 = Alone, 2 = With (specify):____________________)...____

If "No",

3.1.2. Who prepares the kosei you sell?...____________________________

3.2. How do you [*or the answer to Q.3.1.2*] prepare kosei? Please explain step by step.
Ask (a) the time of the day each step is undertaken, and (b) the time needed for each step (including the time for moving from one place to another. e.g., from home to custom miller).

(1)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(2)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(3)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(4)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(5)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(6)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(7)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(8)____ (☐ AM ☐ PM) (☐ min ☐ hour)

(9)____ (☐ AM ☐ PM) (☐ min ☐ hour)

3.3. Do you fry kosei balls here or home? (1 = Here, 2 = Home)......................____

3.4. In the **past month**, did you ever **run out** of kosei balls when there were still customers who wanted to buy kosei? (0 = No, 1 = Yes)........................____

If "No",

3.4.1. How do you make sure that you don't run out of kosei balls?_________

____

If "Yes",

3.4.2.1. How often did this happen? ....____________________

3.4.2.2. How did you feel when you ran out of kosei balls. Which of the following examples best indicates to your feeling?......................____

1 = I should have prepared or brought more kosei balls! I could have made more money! Tomorrow I will prepare or bring more balls.
2 = Good! It's sold out today. I made enough money. Tomorrow, I will prepare or bring the same amount of kosei balls.
3 = Other (specify):____

____

3.5. In the **past month**, did you ever have **remaining** paste or kosei balls when you wanted to end business for the day? (0 = No, 1 = Yes)...........................____

If "No",

3.5.1. How do you make sure that you don't have remaining paste or kosei balls?____

If "Yes",

3.5.2.1. How often did this happen?.................____________________

3.5.2.2. How many leftover balls did you usually have? Or if you had leftover paste, how many balls could you have made from that amount of paste?..______balls

3.5.2.3. What did you do with the leftover paste or balls?...___ ___ ___ ___
Enter all that apply

1 = Threw away, 2 = Gave to family, 3 = Gave to friends
4 = Other (specify):________________________________

3.5.2.4. Did you have any leftover paste or kosei balls **yesterday**?
(0 = No, 1 = Yes)......____

If "Yes",

3.5.2.4.1. How many leftover balls did you have yesterday? Or if you had leftover paste, how many balls could you have made from that amount of paste?...........................______balls

4. SALES

4.1. At what price did you sell kosei **yesterday**?.........._________Cedis/(______)balls

Reminder: Buy kosei balls (at least 5 balls) from the respondent.

4.2. Do you usually keep the **size** of kosei balls the same during the **day** or do you change the size at different times of the day? (1 = Same, 2 = Change)........____

If "Change",

4.2.1. By how much do you change the size during the day, and why?

By how much: ______________________________

Why: ______________________________

4.3. Depending on the availability of cowpeas, do you change the **size** of kosei balls at different times of the **year**? (0 = No, 1 = Yes)....................................____

If "Yes",

4.3.1. When do you change the size during the year, and by how much?

When: ______________________________

By how much: ______________________________

4.4. How much was your total sales from **kosei *[and the answer to Q.1.3.1]* yesterday?**

.........____________________Cedis

4.5. How much was your total sales **from kosei only yesterday**?

.........____________________Cedis

4.6. Were yesterday's sales **from kosei** normal for this time of the year?

(0 = No, 1 = Yes)......____

If "No",

4.6.1. How were they different?______________________________

____

____

____

4.7. Depending on the availability of cowpeas, do your daily sales **from kosei** change at different times of the year? (0 = No, 1 = Yes)..____

If "Yes",

4.7.1. When do they change, and by how much?

When: ____

By how much: ____

4.8. Do you have any other sources of income other than selling kosei [*and the answer to Q.1.3.1*]? (0 = No, 1 = Yes) ....____

If "Yes",

4.8.1 What are these income sources?.......______________________________

4.8.2. In the **past year**, was your income from selling **kosei [*and the answer to Q.1.3.1*]**:...____

1 = the most part of your total income
2 = not the most part but more than half of your total income
3 = half of your total income
4 = not little part but less than half of your total income
5 = the little part of your total income

5. USE OF COWPEA FLOUR AND MEAL

5.1. Have you ever used commercial dry cowpea flour to make kosei?................. ____

1 = Currently using, 2 = Once used but stopped, 3 = Never used

5.1.1. Why? ____

____

____

Say, "There is a new type of cowpea flour specially developed for kosei preparation. You can soak the flour in water for between 30 and 60 minutes to make paste, and the kosei made from that paste tastes as good as the kosei made from cowpea grains."

5.2. Would you be interested in using this new product to make kosei, if you could buy this product? (0 = No, 1 = Yes)... ____

If "Yes",

5.2.1.1. How much would you be willing to pay for 1 olonka or margarine tin of this product?... ____________ Cedis/ □ olonka □ margarine tin

5.2.1.2. From whom would you prefer to buy this product?
Enter all that apply. .... ___ ___ ___ ___

1 = Vendor in the market, 2 = Small retail store,
3 = Big retail store such as supermarkets
4 = Wholesaler, 5 = Flour processor,
6 = Other (specify): ____________________

If "No",

5.2.2. Why not? ____

____

____

Say, "Thank you for answering my questions."

[END OF INTERVIEW]

6. WEIGHT OF KOSEI BALLS

After the interview, measure the weight of kosei balls purchased.

.... ________ kg/(____) balls

A.1.2 Questionnaire for Processors of Cowpea or Soybean Flour, Weaning Foods and/or Gari[1]

[1] As mentioned in Chapter 1, cowpea-fortified *gari* (grated, fermented, and roasted cassava) was originally among the suggested target products for this case study.

Competitiveness of Cowpea-Based Processed Products: A Case Study in Ghana

- Questionnaire for Processors of Cowpea or Soyabean Flour, Weaning Foods and/or Gari–

Enumerator:____________________ **Respondent Number:**__________

Date:________________/2007 **Processor's location:**________________

Time Interview Began:____:____ **Time Interview Ended:**____:____

INSTRUCTIONS: Read the consent statement to the respondent. If she/he agrees, begin the interview.

(Revised Mar. 5, 2007, final version)

1. GENERAL INFORMATION ABOUT THE FACILITY

1.1. In what year did your facility start business? .... ______

1.2. How many **hours per day** does your facility operate in **each day of the week**?
...........Mon.: ______ h; Tue.: ______ h; Wed.: ______ h; Thu.: ______ h; Fri.: ______ h; Sat.: ______ h; Sun.: ______ h

1.2.1. Does the answer change depending on the seasons of the year? (0 = No, 1 = Yes).. ____

If "Yes",

1.2.1.1. When, why and how does it change?

When: ______________________________

Why: ______________________________

How: ______________________________

1.3. Are there periods in the year when your facility is closed? (0 = No, 1 = Yes).. ____

If "Yes",

1.3.1. Please tell me from and until when and for what reason?

From ______ until ______ Why: ______________________________

From ______ until ______ Why: ______________________________

1.4.1. How many hours **per week** do you usually work in your facility?.. ______ hours

1.4.2.1. How many **family members** other than you work in this facility?.. ______

1.4.2.2. How many hours **per week** do they usually work?.. ______ hours

1.4.3.1. How many hired **full-time** employees work in this facility?.. ______

1.4.3.2. How many hours **per week** do they usually work?.. ______ hours

1.4.4.1. How many hired **part-time** employees work in this facility?.. ______

1.4.4.2. How many hours **per week** do they usually work?.. ______ hours

1.5. In the **past year**, what products did you produce? Please tell me the brand names.
Enter the answer to the table below. Write (F), (W), or (G) beside the brand name if the product is cowpea or soyabean flour, weaning food, or gari, respectively.

1.6. What are the ingredients of each product? **Ask only about (F), (W), and (G). Check the box.**

1.7. From whom do you buy each ingredient? **Enter the code.**
1 = Farmer, 2 = Wholesaler, 3 = Vendor in the market, 4 = Other (specify)________________

	1.5	1.6 & 1.7																		
	Brand name	**Ingredients**																		
		Maize	**Sorghum**	**Millet**	**Rice**	**Wheat**	**Cassava**	**Yam**	**Cowpea**	**Soyabean**	**Ground nut**	**Plantain**	(1) (2) (3) (4)				(a) (b) (c) (d)			
													(1)	**(2)**	**(3)**	**(4)**	**(a)**	**(b)**	**(c)**	**(d)**
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
Source																				

1.8. How much of each of these products did you **produce** **last month**?

Enter the answers. If the respondent gives the answers in a unit other than kg or ton, ask how many kg that unit contains.
If the respondent shows difficulty in answering the question, ask about only one product, then ask about the proportion of each of the other products relative to the selected product.

1.9. In the **past year**, how much of each of these products did you **produce**?

	Brand name (see previous page)	1.8			1.9		
		Production last month	Unit	kg/unit	Production past year	Unit	kg/unit
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

In the table, circle the facility's most important weaning food and gari brands that use cowpeas as an ingredient;
If none of the weaning foods or gari uses cowpeas, choose the ones that use soyabeans;
If neither cowpeas nor soyabeans are used, circle the ones most produced.

Notes:

If the respondent produces cowpea flour, "cowpea/soyabean flour" hereafter refers to cowpea flour;

If the respondent does NOT produce cowpea flour, BUT soyabean flour, "cowpea/soyabean flour" hereafter refers to soyabean flour;

If the respondent produces NEITHER cowpea NOR soyabean flour, ignore "cowpea/soyabean flour" hereafter.

1.10. During the **last month**, at what price did you sell your cowpea/soyabean flour, [*selected weaning food*], and/or [*selected gari*]?
Ask for all kinds of packages they use.
If the unit price of products changes for different packages, ask about the selling share of each package.

		1.10								
	Product	Package (a)			Package (b)			Package (c)		
		Price (Cedis) last month	kg /unit	(%)	Price (Cedis) last month	kg /unit	(%)	Price (Cedis) last month	kg /unit	(%)
1	*Cowpea/Soyabean flour*									
2	*Selected weaning food*									
3	*Selected gari*									

1.11. In the **last month**, how much was your total sales for **all of the products** you produced, including cowpea/soyabean flour, weaning foods, gari, and non flour type products?..________________ Cedis

If the respondent cannot answer, ask Q.1.10 for all the products so that the total sales can be calculated later.

1.12. In the **past year**, how much was your total sales for **all of the products** you produced, including cowpea/soyabean flour, weaning foods, gari, and non flour type products?..________________ Cedis

2. EQUIPMENT

2.1. What equipment do you use to produce cowpea/soyabean flour, [*selected weaning food*], and/or [*selected gari*]? **Check the box in the table.**

2.2. In what year did you buy this equipment? **Enter the answer in the table below.**

2.3. Did you buy it new or used? **If "New", check the box "New";**
If "Used", 2.3.1. How old was the equipment when you bought it? **Enter the year.**

2.4. Who is the maker of this equipment? **Enter the answer.**

2.5. From whom did you buy this equipment? **Enter the answer.**

2.6. How much did this equipment cost? **Enter the answer.**

2.7. How much on average do you spend per year for repairing this equipment? **Enter the answer.**

2.1		2.2	2.3	2.4	2.5	2.6	2.7
Equipment		**Year bought**	**New or used**	**Maker**	**Seller**	**Price (Cedis)**	**Annual repair cost (Cedis)**
□	Grater		□ New □ ____				
□	Plate (Attrition) mill		□ New □ ____				
□	Hammer mill		□ New □ ____				
□	Roaster		□ New □ ____				
□	Press		□ New □ ____				
□	Dryer		□ New □ ____				
□	Winnower		□ New □ ____				
□	Sealing machine		□ New □ ____				
□			□ New □ ____				

2.8. What products do you process using the same equipment?
Enter the product names in the table below.
2.9. Are your **grater** and **milling machine(s)** powered by an electric motor or diesel engine? **Check the box.**
2.10. How much horsepower do the **grater** and **milling machine(s)** have? **Enter the answer.**
2.11. If you run this (these) **grater** and **milling machine(s) for one hour**, how much of each of those products can you produce?
Fill out the table below. If the respondent gives the answers in a unit other than kg, ask how many kg that unit contains.

	2.8	2.9	2.10	2.11		
Equipment	**Used to produce**	**Power**	**Horse-power**	**Production per hour**		
				Amount	**Unit**	**kg/unit**
☐ Grater		☐ electric motor ☐ diesel engine				
☐ Plate (Attrition) mill		☐ electric motor ☐ diesel engine				

(Continue to next page)

(Continued from previous page)

	2.8	2.9	2.10	2.11		
Equipment	**Used to produce**	**Power**	**Horse-power**	**Production per hour**		
				Amount	**Unit**	**kg/unit**
☐ Hammer mill		☐ electric motor ☐ diesel engine				
☐ Roaster						
☐ Press						
☐ Dryer						
☐ Winnower						
☐ Sealing machine						

3. COST OF FACILITY OPERATION

Say, "Now I would like to ask questions about the cost of operating your facility."

3.1. To operate your whole facility, not only for producing cowpea/soyabean flour, weaning foods, and/or gari, but also for producing all of your other products, what kind of costs do you have to pay?

1 = Wage, 2 = Electricity, 3 = Fuel (excluding gas for transportation), 4 = Water, 5 = Rent,
6 = Transportation (including gas for vehicle), 7 = Printing & Stationery, 8 = Telecommunication,
9 = Tax, 10 = Other (specify):____________________

Enter all the codes that apply (if the respondent doesn't mention any item listed, ask if she/he has to pay for the item).... ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

If wage was given as a cost of operation,
3.2. Do you pay a fixed monthly wage to your workers, or do wages change according to the volume of work?
(1 = Fixed monthly wage, 2 = Change)........____

If "fixed monthly wage",
3.2.1. How much do you spend for total wage payment **per month**?..........____________________ Cedis

If "Change",
3.2.2.1. How much did you spend for total wage payment **last month**?.......____________________ Cedis

3.2.2.2. How much was your total **annual** wage payment in the **past year**?..____________________ Cedis

If electricity was given as a cost of operation,

3.3.1. How much did you spend for electricity payment **last month**? .... ______________________ Cedis

3.3.2. Do you pay the same amount of money for electricity every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................. ____

If "Change",

3.3.2.1. How much **on average** do you pay for electricity every month?..... ______________________ Cedis

If fuel (excluding gas for transportation) was given as a cost of operation,

3.4.1. How much did you spend for fuel payment **last month**? .... ______________________ Cedis

3.4.2. Do you pay the same amount of money for fuel every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................. ____

If "Change",

3.4.2.1. How much **on average** do you pay for fuel every month?............ ______________________ Cedis

If water was given as a cost of operation,

3.5.1. From whom do you buy water?
(1 = Ghana Water Company, 2 = Other (specify)__________________, 3 = Both)............................... ____

3.5.2. How much did you spend for water payment **last month**? .... ______________________ Cedis

3.5.3. Do you pay the same amount of money for water every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................. ____

If "Change",

3.5.3.1. How much on average do you pay for water every month?........... ______________________ Cedis

If rent was given as a cost of operation,

3.6. How much is the rent? .... ________ Cedis/ □ month □ year

If transportation (including gas for vehicle) was given as a cost of operation,

3.7.1. How much did you spend for transportation **last month**? .... ________ Cedis

3.7.2. Do you pay the same amount of money for transportation every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................ ____

If "Change",

3.7.2.1. How much **on average** do you pay for transportation every month?... ________ Cedis

If printing and stationery was given as a cost of operation,

3.8.1. How much did you spend for printing and stationery **last month**? .... ________ Cedis

3.8.2. Do you pay the same amount of money for printing and stationery every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................ ____

If "Change",

3.8.2.1. How much **on average** do you pay for printing and stationery every month?... ________ Cedis

If telecommunication was given as a cost of operation,

3.9.1. How much did you spend for telecommunication **last month**? .... ________ Cedis

3.9.2. Do you pay the same amount of money for telecommunication every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................ ____

If "Change",

3.9.2.1. How much **on average** do you pay for telecommunication every month?... ________ Cedis

If tax was given as a cost of operation,

3.10. How much tax **on average** do you pay every month?.. ________________ Cedis/month

If other costs of operation were given, ask the same series of questions.

3.11.1. How much did you spend for [________________] **last month**? ....________________________ Cedis

3.11.2. Do you pay the same amount of money for [________________] every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)................____

If "Change",

3.11.2.1. How much **on average** do you pay for [________________] every month?...________________ Cedis

3.12. Are there any other costs that are specific to producing cowpea/soyabean flour, weaning foods, and/or gari but not included above? (0 = No, 1 = Yes)..._____

If "Yes", What are they, and how much do you pay for them?

(1)____ Cedis/ □ month □ year □ processing

(2)____ Cedis/ □ month □ year □ processing

(3)____ Cedis/ □ month □ year □ processing

Note: Especially check if the respondent pays for custom milling, custom roasting, etc.

3.13. Have you ever received any financial grants from the governmental, non-governmental organizations, or business associations?

(0 = No, 1 = Yes)........___

If "Yes",

3.13.1. For which products did you receive grants?
3.13.2. Who provided the grants?
3.13.3. When were the grants provided?

3.13.1	3.13.2	3.13.3
Products	**Provided by**	**When**

Among the cowpea/soyabean flour, selected weaning food, and/or selected gari, choose the most important one (considering the number of interviews already conducted in each category)

If cowpea/soyabean flour was selected, go to "4" (p.13), weaning food, "5" (p.17), and gari "6" (p.22).

4. PRODUCTION OF COWPEA/SOYABEAN FLOUR

Say, "Now I would like to ask some questions about your production of cowpea/soyabean flour."

4.1. In what year, did your facility start producing cowpea/soyabean flour? .... ____

If interviewing about cowpea flour,

4.2. Do you produce cowpea flour from cowpea grains that customers bring and ask you to mill? (0 = No, 1 = Yes)......... ____

4.3. Which variety of cowpeas do you use to produce flour?
(1 = Nigeria, 2 = Niger, 3 = Togo, 4 = Burkina, 5 Red, 6 = Other (specify):____________)
Enter all that apply.. __ __ __ __ __ __

4.4. How much cowpea/soyabean grains do you use each time you produce flour, and from that amount of grains, how much flour can you obtain?

.....Put ____ (unit: ____) [____ kg/unit] →→→ Obtain ____ (unit: ____) [____ kg/unit]

4.5. Do you produce the same amount of cowpea/soyabean flour every month, or does the amount change at different times of the year?
(1 = Same, 2 = Change)........................ ____

If "Change",

4.5.1. When does it change, by how much, and why?

When: ____________________

By how much: ____________________

Why: ____________________

4.6. What are the procedures you follow **each time you produce** cowpea/soyabean flour? Please explain step by step and estimate the time typically needed for each step. **Write down the answer.**

(1) ____ (______ □ min □ hour)

(2) ____ (______ □ min □ hour)

(3) ____ (______ □ min □ hour)

(4) ____ (______ □ min □ hour)

(5) ____ (______ □ min □ hour)

(6) ____ (______ □ min □ hour)

(7) ____ (______ □ min □ hour)

(8) ____ (______ □ min □ hour)

(9) ____ (______ □ min □ hour)

(10) ____ (______ □ min □ hour)

If the respondent produces both cowpea and soyabean flour,

4.6.2. Are there any differences in the procedures you use to process cowpea versus soyabean flour? (0 = No, 1 = Yes)….. ____

If "Yes",

4.6.2.1. What are the differences? ____

____

4.7.1. What is the material of the package(s) you use to sell cowpea/soyabean flour? **(see Q1.10. p.4)**....(a)_____; (b)_____; (c)______

1 = Polyethylene bag,   2 = Can,   3 = Paper,   4 = Other (specify)____________________________

4.7.2. How much does the packaging material cost?... (a)________________Cedis/(   ) packages
(b)________________Cedis/(   )packages
(c)________________Cedis/(   ) packages

4.8. Do you sell cowpea/soyabean flour for the same price throughout the year, or does the price change at different times of the year?
(1 = Same,   2 = Change) ....____

If "Change",
4.8. When does it change, by how much, and why?
When: ____________________
By how much: ____________________
Why: ____________________

4.9. I would like to ask you about your customers of cowpea/soyabean flour. What proportion do you sell to:
Wholesalers (%), Retailers (%), Restaurants (%), Individuals (%),
Other(specify): ____________ (%) ____________ (%)

4.10. Do you store cowpea/soyabean flour or do you sell all the flour as quickly as possible?
(1 = Store, 2 = Sell as quickly as possible).....____

If "Store",
4.10.1. How long can you store cowpea/soyabean flour at maximum? ....____ months

4.11. In the **past three years**, did your production of cowpea/soyabean flour increase, decrease, not change, or fluctuate?
(1 = Increased, 2 = Decreased, 3 = Didn't change, 4 = Fluctuated, 5 = Don't know)............____

4.11.1. Why?____________________

____

If the respondent currently produces only soyabean flour,

4.12 Have you ever produced cowpea flour? (0 = No, 1 = Yes)............____

If "Yes",

4.12.1. Why did you stop producing cowpea flour?____________________

____

____

4.13. What do you think are the advantages, disadvantages, and/or constraints to producing **cowpea** flour?____________________

____

____

____

If not done yet, and if the respondent allows, go to either "5" (p.17) or "6" (p.22), the one which is more important.
Otherwise, Say "Thank you for answering my questions", **and end the interview.**

5. PRODUCTION OF THE SELECTED WEANING FOOD

Say, "Now I would like to ask some questions about your production of [*selected weaning food*]."

5.1. In what year did your facility start producing [*selected weaning food*]?.. ________

If the selected weaning food contains cowpeas,

5.2. Which variety of cowpeas do you use to make [*selected weaning food*]?
(1 = Nigeria, 2 = Niger, 3 = Togo, 4 = Burkina, 5 Red, 6 = Other (specify):________________)
Enter all that apply.. ___ ___ ___ ___ ___ ___

5.3. How much of each ingredient do you use each time you produce [*selected weaning food*], and from that amount of ingredients, how much of the product can you obtain?

Ingredients (see Q.1.6, p.2)		Output
________ (unit: ______) [____ kg/unit]		
________ (unit: ______) [____ kg/unit]		
________ (unit: ______) [____ kg/unit]	→→→→→	________ (unit: ______) [____ kg/unit]
________ (unit: ______) [____ kg/unit]		

5.4. Do you produce the same amount of [*selected weaning food*] every month, or does the amount change at different times of the year? (1 = Same, 2 = Change)...................... ____

If "Change",

5.4.1. When does it change, by how much, and why?
When: ________________
By how much: ________________
Why: ________________

5.5. What are the procedures you follow **each time you produce** [*selected weaning food*]? Please explain step by step and estimate the time typically needed for each step. **Write down the answer.**

(1) ______________________________ (______ □ min □ hour)

(2) ______________________________ (______ □ min □ hour)

(3) ______________________________ (______ □ min □ hour)

(4) ______________________________ (______ □ min □ hour)

(5) ______________________________ (______ □ min □ hour)

(6) ______________________________ (______ □ min □ hour)

(7) ______________________________ (______ □ min □ hour)

(8) ______________________________ (______ □ min □ hour)

(9) ______________________________ (______ □ min □ hour)

(10) ______________________________ (______ □ min □ hour)

5.6.1. What is the material of the package(s) that you use to sell [*selected weaning food*]? **(see Q1.10. p.4)**
..................(a)_____; (b)_____; (c)_____

1 = Polyethylene bag, 2 = Can, 3 = Paper, 4 = Other (specify)____________________

5.6.2. How much does the packaging material cost?.. (a)__________ Cedis/(   ) packages
(b)__________ Cedis/(   )packages
(c)__________ Cedis/(   ) packages

5.7. Do you sell [*selected weaning food*] for the same price throughout the year, or does the price change at different times of the year?
(1 = Same, 2 = Change) ....____

If "Change",
5.7.1. When does it change, by how much, and why?
When: __________
By how much: __________
Why: __________

5.8. I would like to ask you about your customers of [*brand name of the selected weaning food*]. What proportion do you sell to:
Retailers (%), Wholesalers (%), Hospitals and health clinics (%), __________
Individual customers like mothers (%), Other (specify): __________ (%), __________ (%)

5.9. Do you store [*selected weaning food*] or do you sell the product as quickly as possible?
(1 = Store, 2 = Sell as quickly as possible).....____

If "Store",
5.9.1. How long can you store [*selected weaning food*] at maximum? ....____ months

If cowpeas are used to produce any weaning food in the facility,

5.10. In the **past three years**, did your production of weaning foods containing **cowpeas** increase, decrease, not change, or fluctuate?
(1 = Increased, 2 = Decreased, 3 = Didn't change, 4 = Fluctuated, 5 = Don't know) ....____
5.10.1. Why?__________
____

If soyabeans are used to produce any weaning food in the facility,

5.11. In the **past three years**, did your production of weaning foods containing **soyabeans** increase, decrease, not change, fluctuate?

(1 = Increased, 2 = Decreased, 3 = Didn't change, 4 = Fluctuated, 5 = Don't know) ....____

5.11.1. Why?____

____

If cowpeas and soyabeans are BOTH used to produce weaning foods in the facility (not necessarily in one product),

5.12.1 What are the reasons you use both cowpeas and soyabeans to produce your weaning foods?____________________

____

5.12.2. Are there any differences in the procedures you use to process cowpeas versus soyabeans? (0 = No, 1 = Yes).......____

If "Yes",

5.12.2.1. What are the differences?____

____

If cowpeas are NOT used to produce any weaning food in the facility,

5.13. Have you ever used cowpeas as an ingredient in your weaning foods? (0 = No, 1 = Yes)..................................____

If "No",

5.13.1. Why not? ____

If "Yes",

5.13.2. Why did you stop using cowpeas?____

If soyabeans are NOT used to produce any weaning food in the facility,

5.14. Have you ever used soyabeans as an ingredient in your weaning foods? (0 = No, 1 = Yes)............................... ____

If "No",

5.14.1. Why not? ______________________________

If "Yes",

5.14.2. Why did you stop using soyabeans? ______________________________

5.15. What do you think are the advantages, disadvantages, and/or constraints to producing a weaning food with cowpeas as an ingredient?

____

____

____

____

If not done yet, and if the respondent allows, go to either "4" (p.13) or "6" (p.22), the one which is more important. Otherwise, Say "Thank you for answering my questions"**, and end the interview.**

6. PRODUCTION OF THE SELECTED GARI

Say, "Now I would like to ask some questions about your production of [*selected gari*]."

6.1. In what year did your facility start producing [*selected gari*]?.. ________

If the selected gari contains cowpeas,

6.2. Which variety of cowpeas do you use to make [*brand name of the selected gari*]?

(1 = Nigeria, 2 = Niger, 3 = Togo, 4 = Burkina, 5 Red, 6 = Other (specify):________________)

Enter all that apply.. ___ ___ ___ ___ ___ ___

6.3. How much of each ingredient do you use each time you produce [*selected gari*] and from that amount of ingredients, how much of the product can you obtain?

Ingredients (**see Q.1.6, p.2**)		Output
________ (unit:) [kg/unit]		
________ (unit:) [kg/unit]	→→→→→	________ (unit:) [kg/unit]
________ (unit:) [kg/unit]		

6.4. Do you produce the same amount of [*selected gari*] every month, or does the amount change at different times of the year?

(1 = Same, 2 = Change)........................ ____

If "Change",

6.4.1. When does it change, by how much, and why?

When: ________________________________

By how much: ________________________________

Why: ________________________________

6.5. What are the procedures you follow **<u>each time you produce</u>** [*selected gari*]? Please explain step by step and estimate the time typically needed for each step. **Write down the answer.**

(1) ____ (______ ☐ min ☐ hour)

(2) ____ (______ ☐ min ☐ hour)

(3) ____ (______ ☐ min ☐ hour)

(4) ____ (______ ☐ min ☐ hour)

(5) ____ (______ ☐ min ☐ hour)

(6) ____ (______ ☐ min ☐ hour)

(7) ____ (______ ☐ min ☐ hour)

(8) ____ (______ ☐ min ☐ hour)

(9) ____ (______ ☐ min ☐ hour)

(10) ____ (______ ☐ min ☐ hour)

6.6.1. What is the material of the package(s) that you use to sell [*selected gari*]? **(see Q1.10. p.4)**........ (a)_____; (b)_____; (c)_____

1 = Polyethylene bag, 2 = Can, 3 = Paper, 4 = Other (specify)____________________

6.6.2. How much does the packaging material cost?.. (a)__________ Cedis/(____) packages
(b)__________ Cedis/(____)packages
(c)__________ Cedis/(____) packages

6.7. Do you sell [*selected gari*] for the same price throughout the year, or does the price change at different times of the year?
(1 = Same, 2 = Change) ....____

If "Change",

6.7.1. When does it change, by how much, and why?

When: __________

By how much: __________

Why: __________

6.8. I would like to ask you about your customers of [*brand name of the selected gari*]. What proportion do you sell to:
Wholesalers (%), Retailers (%), Restaurants (%), Individual customers (%),
Other (specify): __________ (%), __________ (%)

6.9. Do you store [*selected gari*] or do you sell the product as quickly as possible? (1 = Store, 2 = Sell as quickly as possible)....____

If "Store",

6.9.1. How long can you store [*selected gari*] at maximum? ....______ months

If <u>cowpeas are used</u> to produce any gari product in the facility,

6.10. In the **<u>past three years</u>**, did your production of gari containing **<u>cowpeas</u>** increase, decrease, not change, or fluctuate?
(1 = Increased, 2 = Decreased, 3 = Didn't change, 4 = Fluctuated, 5 = Don't know) ....____

6.10.1. Why?__________

If soyabeans are used to produce any gari product in the facility,

6.11. In the past three years, did your production of gari containing **soyabeans** increase, decrease, not change, or fluctuate?
(1 = Increased, 2 = Decreased, 3 = Didn't change, 4 = Fluctuated, 5 = Don't know) ....____

6.11.1. Why?____________________

If cowpeas and soyabeans are BOTH used to produce gari in the facility (not necessarily in one product),

6.12.1. What are the reasons you use both cowpeas and soyabeans to produce your gari?____________________

6.12.2. Are there any differences in the procedures you use to process cowpeas versus soyabeans? (0 = No, 1 = Yes)......____

If "Yes",

6.12.2.1. What are the differences?____________________

If cowpeas are NOT used to produce any gari in the facility,

6.13. Have you ever used cowpeas as an ingredient in your gari? (0 = No, 1 = Yes)..____

If "Yes",

6.13.1. Why did you stop using cowpeas?____________________

If soyabeans are NOT used to produce any gari in the facility,

6.14. Have you ever used soyabeans as an ingredient in your gari? (0 = No, 1 = Yes).. _____

If "Yes",

6.14.1. Why did you stop using soyabeans? ____

____

6.15. What do you think are the advantages, disadvantages, and/or constraints to producing a gari with cowpeas as an ingredient?

____

____

____

____

If not done yet, and if the respondent allows, go to either "4" (p.13) or "5" (p.17), the one which is more important.
Otherwise, Say "Thank you for answering my questions", **and end the interview.**

A.1.3 Questionnaire for Custom Millers

Competitiveness of Cowpea-Based Processed Products: A Case Study in Ghana

- Questionnaire for Custom Millers –

Enumerator:______________________________ **Respondent Number:**_____

Date:__________________/2007 **Area in Accra**________________________

Time Interview Began:____:______ **Time Interview Ended:**____:______

INSTRUCTIONS: Read the consent statement to the respondent. If she/he agrees, begin the interview.

(Revised Mar. 3, 2007, final version)

1.1. In what year did you start your milling business? ....__________
1.2. What do you mill? **Check all that apply.**
1.3. How often do you mill each? **Ask only about cowpeas, soyabeans and maize.**
1.4. How much do you charge for milling one olonka of each?
1.5. How much would you charge if your customer bring one olonka of [*(a) to (e)*]?

	1.2	1.3	1.4 & 1.5
	Grains/Dough to mill	**Frequency**	**Fee (Cedis)/olonka**
□	Cowpeas (dry)		
□	Cowpeas (wet)		
□	Soyabeans (dry)		
□	Soyabeans (wet)		
□	Maize (dry)		
□	Fermented maize (wet)		
□	Fermented maize dough (dry)		
□	Millet (dry)		
□	Millet (wet)		
□	Cassava (dry) [*kokonte*]		
□	Cassava (wet)		
□	Groundnuts		
□	Spices		
□	Other:____________ □ dry □ wet		
□	Other:____________ □ dry □ wet		
□	Other:____________ □ dry □ wet		
(a)	[Fermented maize] + Cowpea (wet)		
(b)	Fermented [maize + cowpea] dough (dry)		
(c)	Roasted maize (dry)		
(d)	Roasted [maize + cowpeas + groundnuts] (dry)		
(e)	Roasted [maize + soyabeans + groundnuts] (dry)		

If the fees are NOT the same between dry and wet,
1.6. Why do you charge different fees for dry and wet product?________________

If the fees are NOT the same between different grains,
1.7. Why do you charge different fees for different grains?__________________

If the respondent does <u>only wet</u> milling of <u>cowpeas</u>,

1.8.1 Would you be willing to do dry milling of cowpeas if your customers request?
(0 = No, 1 = Yes)......._____

If "Yes",

1.8.1.1. How much would you charge for one olonka of dry cowpeas?
......._______________Cedis

If "No",

1.8.1.2. Why not?____
____

If the respondent does <u>only dry</u> milling of <u>cowpeas</u>,

1.8.2 Would you be willing to do wet milling of cowpeas if your customers request?
(0 = No, 1 = Yes)......._____

If "Yes",

1.8.2.1. How much would you charge for one olonka of wet cowpeas?
......._______________Cedis

If "No",

1.8.2.2. Why not?____
____

1.9. If your customers bring a large quantity of grains or dough, do you usually offer a discount? (0 = No, 1 = Yes)......._____

If "Yes",

1.9.1. Could you give some example of such discount?
What to mill:____
How much to mill:______________________________olonka
How much (charge):_____________________________Cedis

1.10. I would like to ask you about the customers who bring you **<u>cowpeas</u>** for milling. What proportions are:

□ Kosei vendors (%), □ Individuals (%), □ Restaurants (%)
□ Other (specify): ____________ (%), ____________ (%)

1.11. How much cowpeas do you typically mill **<u>per day</u>**?
(Dry milling).............................______________________olonka
(Wet milling).............................______________________olonka

1.11.1. Does the amount of cowpeas you mill change depending on the seasons of the year? (0 = No, 1 = Yes)......_____

If "Yes",

1.11.1.1. When does it change, by how much, and why?
When:____
By how much:__________________________________
Why: ____

1.12. Which grades do you normally mill cowpeas for customers?
(1 = very fine, 2 = fine, 3 = coarse, 4 = very coarse)
(Dry milling)..____
(Wet milling) ....____

1.13. Is it easy to mill cowpeas to different flour grades? (0 = No, 1 = Yes)..........___

If "No",
1.13.1. Why?____
____
____

1.14. What do you have to do when you switch from milling cowpeas to milling other things, and vise-versa?

(from **dry** cowpeas to others)________________________________
____
(from **wet** cowpeas to others)________________________________
____
(from **dry** others to cowpeas)________________________________
____
(from **wet** others to cowpeas)________________________________
____

1.15. Is the machine you use to mill cowpeas a plate mill, hammer mill or other?......____

1 = Plate mill, 2 = Hammer mill, 3 = Other (specify):__________________

1.16. What is the brand of the milling machine?....................__________________

1.17. Is your mill powered by an electric motor or diesel engine?
(1 = electric motor, 2 = diesel engine)...____

1.18. What are the horsepower and capacity per hour of the milling machine?

..........(   ) horsepower; (   ) □ kg □ ton of (product:)/ hour

1.19. In what year did you buy the milling machine?............................. ________

1.20. From whom did you buy the milling machine?......________________________

1.21. How much did it cost?....................____________________________ Cedis

Say, "Thank you for answering my questions."

[END OF INTERVIEW]

A.1.4 Questionnaire for Retailers

Competitiveness of Cowpea-Based Processed Products: A Case Study in Ghana

- Questionnaire for Retailers -

Enumerator:_____________________________ **Respondent Number:**_____

Date:___________________/2007 **Area in Accra**________________________

Type of Retailer...____

1 = Grain/flour vendor in a market, 2 = Small shop in a market,
3 = Small shop located other than in the market, 4 = Supermarket
5 = Other (specify)____

Time Interview Began:_____:______ **Time Interview Ended:**_____:______

INSTRUCTIONS: Read the consent statement to a retailer. If she/he agrees, begin the interview.

(Revised Mar. 3, 2007, final version)

1. COWPEA/SOYABEAN FLOUR

1.1. In the **past year** did you sell cowpea or soyabean flour? (0 = No, 1 = Yes)......____

If "No", go to "2. WEANING FOODS" (p. 4).
If "Yes", continue.

1.2. What are the **brand** and **company** names of those products?
For small local firms without a brand or producer name, ask for the firms' location. Enter the answers in the table below.

1.3. Do you have each of these products on the shelf throughout the year?
Check the answer in the table below.

For the brand(s) "No",

1.3.1. In what months do you have shortage and why?

↓ **Put the brand number(s) for which the same answers were given.**

( ) Months: ____
Why: ____

( ) Months: ____
Why: ____

( ) Months: ____
Why: ____

1.4. In the **past month**, which one did you sell the most? Which one did you sell the second most? ... **Rank the products.**

	1.2		1.3	1.4
	Brand	**Producer/Location**	**Year round availability**	**Sales rank**
1			☐ No ☐ Yes	
2			☐ No ☐ Yes	
3			☐ No ☐ Yes	
4			☐ No ☐ Yes	
5			☐ No ☐ Yes	

1.5. From whom do you buy each of these products?

1 = Producer, 2 = Wholesaler, 3 = Grain/flour vendor in a market,
4 = Other (specify):____

↓ **Brand number**

(1)____ (2)____ (3)____ (4)____ (5)____

1.6. How much do you **pay** for each of these products when you purchase them?
If the respondent gives the price in a unit other than kg, ask how many kg that unit contains. Enter the answers in the table below.

1.7. Are there **seasonal** changes in the prices you **pay** to buy these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",
1.7.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months: ____________________
By how much: ____________________

( ) Months: ____________________
By how much: ____________________

( ) Months: ____________________
By how much: ____________________

1.8. At what price do you **sell** each of these products?

1.9. Are there **seasonal** changes in the prices at which you **sell** these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",
1.9.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months: ____________________
By how much: ____________________

( ) Months: ____________________
By how much: ____________________

( ) Months: ____________________
By how much: ____________________

		1.6			1.7	1.8			1.9
	Brand (see p.1)	**Purchase price (Cedis)**	**Unit**	**kg /unit**	**Season' change**	**Selling price (Cedis)**	**Unit**	**kg /unit**	**Season' change**
1					0 • 1				0 • 1
2					0 • 1				0 • 1
3					0 • 1				0 • 1
4					0 • 1				0 • 1
5					0 • 1				0 • 1

1.10. I'd like to ask you about your customers who buy each of these products. What proportion of [*brand 1*] do you sell to: Restaurants? ... Caterers? ... Individuals? ... Other customers? **Put the percentage in the table below.**

Repeat the same questions for each brand.

		1.10					
		Customers (%)					
	Brand (see p.1)	**Restaurants**	**Caterers**	**Individuals**	**Other 1***	**Other 2***	**Other 3***
1							
2							
3							
4							
5							

*Other 1 (specify):_____________; 2:______________; 3:______________

If the respondent sells <u>both cowpea and soyabean</u> flour,

1.11. Do you sell cowpea flour more or less than soyabean flour? Please select from the following choices. "Cowpea flour sells:..................................____

1 = Much more than soyabean flour,
2 = A little more than soyabean flour
3 = The same as soyabean flour,
4 = A little less than soyabean flour
5 = Much less than soyabean flour

2. WEANING FOODS

2.1. In the **past year** did you sell Tom Brown, Weanimix, any other maize-based flour type products, or maize dough? (0 = No, 1 = Yes)................................_____

If "No", go to "3. GARI". (p. 7)
If "Yes", continue.

2.2. What are the **brand** and **company** names of those products?
For small local firms without a brand or producer name, ask for the firms' location. Enter the answers in the table below.

2.3. Do you have each of these products on the shelf throughout the year?
Check the answer in the table below.

For the brand(s) "No",

2.3.1. In what months do you have shortage and why?

↓ **Put the brand number(s) for which the same answers were given.**

(__________) Months:______________________________

Why:______________________________

(__________) Months:______________________________

Why:______________________________

(__________) Months:______________________________

Why:______________________________

2.4. In the **past month**, which one did you sell the most? Which one did you sell the second most? ... **Rank the products.**

	2.2		2.3	2.4
	Brand	**Producer/Location**	**Year round availability**	**Sales rank**
1			☐ No ☐ Yes	
2			☐ No ☐ Yes	
3			☐ No ☐ Yes	
4			☐ No ☐ Yes	
5			☐ No ☐ Yes	

2.5. From whom do you buy each of these products?

1 = Producer, 2 = Wholesaler, 3 = Grain/flour vendor in a market
4 = Other (specify):____________________

↓ **Brand number**

(1)__________ (2)__________ (3)__________ (4)__________ (5)__________

2.6. How much do you **pay** for each of these products when you purchase them?
If the respondent gives the price in a unit other than kg, ask how many kg that unit contains. Enter the answers in the table below.

2.7. Are there **seasonal** changes in the prices you **pay** to buy these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",
2.7.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months:
By how much:

( ) Months:
By how much:

( ) Months:
By how much:

2.8. At what price do you **sell** each of these products?

2.9. Are there **seasonal** changes in the prices at which you **sell** these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",
2.9.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months:
By how much:

( ) Months:
By how much:

( ) Months:
By how much:

		2.6			2.7	2.8			2.9
	Product (see p.4)	**Purchase price (Cedis)**	**Unit**	**kg /unit**	**Season' change**	**Selling price (Cedis)**	**Unit**	**kg /unit**	**Season' change**
1					0 • 1				0 • 1
2					0 • 1				0 • 1
3					0 • 1				0 • 1
4					0 • 1				0 • 1
5					0 • 1				0 • 1

Ask only to <u>grain/flour vendors in a market</u>,

2.10. I'd like to ask you about your customers who buy each of these products. What proportion of [*brand 1*] do you sell to Individuals? ... Retailers? ... Other customers? **Put the percentage in the table below.**

Repeat the same questions for each brand.

		2.10				
		Customer (%)				
	Brand (see p.4)	**Individuals**	**Retailers**	**Other 1***	**Other 2***	**Other 3***
1						
2						
3						
4						
5						

*Other 1 (specify):______________; 2:______________; 3:______________

3. GARI

3.1. In the **past year** did you sell gari? (0 = No,   1 = Yes)................................___

If "No", Say "Thank you for answering my questions"**, and end the interview.**
If "Yes", continue.

3.2. What are the **brand** and **company** names of those products?
For small local firms without a brand or producer name, ask for the firms' location. Enter the answers in the table below.

3.3. Do you have each of these gari brands on the shelf throughout the year?
Check the answer in the table below.

For the brands "No",
3.3.1. In what months do you have shortage and why?

↓ **Put the brand number(s) for which the same answers were given.**
(   ) Months: ____________________
Why: ____________________

(   ) Months: ____________________
Why: ____________________

(   ) Months: ____________________
Why: ____________________

3.4. In the **past month**, which one did you sell the most? Which one did you sell the second most? ... **Rank the products.**

	3.2		3.3	3.4
	Brand	**Producer/Location**	**Year round availability**	**Sales rank**
1			□ No □ Yes	
2			□ No □ Yes	
3			□ No □ Yes	
4			□ No □ Yes	
5			□ No □ Yes	

3.5. From whom do you buy each of these gari brands?

1 = Producer, 2 = Wholesaler, 3 = Grain/flour vendor in a market,
4 = Other (specify):____________________
↓ **Brand number**
(1)________ (2)________ (3)________ (4)________ (5)________

3.6. How much do you **pay** for each of these gari brands when you purchase them?
If the respondent gives the price in a unit other than kg, ask how many kg that unit contains. Enter the answers in the table below.

3.7. Are there **seasonal** changes in the prices you **pay** to buy these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",

3.7.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months:
By how much:

( ) Months:
By how much:

( ) Months:
By how much:

3.8. At what price do you **sell** each of these gari brands?

3.9. Are there **seasonal** changes in the prices at which you **sell** these products?
(0 = No, 1 = Yes) **Circle the code in the table below.**

If "Yes",

3.9.1. In what months does the price change, and by how much?
↓ **Put the brand number(s) for which the same answers were given.**
( ) Months:
By how much:

( ) Months:
By how much:

( ) Months:
By how much:

		3.6			3.7	3.8			3.9
	Brand (see p.6)	**Purchase price (Cedis)**	**Unit**	**kg /unit**	**Season' change**	**Selling price (Cedis)**	**Unit**	**kg /unit**	**Season' change**
1					0 • 1				0 • 1
2					0 • 1				0 • 1
3					0 • 1				0 • 1
4					0 • 1				0 • 1
5					0 • 1				0 • 1

Ask only when the respondent sells either cowpea- or soyabean-fortified gari,

3.10. I'd like to ask you about your customers who buy each of these gari brands. What proportion of [*brand 1*] do you sell to Restaurants? ... Caterers? ... Housewives? ... Other customers? **Put the percentage in the table below.**

Repeat the same questions for each brand.

		3.10					
		Customers (%)					
	Brand (see p.6)	**Restaurants**	**Caterers**	**Individuals**	**Other 1***	**Other 2***	**Other 3***
1							
2							
3							
4							
5							

*Other 1 (specify):_______________; 2:_______________; 3:_______________

Say, "Thank you for answering my questions."

[END OF INTERVIEW]

A.1.5 Questionnaire for Weaning Mothers

Competitiveness of Cowpea-Based Processed Products: A Case Study in Ghana

- Questionnaire for Weaning Mothers –

Enumerator:______________________________ **Respondent Number:**_____

Date:__________________/2007 **Area in Accra**________________________

Time Interview Began:_____:______ **Time Interview Ended:**_____:______

INSTRUCTIONS: Read the consent statement to the respondent. If she agrees, begin the interview.

(Revised Feb. 20, 2007, final version)

1. WEANING FOODS

1.1. Do you give your baby weaning foods, that is, special foods easy for babies to eat?

If "Yes", continue.
If "No", go to "2. KOSEI".

1.2. How many children do you have, how old are they, and to which child do you give weaning foods?

Write down the age specifying month(s) or year(s).
Check the box if the child is weaned.

	1.2						
	1	2	3	4	5	6	7
Age							
Weaning	☐	☐	☐	☐	☐	☐	☐

1.3. How often do you give weaning foods to your child?................................____

1 = 3 times or more/day, 2 = Twice/day, 3 = Once/day, 4 = Less than once/day

1.4. What are the characteristics of the weaning foods that you prefer? Please rate each of the following criteria by using the number 1, 2 and 3: the 1 means "Very important", 2 means "Somewhat important", and 3 means "Not important".

1 = Very important, 2 = Somewhat important, 3 = Not important

(1) Easy for you to prepare..____
(2) Cheap ....____
(3) Nutritional value is high...____
(4) Give a variety of foods to your child......................................____
(5) Your child likes the taste..____
(6) Easy for your child to digest..____
(7) Your mother or grandmother prepared in the same way.................____

1.4.1. Are there any other characteristics of weaning foods that you think are important?________________________________

____

____

1.5. Do you prepare your own weaning foods, or do you buy ready-to-use commercial weaning foods, or do you use both types?...____

1 = Always self prepared, 2 = Always commercial, 3 = Both

If "Always self prepared" or "Both", go to the next page.
If "Always commercial", go to p. 3.

Questions for "Always self prepared" and "Both":

1.5.1.1. **Ask only if "Always self prepared",**
Why don't you use commercial weaning foods?................ ___ ___ ___
Enter all that apply.

1 = Your child doesn't like the taste of commercial weaning foods
2 = Commercial weaning foods are expensive
3 = Other (specify):______________________________
____

1.5.1.2. To make weaning foods, do you use: **Check all that apply.**

□ Maize □ Sorghum □ Millet □ Rice □Cassava □ Yam
□ Cowpeas □ Soyabeans □ Groundnuts □ Bambara beans
□ Milk □ Egg □ Fish □ Meat
□ Other (specify):______________________________

1.5.1.3. What are the relative amounts of those ingredients in the weaning foods that you prepare? If you prepare different types of weaning foods, **please begin with the one you prepare the most often**.
Enter the answers in the table below.

[Codes: L = Large amount; M = Medium amount; S = Small amount]

	Maize	**Sorghum**	**Millet**	**Rice**	**Cassava**	**Yam**	**Cowpeas**	**Soyabeans**	**G-nuts**	**B-beans**	**Milk**	**Egg**	**Fish**	**Meat**	
Formula 1															
Formula 2															
Formula 3															

1.5.1.4. How do you prepare [*Formula 1*]? **Please begin with the materials you buy.**
(1) ____
____
(2) ____
____
(3) ____
____
(4) ____
____

If the respondent prepares dough or Tom Brown from raw materials,

1.5.1.4.1. How often do you prepare dough/Tom Brown?
..........________________

1.5.1.4.2. How much do you prepare dough/Tom Brown each time?
..........________________

1.5.1.4.3. How long does it take to prepare dough/Tom Brown each time?..........____

1.5.1.4.4. How long can you keep dough/Tom Brown before it goes bad?..___days

1.5.1.5. From whom did you learn how to prepare weaning foods?...___ ___ ___
Enter all that apply.

1 = Mother, 2 = Health worker, 3 = Other (specify):________________

Questions for "<u>Always commercial</u>" and "<u>Both</u>":

1.5.2.1. **Ask only if "Always commercial",**
Why don't you make weaning foods by yourself?...........___ ___ ___ ___
Enter all that apply.

1 = It takes time to prepare by yourself
2 = Your child prefers the taste of commercial weaning foods
3 = Commercial weaning foods are more nutritious
4 = Other (specify):____

(Continue to next page)

1.5.2.2. What brands of weaning foods do you buy? If you buy different brands, **please begin with the one you buy the most often**.

Enter the answer in the table below.

If the answer includes products of local small firm without a brand name, ask the respondent to describe the products.

1.5.2.3. Where do you buy each of these weaning foods, and how much does each cost? **Enter the code and answer.**

1 = Market, 2 = Small store, 3 = Supermarket,
4 = Other (specify)____________________

	1.5.2.2	1.5.2.3	
	Brand/Description of weaning foods	**Where**	**Price (Cedis)**
1			
2			
3			

1.5.2.4. Do you add any other ingredients to any of the commercial weaning foods you buy before you give them to your child? (0 = No, 1 = Yes)..........____

If "Yes",

1.5.2.4.1. What do you add to each commercial weaning foods, and why?

(1) Add: ____________________
Why: ____________________

(2) Add: ____________________
Why: ____________________

(3) Add: ____________________
Why: ____________________

1.5.2.5. Have you ever bought cowpea-fortified maize dough? (0 = No, 1 = Yes) ....____

If "Yes",

1.5.2.5.1.1. Where did you buy?......____________________

1.5.2.5.1.2. How often do you buy?......____________________

If "No",

1.5.2.5.2. Why not?____________________

1.5.2.6. Have you ever bought weanimix? (0 = No, 1 = Yes)......................_____

If "Yes",

1.5.2.6.1.1. Where did you buy?......______________________________

1.5.2.6.1.2. How often do you buy?......___________________________

If "No",

1.5.2.6.2. Why not?____
____

Questions for "<u>Both</u>":

1.5.3.1. How often do you use commercial weaning foods compared to weaning foods that you prepare by yourself? ...._____

1 = Most of the time, 2 = More often than self-prepared
3 = As often as self-prepared, 4 = Less than self-prepared, 5 = Rarely

1.5.3.2. Does the answer change depending on the seasons of the year?
(0 = No, 1 = Yes).....______

If "Yes",

1.5.3.2.1. When does it change, by how much, and why?

When: ____

By how much: ________________________________

Why: ____

2. KOSEI

Say, "Now I would like to ask you some questions about foods that you prepare."

2.1. How often do you prepare a meal with **cowpeas** as an ingredient?...______________

2.1.1. Does the answer change depending on the seasons of the year?
(0 = No, 1 = Yes)......____

If "Yes",

2.1.1.1. When does it change, by how much and why?

When: ________________________________
by how much: ________________________________
Why: ________________________________

2.2. What dishes do you prepare using cowpeas? **Please begin with the one you prepare the most often**.

(1) ________________________________
(2) ________________________________
(3) ________________________________
(4) ________________________________
(5) ________________________________

2.3. Do you eat kosei? (0 = No, 1 = Yes)...____

If "Yes",

2.3.1. How often do you eat **kosei**?..........................______________

2.3.2. Does the answer change depending on the seasons of the year?
(0 = No, 1 = Yes)......____

If "Yes",

2.3.2.1. When does it change, by how much and why?

When: ________________________________
By how much: ________________________________
Why: ________________________________

2.4. Do you know how to prepare kosei? (0 = No, 1 = Yes)...........................____

If "No", go to 2.5.
If "Yes",

2.4.1. Do you prepare kosei at home? (0 = No, 1 = Yes)..................____

If "Yes", go to 2.4.2.
If "No",

2.4.1.1. Why not? **Enter all that apply**............___ ___ ___

1 = It's tedious to make, 2 = It's cheap to buy
3 = Other (specify):______________________________
____
____

2.4.2. If a commercial cowpea powder was available that you could use to easily prepare good quality of kosei, would you be interested in buying it and make kosei at home? (0 = No, 1 = Yes)........................___

If "No",

2.4.2.1. Why not?______________________________
____

2.5. Have you ever bought cowpea flour? (0 = No, 1 = Yes)..........................___

If "Yes",

2.5.1.1. How often do you buy cowpea flour?...........______________

2.5.1.2. Where do you usually buy cowpea flour?...........................___

1 = Market, 2 = Small store, 3 = Supermarket,
4 = Other (specify)______________________________

2.5.1.3. What do/did you use it for?______________________________
____
____
____

If "No" or "Once bought but not any more",

2.5.2. Why not? ______________________________
____
____

3. GARI

3.1. Do you eat gari? (0 = No, 1 = Yes) ....____

If "Yes",

3.1.1. How often do you eat gari?........................______________

3.1.1.1. Does the answer change depending on the seasons of the year? (0 = No, 1 = Yes)......._____

If "Yes",

3.1.1.1.1. When does it change, by how much and why?

When: ______________________________

By how much: ______________________________

Why: ______________________________

3.2. What dishes do you prepare using gari, when you prepare foods for your family? **Please begin with the one you prepare the most often**.

(1) ______________________________

(2) ______________________________

(3) ______________________________

(4) ______________________________

(5) ______________________________

3.3. Do you make gari from cassava yourself? (0 = No, 1 = Yes) ...._____

3.4. Where do you usually buy gari?..._____

1 = Market, 2 = Small store, 3 = Supermarket,
4 = Other (specify)______________________________

3.5. How much do you usually pay for 1 olonka of gari?.................____________Cedis

3.6. Let's assume that you found two different types of gari on the shelf in the store. One is normal gari that you always buy. The other one has a label which reads "New Gari – Supplemented by **Cowpeas** – More Nutritious". Do you think you would want to try this new product **if the price is the same**? (0 = No, 1 = Yes)......._____

If "No",

3.6.1. Why not?____

If "Yes",

3.6.2. **<u>If the price of the new product was higher than the price of gari you usually buy</u>**, how much more would you be willing to pay for the new product?......<u>Up to ____________ Cedis of increase</u>

3.7. Let's assume that you found two different types of gari on the shelf in the store. One is normal gari that you always buy. The other one has a label which reads "New Gari – Supplemented by **<u>Soyabeans</u>** – More Nutritious". Do you think you would want to try this new product **<u>if the price is the same</u>**? (0 = No, 1 = Yes)......___

If "No",

3.7.1. Why not?____

If "Yes",

3.7.2. **<u>If the price of the new product was higher than the price of gari you usually buy</u>**, how much more would you be willing to pay for the new product?......<u>Up to ____________ Cedis of increase</u>

Say, "Thank you for answering to my questions."

[END OF INTERVIEW]

<u>4. NUTRITIONAL STATUS OF THE CHILD</u>

Observe the respondent's child. Does she/he show an apparent symptom of malnutrition? (0 = No, 1 = Yes) ....____

APPENDIX 2

Volume-Weight Conversion Rates

Olonka-kg conversion rates obtained from the samples of different commodities are presented in Table A.2.1. The samples were purchased and weighed as described in Chapter 3. The ratios of "heaped up" olonka to kg (figures in the right column in Table A.2.1) were used throughout this study when the unit conversions were necessary between olonka and kg.

Table A.2.1 Olonka-kg conversion rates

Commodity	kg/olonka (flat to cup)	kg/olonka (heaped up)
Cowpea*	2.2291	2.5094
Gari	1.7174	1.9782
Groundnut	1.9803	2.2426
Maize	2.3043	2.5344
Millet	2.3550	2.6504
Onion	1.6037	3.1123
Pepper	0.6193	0.8642
Sorghum	2.3666	2.6878
Soybean	2.2377	2.5039
Tom Brown	1.4406	1.7080

* type called "Niger"

Source: (all except Tom Brown) samples purchased at Nima Market, Accra, on March 23, 2007; (Tom Brown) G. A. Annor, personal communication, November 6, 2007; samples were weighed at a laboratory of the Department of Nutrition and Food Science at UGL.

To measure the volume of fermented maize dough, vendors commonly used a measuring cup called the "rubber cup," which was different in size from the olonka cup. The rubber cup-kg conversion rate obtained from the sample of fermented maize dough is presented in Table A.2.2. This rate was used to derive the price per kg of fermented maize dough sold by the grain/flour-type product vendor respondents (see Section 6.2.1).

Table A.2.2 Rubber cup-kg conversion rate

	kg/rubber cup (flat to cup)	kg/rubber cup (heaped up)
Fermented maize dough	3.2998	6.8033

Source: Sample purchased at Nima Market, Accra, and weighed at a laboratory of the Department of Nutrition and Food Science at UGL, on March 23, 2007.

APPENDIX 3

Representative Prices of Raw Materials

For the prices of raw materials, the same representative prices calculated for each commodity were used across the industrial processor respondents, whether the respondents purchased raw materials from markets or middlemen or grew them on their own farms. Also, when the kosei vendor respondents could only recall the monetary value of onion, pepper, and/or salt that they used, the weight of these ingredients was estimated using their representative price per kg. The values and sources of these representative prices are summarized in Table A.3.1.

Table A.3.1 Representative price per kg of raw materials

Raw material	Rep. price/kg (¢)	Source
Cowpeas	5,474	See Section 4.2.5.
Groundnuts	7,650	See Section 6.2.6.
Maize	3,000	See Section 6.2.6.
Millet	4,450	Median of ¢4,800 per kg at Makola market (commodity classified as "millet (sanio, grain)") and ¢4,100 per kg at Tema (commodity classified as "millet (sounna, grain)") in February 2007, obtained from http://www.tradenet.biz/ (retrieved October 1, 2007). These two locations and commodity classifications were selected because the price data obtained were close to the wholesale price data (urban average) obtained from the MoFA up to December 2006.
Onion	7,013	Median of: (1) ¢20,000 per olonka observed by the author at Nima market on March 23, 2007, converted to price per kg using the olonka-kg conversion rate of 3.1123 (see Appendix 2); (2) ¢25,000 per olonka observed by the author at Madina market on March 27, 2007, converted to price per kg using the olonka-kg conversion rate; and (3) ¢7,600 per kg at Makola market (yellow variety) and ¢3,750 per kg at Agbogbloshie market (violet variety) in March 2007, obtained from http://www.tradenet.biz/ (retrieved July 13, 2007).
Pepper	32,545	Mean of: (1) eight prices per olonka each reported by eight kosei/agawu vendor respondents, respectively; (2) ¢30,000 per olonka observed by the author at Nima market on March 23, 2007; and (3) ¢10,000 for 0.5158 kg observed by the author at Madina market on March 27, 2007. (Prices per olonka were converted to prices per kg using the olonka-kg conversion rate of 0.8642 [see Appendix 2].) (standard deviation = 7,066.)
Salt	5,126	Mean of 19 prices per kg each reported by 18 kosei/agawu vendor respondents, respectively (one of the respondents reported 2 different prices for different purchase units). (standard deviation = 1,007.)
Soybeans	4,069	See Section 6.2.6.

APPENDIX 4

Notes on the Calculation of Representative Budgets for Dry Cowpea Meal and Tom Brown/Weanimix

The data collected from the industrial grain flour/weaning food processor respondents needed modifications to calculate budgets for producing dry cowpea meal, Tom Brown, cowpea-Weanimix, and soybean-Weanimix, because no respondent was actually producing all of these products. In other words, the data had to be adjusted to reflect the difference in the cost of production between our target products and the products for which the data were collected. Also, some values needed to be assumed or estimated because of missing or apparently erroneous information. The main methods used for these modifications, assumptions, and estimations were noted below (except those ones already explained in the text of this thesis). Further details are available from the author upon request.

Raw material

(1) The input-output ratio (or [1 – waste rate]) was assumed not to change between soybean flour, cowpea flour, and cowpea meal production (for the analysis of dry cowpea meal), as well as between maize, cowpea, soybean, and groundnut processing (for the analysis of Tom Brown/Weanimix).

(2) There was a respondent whose cowpea flour contained onion as an ingredient. To construct a budget for producing dry cowpea meal with cowpeas as the only ingredient, the cost of onion was subtracted from the raw material costs and an estimated cost of cowpea grain that would be needed to obtain the same end product weight was added.

Equipment

(1) The purchase prices of the equipment were inflation-adjusted using the CPI obtained from the IMF.

(2) Costs for owned equipment were calculated as follows:

- Plate mill: to estimate the monthly share of the target products in the purchase cost, a lifetime of 30 years was arbitrarily assumed, and the purchase price (inflation-adjusted) was divided by 360 (= 30 × 12). When a respondent mentioned that she/he paid maintenance costs but did not know how much, it was assumed that she/he re-sharpened the plates once a month paying ¢30,000 (the charge of ¢30,000 is information obtained from custom millers). When a respondent mentioned that there was no maintenance cost, we thought it was unrealistic. Therefore, the same assumption was made about the re-sharpening of the plates, and the cost was added.

- Sealer: to estimate the monthly share of the target products in the purchase cost, a lifetime of three years was arbitrarily assumed, and the purchase price was divided by 36 (= 3 × 12). However, a wide range was observed in the lifetime of sealers across the respondents. If a sealer was already used for more than three years when the interview was conducted, it was assumed that the lifetime would end this year (2007); if a respondent replaced sealers more frequently than every three years (e.g., buy a new sealer every 6 months), the given answer was used for calculation of the monthly cost.

- Gas oven, roaster, roasting pan, dryer, sieving machine, and dehuller: to estimate the monthly share of the target products in the purchase cost, a lifetime of 15 years was arbitrarily assumed, and the purchase price was divided by 180 (= 15 × 12).

<u>Transportation (including fuel for vehicles)</u>

(1) Vehicle purchase and maintenance costs were included in the transportation costs. The purchase prices of the vehicles were inflation-adjusted using the CPI obtained from the IMF. To estimate the monthly share of the purchase cost, a lifetime of 15 years was arbitrarily assumed, and the purchase price was divided by 180 (= 15 × 12).

<u>Miscellaneous</u>

(1) One of the respondents mentioned that a certification from the Ghana Standards Board (GSB) cost ¢8,000,000 per year for all the products and a registration from the Food and Drugs Board (FDB) cost ¢1,000,000 every three years per product. These payments were added to the miscellaneous costs of all the respondents (the cost of GSB certification was multiplied by the share of the target products in the value of all products produced), whether or not the respondents mentioned that they paid these fees.

<u>Share calculation</u>

(1) Some respondents did not produce but bought, packaged, and resold an oil product. Due to lack of information, this product was not included in the share calculation of the budgeting analysis. (However, if the payment for different cost components reported by the respondents in fact included the payment for the resources used to sell this oil product, the calculated share of the target products in the payment for such cost components would be overestimated.)

APPENDIX 5

Data and Notes on the Calculation of Representative Budgets for Kosei Preparation

The data collected from 13 kosei vendor respondents on the costs and sales of kosei business are presented below. Many numerical values that were supposed to be collected from kosei vendor respondents were missing or found to be inconsistent with other pieces of information obtained from the same respondents. As a result, the unit cost calculation involved a number of estimations and assumptions. Also, since all the respondents were not preparing kosei in the same way, some modifications were made to several figures in the data to adjust for uncommon payments made by some of the respondents. The notes following Table A.5.1 explains major estimations, assumptions, and modifications that were made. Further details are available from the author upon request.

Table A.5.1 Cost and sale *per day* of kosei business

Resp. number	Cowpea grain	Onion	Pepper	Other ingredients	Salt	Water	Oil	Fuel	Custom dehull/mill	Hired assistants	Total cost*	Revenue	Return*	Kosei produced (kg)*	Number of balls*	Input-output conversion rate*	kg/ball
1	4,667	333	333	0	86	3,600	18,000	6,429	2,000	0	35,448	20,539	-14,908	1.4	41	2.42	.034
2	74,627	50,000	35,000	**0**	1,200	12,000	114,000	14,736	9,498	0	311,061	299,138	-11,923	16.5	598	2.42	.028
3	14,167	5,000	2,500	**0**	286	2,000	25,000	5,000	2,000	0	55,952	100,000	44,048	7.6	200	4.28	.038
4	18,000	5,000	1,000	0	400	1,500	20,000	5,000	3,500	0	54,400	**57,000**	2,600	3.5	114	1.95	.031
5	70,000	20,000	10,000	0	1,800	0	60,333	15,556	7,000	0	184,689	293,142	108,453	17.3	586	2.42	.030
6	44,776	13,125	5,000	0	1,100	7,500	34,545	10,000	6,332	0	122,379	159,640	37,261	10.8	319	2.42	.034
7	8,333	4,000	2,000	**0**	174	250	8,274	1,250	2,000	0	26,282	35,000	8,718	2.5	70	2.12	.036
8	102,612	7,000	3,929	**0**	1,000	450	23,571	23,571	16,413	0	178,546	652,276	473,729	28.1	1,305	2.42	.022
9	43,200	3,333	3,333	**0**	893	2,250	44,444	8,000	4,960	0	110,415	130,000	19,585	7.4	260	1.78	.029
10	34,204	12,500	10,135	0	2,000	1,500	70,000	7,000	6,488	0	143,827	160,000	16,173	10.8	320	2.42	.034
11	24,096	10,000	3,000	0	600	2,100	17,778	7,000	**5,291**	0	69,865	112,072	42,207	8.5	224	2.78	.038
12	12,438	3,333	3,667	**0**	316	1,500	19,167	3,500	3,498	**0**	47,418	65,231	17,813	3.6	130	2.42	.028
13	4,975	1,429	1,429	0	167	403	5,000	2,000	2,276	0	17,678	**28,000**	10,322	1.8	56	2.47	.033
mn.	35,084	10,389	6,256	0	801	2,888	35,393	8,460	4,502	0	104,458	162,464	58,006	9.2	325	2.54	.032
s.d.	30,841	13,118	9,158	0	671	3,486	30,416	6,164	1,638	0	83,781	172,778	128,798	7.7	346	0.84	.005

Notes: *: variable not reported by the respondents but calculated by the author using the values of other variables; highlighted: estimated values; boxed: assumed values; bolded: modified values; mn.: mean excluding assumed values; s.d.: standard deviation excluding assumed values.
Source: Fieldwork in Accra, February and March 2007.

Other ingredients

(1) Respondents 2, 3, 7, 8, 9, and 12: Only these respondents used ingredients other than cowpeas, onion, pepper, and salt. Even if used, the share of other ingredients in the total cost was small for most respondents. Furthermore, other ingredients reported by the respondents (ginger, garlic, green leaves, and spices) seemed to have light weight relative to their volume. Therefore, the contribution of all such ingredients to the cost of preparation and weight of kosei were ignored (the payment for these ingredients was subtracted from the cost). By doing so, the representative budget derived using the data collected from the 13 respondents became a budget for preparing kosei using the same ingredients (cowpeas, onion, pepper, and salt)[2].

Salt

(1) Respondent 9: The frequency of purchase and the quantity at each purchase were missing information. To assume the cost of salt the respondent used the day before the interview was conducted, the mean quantity of salt used for 1 kg of cowpea grains was calculated using the data obtained from 11 other kosei respondents (0.030 kg). Then, using the price of salt the respondent could recall (¢2,500 for 0.5 kg) and the amount of cowpeas the respondent used (6.02 kg), the cost of salt needed for the amount of kosei prepared by the respondent was calculated as follows: $0.030 \times 6.02 \times (2{,}500 / 0.5) = 893$.

(2) Respondent 12: The respondent answered that she paid ¢20,000 for 1 olonka of salt and used it also for family cooking. Since the weight of 1 olonka of salt was missing, the mean price of salt per kg was calculated from the information obtained from the 17 respondents (including agawu vendors) who could recall the cost of salt (¢5,126). Then, the same calculation done for Respondent 9 was applied: $0.030 \times 2.08 \times 5{,}126 = 316$.

Water

(1) Respondent 13: The respondent did not know how much she paid for the water that she used for kosei preparation (she paid a water bill to the Ghana Water Company every month). To assume the cost of water, the mean value of the ratio of water cost to cowpea cost was calculated using the data collected from the other kosei respondents, excluding one outlier. The value obtained was 0.081. Then, this number was multiplied by the cost of cowpeas that the respondent used the day before the interview was conducted (¢4,975): $0.081 \times 4{,}975 = 403$.

---

[2] As shown in Table A.5.1, no obvious difference was found between the daily revenue as well as return of those respondents who used additional ingredients and the daily revenue and return of those who used only cowpeas, onion, pepper, and salt—a wide range in both revenues and returns was observed in both groups. If it is appropriate to use the size of revenue and/or return as a measurement of success in business, adding extra ingredients to kosei does not seem to be a key for success, at least among the 13 respondents.

Fuel

(1) Respondent 2: The respondent was the only vendor interviewed who used LP-gas as fuel. However, the respondent could not recall its cost. Therefore, the mean ratio of the cost of charcoal to 1 kg of kosei prepared was calculated (¢895) using the information obtained from 10 other respondents (excluding 1 outlier and 1 respondent using firewood), and multiplied by the estimated quantity of kosei prepared by this respondent (16.46 kg) to assume the fuel cost paid by this respondent: 895 × 16.46 = 14,736.

(2) Respondent 7: The respondent purchased charcoal for the preparation of kosei, hausa koko, and pinkaso. There was no information available to identify the share of kosei relative to hausa koko and pinkaso. She reported ¢10,000 as the cost of fuel she used for the business during the day before the interview was conducted. It was assumed that: (1) the ratio of charcoal used for kosei to the charcoal used for pinkaso was proportional to the ratio of oil used for kosei to the oil used for pinkaso (3 / (3+13): see the notes for oil); and (2) hausa koko needed the mean amount of charcoal that was used for kosei and pinkaso, that is, the ratio of charcoal use for kosei, hausa koko, and pinkaso was assumed to be 3 : (3+13)/2 : 13. Therefore, the assumed cost of charcoal used by the respondent for preparation of kosei was calculated as: $10,000 \times 3 / \{3 + (3+13)/2 + 13\} = 1,250$.

Custom dehulling and milling

(1) Respondents 1, 2, 3, 4, 5, 6, 7, and 8: The cost of custom dehulling and/or milling was missing. The value was estimated from the quantity of cowpea grain and/or dehulled cowpeas that the respondents used as well as the representative custom milling charge for that amount of cowpeas—which was calculated based on the data collected from custom millers and other kosei respondents who could recall the custom milling charge (see Table 4.9).

(2) Respondent 11: The respondent's answer included ¢6,000 as transportation cost. No other respondent mentioned paying transportation cost to go to custom milling. The reason might be that the other respondents had a custom miller within walking distance from their house, or it might be that they did not think of transportation cost when asked about the cost of custom milling, even though they were actually paying for transportation. There is no information available to know which was the case. Therefore, the transportation cost paid by this respondent was ignored (¢6,000 was subtracted from the calculated cost of custom milling [¢11,291]). By doing so, the representative budget derived using the data collected from the 13 respondents was not reflective of any transportation cost.

Hired assistants

(1) Respondent 12: The respondent was the only vendor who hired assistants among the 13 kosei respondents. The payment for assistants on the day before the interview was

conducted (¢20,000 per day for 2 assistants [i.e., ¢10,000 per assistant]) was removed from the cost variables. By doing so, the estimated returns of each respondent included the return to all the labor needed to prepare kosei.

Revenue

(1) Respondents 4 and 13: The respondents reported that they had leftover balls the day before the interview was conducted. The values of leftover balls reported by the respondents were added to their revenue so that the figures reflect the number of balls they prepared times the price per ball.

The values in Table A.5.1 were divided by the estimated weight of kosei prepared by each respondent to obtain the unit cost, revenue, and return. The results are shown in Table A.5.2.

Table A.5.2 Cost and sale *per kg* and representative budgets of kosei business

	Respondent number	Cowpea grain	Onion	Pepper	Salt	Water	Oil	Fuel	Custom dehull/mill	Total cost	Revenue	Return	kg/ball	Q_m/Q_k
	1	3,389	242	242	62	2,614	13,072	4,669	1,452	25,744	14,916	-10,827	.034	.44
	2	4,533	3,037	2,126	73	729	6,924	895	577	18,893	18,169	-724	.028	.41
	3	1,867	659	330	38	264	3,295	659	264	7,375	13,181	5,806	.038	.24
	4	5,173	1,437	287	115	431	5,748	1,437	1,006	15,635	16,383	747	.031	.52
	5	4,045	1,156	578	104	0	3,486	899	404	10,671	16,938	6,266	.030	.42
	6	4,153	1,217	464	102	696	3,204	928	587	11,351	14,808	3,456	.034	.42
	7	3,283	1,576	788	69	98	3,259	492	788	10,353	13,787	3,434	.036	.48
	8	3,655	249	140	36	16	840	840	585	6,360	23,234	16,874	.0215	.44
	9	5,826	450	450	120	303	5,994	1,079	669	14,890	17,532	2,641	.029	.59
	10	3,165	1,157	938	185	139	6,478	648	600	13,311	14,808	1,497	.034	.42
	11	2,834	1,176	353	71	247	2,091	823	622	8,217	13,181	4,964	.038	.37
	12	3,464	928	1,021	88	418	5,338	975	974	13,207	18,169	4,961	.028	.42
	13	2,732	784	784	92	221	2,746	1,098	1,250	9,707	15,375	5,668	.033	.41
mean excl. assumed values: (1)		3,701	1,082	654	86	496	4,806	1,278	823	12,747	16,191	3,443	.032	.43
s.d. excl. assumed values: (2)		1,055	726	522	42	708	3,089	1,146	282	5,256	2,736	6,029	.005	.11
(1) + 2×(2)		5,812	2,534	1,697	169	1,911	10,985	3,570	1,388	23,260	21,663	15,502	.041	.66
(1) – 2×(2)		1,591	-369	-389	2	-919	-1,373	-1,014	259	2,235	10,718	-8,615	.0222	.21
median excl. assval. & outliers: (3)		3,427	1,042	457	72	264	3,391	913	669	**10,233**	**15,142**	**4,909**	.033	.42
s.d. excl. assval. & outliers: (4)		878	445	289	27	248	1,919	232	282				.004	.11
(3) + (4)		4,305	1,487	745	99	511	5,309	1,145	951	**14,553**	**13,594**	**-959**	.037	.53
(3) – (4)		2,549	597	168	45	16	1,472	682	387	**5,914**	**17,089**	**11,175**	.029	.31

Notes: highlighted: outliers (defined as values outside the range of mean ± 2 standard deviations); boxed: assumed values; bolded: calculated following the procedure described as Step 5 in Section 5.1.2; s.d.: standard deviation; assval: assumed value; Q_m/Q_k: weight of dry cowpea meal needed to prepare 1 kg of kosei (see equation [11] in Section 4.2.6.3).

Source: Table A.5.1 (including the data used to construct Table A.5.1) and Table 4.19.

APPENDIX 6

Mean Retail Margin Calculation

The mean retail margin for each of the three supermarket and seven small shop respondents was calculated as follows:

(1) Supermarket Respondent 1: since the respondent answered that the margin for all flour products was 20%, this value was used as it was;

(2) Supermarket Respondent 2: the purchase prices reported by the respondent were VAT/NHIS excluded (i.e., the respondent reported processor prices). The formula $Pc = 1.15\ (1 + m)\ Pp$ (see Section 4.2.4) was used to obtain the value of m for each product, and then the mean value was calculated;

(3) Supermarket respondent 3: the respondent could not provide the purchase prices of the products. Therefore, the processor prices of those products obtained through the processor interviews were used. The formula $Pc = 1.15\ (1 + m)\ Pp$ was used to obtain the value of m for each product, and then the mean value was calculated;

(4) Small shop respondents: no respondent mentioned the VAT/NHIS during the interviews. Although it is uncertain, their margin might not be subject to the VAT/NHIS because these shops are small in scale, large in number, and more importantly, their business records might not be kept well enough for VAT/NHIS calculation; all of these factors could undermine the efforts of the government to check and collect the VAT/NHIS from them. On the other hand, the suppliers of goods to these small shops most likely collect and pay the VAT/NHIS, because the products sold at the small shops observed during the fieldwork were well-packaged and brand-named products, including imported goods; the government could easily collect the VAT/NHIS from such processors. For this reason, it was assumed that the purchase prices reported by the respondents included the VAT/NHIS (i.e., $1.15Pp$). As for the selling prices, regardless of what has just been discussed, it was still assumed that the respondents collected the VAT/NHIS on their margin. This is because it was expected that after the VAT/NHIS was introduced and the purchase price for the respondents increased, the respondents kept the rate of margin to the purchase price (i.e., they receive the margin of $m\{(1{+}0.15)Pp\}$, of which $0.15mPp$ is the additional revenue for them unless it is collected by the government), rather than kept the absolute value of margin (i.e., mPp). The formula $Pc = 1.15\ (1 + m)\ Pp$ was used to obtain the value of m for each product;

As mentioned in Section 3.2.3.2, since few small shops were observed selling cowpea/soybean flour or Weanimix/Tom Brown, it was decided to: (1) ask respondents about Cerelac[3], a popular weaning food produced by the company Nestlé[4], and also about other industrially processed grain flour products, where such products were sold by the respondents; and (2) show respondents a sample bag of cowpea flour purchased from one of the processor respondents and ask them at what price they would sell the product, proposing three different purchase prices (¢7,000, ¢10,000, ¢12,000). Then, the mean values of m were calculated using the formula $Pc = 1.15\ (1 + m)\ Pp$ for Nestlé's products and for a sample bag of cowpea flour (i.e., mean of the 3 self-assumed selling prices), separately from other products;

Finally, the mean values of m for each respondent were calculated using: (1) the values of m for each of the targeted products and other industrially processed flour products sold by the respondent; (2) the mean value of m for Nestlé's products sold by the respondent; and/or (3) the mean value of m for a sample bag of cowpea flour.

[3] Cerelac had a variety of flavors, and it was too time consuming to ask about all different flavors that the respondents sold. Therefore, only two flavors (maize [seemingly cheapest among Cerelac] and "3 fruits" [seemingly most expensive]) were selected. Cerevita (instant maize porridge) was also included when it was sold by the respondent.

[4] There was a concern that the retail margin for products produced by a large-scale company might not provide a good estimate for the potential retail margin for our targeted products. In fact, one respondent mentioned that the selling prices were determined by the processor. Another respondent mentioned that the selling prices were determined by the wholesaler. However, for each respondent, the calculated retail margins for Cerelac were not substantially different from the self-assumed retail margins for cowpea flour.

APPENDIX 7

Weaning Mothers as Consumers of Kosei

As mentioned in Section 4.2.1.9, weaning mothers were asked a set of questions about their consumption and home preparation of kosei. The results are shown below.[5]

There was a wide range in the frequency of eating kosei among the respondents (Table A. 7.1). One third of the respondents knew how to prepare kosei. Only two respondents had ever bought cowpea flour: one of them bought it only once, while the other bought it regularly once a week. Both of them bought it from a hospital and used it for fortification of weaning foods (i.e., they did not buy it to make kosei). Four respondents prepared cowpea flour by themselves.

When asked why they did not buy cowpea flour, the majority of the respondents answered that they had never seen commercial cowpea flour. Two respondents mentioned that they did not know what to use it for. Another respondent mentioned that she generally did not like commercial flour products due to safety concerns.

Table A.7.1 Frequency of eating kosei, knowledge on how to prepare kosei, and experience in purchasing cowpea flour among weaning mother respondents

Consumption and home preparation of kosei / Experience in use of cowpea flour		weaning mother (n = 30)
How many times per month eat kosei	0	5
	1-10	7
	11-20	6
	21-30	5
	Rarely	2
	Often	1
	Depends	3
	Don't know	1
Know how to prepare kosei	No	20
	Yes	10
Ever bought cowpea flour	No*	28
	Yes	2

* Includes four respondents who prepared cowpea flour by themselves.
Source: Field survey in Accra, February and March 2007.

[5] It is not clear whether weaning mothers tend to have any particular behavior towards the consumption of kosei that is not found among general consumers. For example, one of the respondents mentioned that she used to eat kosei but stopped when she got pregnant. Therefore, it should be emphasized that the data were collected from a very specific sample population (i.e., weaning mothers visiting a health clinic/hospital for weighing their babies) and the sample size is very small. The results are not presented here to derive any general characteristics among Ghanaians about their kosei consumption but rather to stimulate discussion and help to design further research on this issue.

As Table A.7.2 shows, among the 10 respondents who knew how to prepare kosei, 5 actually prepared it at home, while the other 5 did not.

Of the five respondents who prepared kosei at home, three answered that they would try commercial cowpea meal/flour for making kosei if such meal/flour was available, while the other two answered that they would not try. One of these two respondents did not buy commercial flour but prepared it by herself, while the other was not sure whether kosei would taste the same when using such meal/flour.

Of the five respondents who did not prepare kosei at home, two did not eat much kosei each time, and therefore it was more convenient for them to just buy the amount they wanted to eat. Another two were not sure whether they could prepare the right amount they wanted to eat. The remaining one thought that the preparation was tedious. All of these five respondents were interested in trying commercial cowpea meal/flour.

Table A.7.2 Home preparation of kosei and interests in dry cowpea flour/meal among weaning mother respondents

Weaning mother who knows how to prepare kosei (n = 10)	Would try cowpea meal/flour	Would NOT try cowpea meal/flour	Total
Currently prepare kosei at home	3	2	5
Currently do NOT prepare kosei at home	5	0	5
Total	8	2	

Source: Field survey in Accra, February and March 2007.

APPENDIX 8

Cowpea-Fortified Gari

Gari (grated, fermented and roasted cassava) is popularly used in Ghanaians' daily diet. It is relatively inexpensive but low in protein. Studies conducted by food scientists associated with the B/C CRSP have found that cowpeas could replace cassava up to 20% by weight while still guaranteeing an acceptable end product quality (G. A. Annor, personal communication, March 22, 2007). As reported in Chapter 1, cowpea-fortified gari was initially among the target products of this case study. However, due to lack of time during the fieldwork in Accra, only one gari processor was interviewed. The respondent produced cowpea-fortified gari, soybean-fortified gari, and yellow gari only when she was requested by customers who brought or paid for additional ingredients. A budgeting analysis of cowpea-fortified gari was conducted using the data collected from this respondent and applying the same methods used to construct the budgets for industrially produced dry cowpea meal and Weanimix. The purpose of this analysis was not to derive general conclusions but to stimulate discussion and provide useful information to design further research on the profitability of cowpea-fortified gari. The results are reported below.

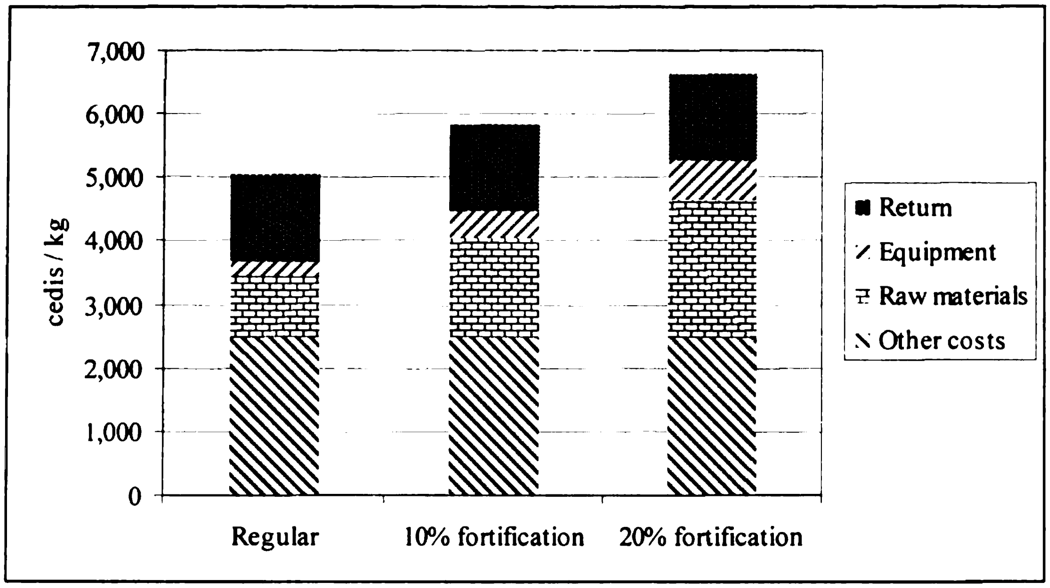
Table A.8.1 Budgets for producing 1 kg of cowpea-fortified gari (¢)

	Regular (no fortification)	10% fortification	20% fortification
Processor price	5,055	5,849	6,642
Raw materials	978	1,569	2,160
Equipment	235	438	640
Wage	1,795	Assumed to be the same as regular	Assumed to be the same as regular
Electricity	0		
Fuel (excl. fuel for vehicles)	233		
Water	65		
Rent	24		
Transportation (incl. fuel for vehicles)	204		
Printing & stationery	0		
Telecommunication	87		
Packaging material	73		
Miscellaneous	0		
Total cost	3,695	4,489	5,282
Return	1,360	Same as regular	

Notes: Raw materials: (cassava) the respondent purchased cassava from a farmer; (cowpeas) the waste rate for processing cowpeas was assumed based on the data collected from cowpea/soybean flour processor respondents; Equipment: (regular) costs of custom-grating and -pressing cassava + own roasting pan; (cowpea-fortified) costs of custom-grating and -pressing cassava + custom-dehulling and -milling cowpeas (the charge was assumed based on the data collected from custom miller and kosei vendor respondents) + own roasting pan; Transportation: the cost for buying inputs (i.e., transportation cost for selling the output is not included).

Source: Field survey in Accra, February and March 2007.

Figure A.8.1 Budgets for producing 1 kg of cowpea-fortified gari



Source: Table A.8.1.

As shown in Table A.8.1 and Figure A.8.1, the cost of raw materials was expected to increase from about ¢1,000 to about ¢1,600 with a 10% replacement of cassava with cowpeas and from about ¢1,000 to about ¢2,200 with a 20% replacement. This sharp increase in the raw material cost is due to the difference in prices between cassava and cowpeas. Price data collected from the MoFA indicates that the monthly wholesale price per kg of cowpeas was on average 4.0 times the price per kg of cassava during 2002-2006 at urban markets of the Greater Accra Region (with a standard deviation of 0.57 times). In fact, the same data show that cowpeas (fortifier) have been more expensive than gari (end product)—for the same period (i.e., 2002-2006) and location (i.e., urban markets of the Greater Accra Region), cowpeas were on average 1.6 times more expensive than gari, with a standard deviation of 0.39 times.

In addition to the increase in the raw material cost, the equipment cost also increased because of the charge for custom-dehulling and -milling to process cowpeas. As a result, the total cost was estimated to increase from about ¢3,700 per kg of gari to ¢4,500 (10% replacement) and to ¢5,300 (20% replacement).

The processor price of 20%-cowpea-fortified gari was estimated to be about ¢6,600 per kg. In fact, during the interview, the respondent mentioned that if she had to replace 20% of cassava with cowpeas, she would have to increase the selling price of gari from ¢10,000 per olonka (estimated to be ¢5,055 per kg)[6] to ¢12,000 per olonka (estimated to be ¢6,066 per kg). However, she also mentioned that at this price the customers would complain, and therefore she did not produce cowpea-fortified gari for normal customers.

[6] This respondent sold her gari for a much higher price than the processor prices of gari reported by retailer respondents. The mean processor price of gari reported by three retailer respondents was ¢3,707 per kg (with a standard deviation of ¢292).

Table A.8.1 and Figure A.8.1 also show that, if it is assumed that the respondent would have to sell cowpea-fortified gari for the same price as regular gari, the return would decline to less than one-half of the original value for 10% replacement, while it would turn negative for 20% replacement.

With regard to the advantages and disadvantages of fortifying gari, the respondent mentioned that fortification with either cowpeas or soybeans would improve the taste and nutritional value of gari, while it makes processing more tedious.

These results suggest that cowpea-fortified gari would face a challenge to be price-competitive with normal gari, because of a large difference in prices between the original ingredient (i.e., cassava) and the fortifier (i.e., cowpeas), unless customers have high willingness to pay for cowpea-fortified gari[7].

[7] It should be noted that the price of gari fluctuates seasonally. Therefore, the results of budgeting analysis might look different if it is conducted in a different season of the year.

REFERENCES

Afoakwa, E. O., Sefa-Dedeh, S., & Sakyi-Dawson, E. (2004). Effects of cowpea fortification, dehydration method and storage time on some quality characteristics of maize-based traditional weaning foods. African Journal of Food, Agriculture, Nutrition and Development, 4, 1.

Annan, N. T., & Plahar, W. A. (1995). Development and quality evaluation of a soy-fortified Ghanaian weaning food. Food and Nutrition Bulletin, 16, 3. Tokyo: United Nations University Press.

Bean/Cowpea Collaborative Research Support Program (B/C CRSP). (2006a). Regional project research and training workplans (October 1, 2006 to September 30, 2007). Technical Committee Meeting, Memphis, Tennessee, May 10-12, 2006.

Bean/Cowpea Collaborative Research Support Program (B/C CRSP). (2006b). Research and training highlights 2006.

Bentley, M. E., Dickin, K. L., Mebrahtu, S., Kayode, B., Oni, G. A., Verzosa, C. C., et al. (1991). Development of nutritionally adequate and culturally appropriate weaning food in Kwara state, Nigeria: An interdisciplinary approach. Social Science & Medicine, 33, 10, 1103-1111.

Bernsten, R. H. (1993). The role of cowpeas in the Ghanaian economy: A rapid appraisal subsector analysis. Michigan State University, Department of Agricultural Economics.

Bernsten, R. H. (2005, Summer). IV. Survey sampling. AEC 874: Michigan State University.

Briggs, P. (2004). Ghana: The Bradt travel guide (3rd ed.). Guilford: The Globe Pequot Press.

Crawford, E. W. (2002, Summer). International farm management analysis methods. AEC 890: Michigan State University.

Davis, D. W., Oelke, E. A., Oplinger, E. S., Doll, J. D., Hanson, C. V., & Putnam, D. H. (1991). Cowpea. In University of Wisconsin-Extension, Cooperative Extension. (1992). Alternative field crops manual. Retrieved August 2, 2006, from http://corn.agronomy.wisc.edu/AlternativeCrops/Cowpea.htm.

Debertin, D. L. (1986). Agricultural production economics. New York: Macmillian Publishing Company.

Dovlo, F. E., Williams, C. E., & Zoaka, L. (1976). Cowpeas: Home preparation and use in West Africa. Ottawa: International Development Center.

Egounlety, M., Aworh, O. C., Akingbala, J. O., Houben, J. H., & Nago, M. C. (2002). Nutritional and sensory evaluation of tempe-fortified maize-based weaning foods. International Journal of Food Sciences and Nutrition, 53, 15-27.

El-Habashy, M., Phillips, R. D., Eitenmiller, R. R., Mostafa, M. M., Rahma, E., & El-Bedaiwy, A. (1995). Computer optimization of weaning food formulas. Journal of Food Quality, 18, 295-312.

El-Habashy, M., Phillips, R. D., Eitenmiller, R. R., Mostafa, M. M., Rahma, E., & El-Bedaiwy, A. (1997). Protein quality assessment of computer optimized weaning formulas. Journal of Food Quality, 20, 267-277.

Faye, M. D. (2005). Investigation of key aspects for the successful marketing of cowpeas in Senegal. Ph.D. Dissertation, Department of Agricultural Economics, University of the Free State.

Food and Agriculture Organization of the United Nations (FAO). (1997). Agriculture, food and nutrition for Africa: A resource book for teachers of agriculture. Rome: Author.

Fulton, J. (2004). Trip report: Senegal May 11-26, 2004. Bean/Cowpea Collaborative Research Support Program (B/C CRSP).

Harsh, S. B., Connor, L. J., & Schwab, G. D. (1981). Managing the farm business. Englewood Cliffs, NJ: Prentice-Hall.

Hayes, R. E., Mwale, J. M., Tembo, P., & Wadsworth, J. I. (1995). Computer-optimized weaning food blends. Food and Nutrition Bulletin, 16, 3. Tokyo: United Nations University Press.

Henshaw, F. O., McWatters, K. H., Oguntunde, A. O., & Phillips, R. D. (1996). Pasting properties of cowpea flour: Effects of soaking and decortication method. Journal of Agricultural and Food Chemistry, 44, 1864-1870.

International Institute of Tropical Agriculture (IITA). (2006). Cowpea. Retrieved August 2, 2006, from http://www.iita.org/crop/cowpea.htm.

Kethireddipalli, P., Hung, Y. C., McWatters, K. H., & Phillips, R. D. (2002). Effect of milling method (wet and dry) on the functional properties of cowpea (Vigna unguiculata) pastes and end product (akara) quality. Journal of Food Science, 67, 1, 48-52.

Lambot, C. (2002). Industrial potential of cowpea. In C. A. Fatokun, S. A. Tarawali, B. B. Singh, P. M. Kormawa, & M. Tamò (Eds.), Challenges and opportunities for enhancing sustainable cowpea production (pp. 367-375). Proceedings of the World Cowpea Conference III held at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, 4–8 September 2000. IITA, Ibadan, Nigeria.

Langyintuo, A. S., Lowenberg-DeBoer, J., & Arndt, C. (2005). Potential impacts of the proposed West African monetary zone on cowpea trade. Agricultural Economics, 33, supplement 411-421.

Langyintuo, A. S., Lowenberg-DeBoer, J., Faye, M., Lambert, D., Ibro, G., Moussa, B., et al. (2003). Cowpea supply and demand in West and Central Africa. Field Crops Research, 82, 215-231.

Langyintuo, A. S., Ntoukam, G., Murdock, L., Lowenberg-DeBoer, J., & Miller, D. J. (2004). Consumer preferences for cowpea in Cameroon and Ghana. Agricultural Economics, 30, 203-213.

Lartey, A., Manu, A., Brown, K. H., Peerson, J. M., & Dewey, K. G. (1999). A randomized, community-based trial of the effects of improved, centrally processed complementary foods on growth and micronutrient status of Ghanaian infants from 6 to 12 mo of age. The American Journal of Clinical Nutrition, 70, 391-404.

Leung, W. W. (1968). Food composition table for use in Africa. Bethesda, Maryland: US Department of Health, Education, and Welfare, and Rome: Food and Agriculture Organization of the United Nations (FAO).

Masters, W. A., & Sanogo, D. (2002). Welfare gains from quality certification of infant foods: Results from a market experiment in Mali. American Journal of Agricultural Economics, 84, 4, 974-989.

McWatters, K. H. (1986). Use of peanut and cowpea flours in selected fried and baked foods. In R. L. Ory (Ed.), Plant proteins: Applications, biological effects, and chemistry. Washington, DC: ACS Symposium, Series 312, American Chemical Society.

McWatters, K. H., & Brantley, B. B. (1982). Characteristics of akara prepared from cowpea paste and meal. Food Technology 36, 66-68.

McWatters, K. H., Chinnan, M. S., Phillips, R. D., Beuchat, L. R., Reid, L. B., & Mensa-Wilmot, Y. M. (2002). Functional, nutritional, mycological, and akara-making properties of stored cowpea meal. Journal of Food Science, 67, 6, 2229-2234.

McWatters, K. H., Resurreccion, A. V. A., & Fletcher, S. M. (1990). Response of American consumers to akara, a traditional West African food made from cowpea paste. International Journal of Food Science and Technology 25, 551-557.

Mensa-Wilmot, Y., Phillips, R. D., & Hargrove, J. L. (2001a). Protein quality evaluation of cowpea-based extrusion cooked cereal/legume weaning mixtures. Nutrition Research, 21, 849-857.

Mensa-Wilmot, Y., Phillips, R. D., Lee, J., & Eitenmiller, R. R. (2003). Formulation and evaluation of cereal/legume-based weaning food supplements. Plant Foods for Human Nutrition, 58, 1-14.

Mensa-Wilmot, Y., Phillips, R. D., & Sefa-Dedeh, S. (2001b). Acceptability of extrusion cooked cereal/legume weaning food supplements to Ghanaian mothers. International Journal of Food Sciences and Nutrition, 52, 83-90.

Mishili, F. J. (2005). Cowpea markets and consumer preferences in Ghana. M.S. Thesis, Purdue University.

Nimoh, F. (2004). Consumer preference and market opportunities for processed cowpea-based products in the coastal regions of Ghana. M.Phil. Thesis, Department of Agricultural Economics and Agribusiness, University of Ghana-Legon.

Nti, C. A., & Plahar, W. A. (1995). Chemical and biological characteristics of West African weaning food supplemented with cowpea (Vigna unguiculata). Plant Foods for Human Nutrition, 48, 45-54.

Onofiok, N. O., & Nnanyelugo, D. O. (1998). Weaning foods in West Africa: Nutritional problems and possible solutions. Food and Nutrition Bulletin, 19, 1. Tokyo: United Nations University Press.

Phillips, R. D., McWatters, K. H., Chinnan, M. S., Hung, Y., Beuchat, L. R., Sefa-Dedeh, et al. (2003). Utilization of cowpeas for human food. Field Crops Research, 82, 193–213.

Plahar, W. A., Nti, C. A., & Annan, N. T. (1997). Effect of soy-fortification method on the fermentation characteristics and nutritional quality of fermented maize meal. Plant Foods for Human Nutrition, 51, 365-380.

Plahar, W. A., Onuma Okezie, B., & Gyato, C. K. (2003). Development of a high protein weaning food by extrusion cooking using peanuts, maize and soybeans. Plant Foods for Human Nutrition, 58, 1-12.

Reardon, T., & Timmer, C. P. (2007). Transformation of markets for agricultural output in developing countries since 1950: How has thinking changed? In R. E. Evenson & P. Pingali (Eds.), Handbook of agricultural economics, 3: Agricultural development: Farmers, farm production and farm markets. Amsterdam: Elsevier Press.

Sefa-Dedeh, S. (2005). Final report for USAID associate cooperative agreement No. 641-A-00-03-0003. Ghana Private-Public Partnership Food Industry Development Program.

Singh, A., Hung, Y., Corredig, M., Phillips, R. D., Chinnan, M. S., & McWatters, K. H. (2005). Effect of milling method on selected physical and functional properties of cowpea (*Vigna unguiculata*) paste. International Journal of Food Science and Technology 40, 525-536.

Smith, I. F. (1995). The case for indigenous West African food culture. BREDA Series No. 9. United Nations Educational, Scientific and Cultural Organization (UNESCO), Bureau Régional pour l'Education en Afrique (BREDA).

United Nations Statistics Division (UNSD). (2005). Per capita GDP in US dollars: All countries for all years – sorted alphabetically. Retrieved September 6, 2006, from http://unstats.un.org/unsd/snaama/dnllist.asp.

United Nations Statistics Division (UNSD). (2006). Millennium Development Goals Indicators. Retrieved October 4, 2006, from http://mdgs.un.org/unsd/mdg/Default.aspx.

Varian, H. R. (2003). Intermediate microeconomics: A modern approach (6th ed.). New York: W. W. Norton & Company.

World Bank. (2006). Africa development indicators 2006. Washington, DC: Author.