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Plan B Paper

An Analysis of the Recent Evolution of Mali's Maize Subsector

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ABSTRACT

In most developing countries, historically, the main strategy for improving the food sector has focused on increasing farm-level production. But in recent years, with the emphasis on value chain analysis, there has been much more focus on subsector studies, demand-driven approaches, and improving vertical coordination to assure product quality to final consumption markets. Millet, sorghum, and later rice were the traditional leading three cereal crops produced and consumed in Mali. Maize has trailed them for more than two decades, but from mid 1990s on, it has been produced and consumed in much larger quantities. Given the potentials of maize, developing and better organizing its subsector has the potential to not only increase revenues for maize farmers, but also create profitable opportunities for other actors in the subsector (traders, marketers, processors, industries, and consumers). This paper seeks to provide a description of the changing supply and demand dynamics for maize in Mali, the organization of the marketing channels and players, and the characteristics of the main consumption markets. The main conceptual tools to be used are subsector analysis and the structure-conduct-performance (SCP) approach. The paper will draw on literature reviews, the author's personal interviews with value chain participants, and tabular and graphical analysis of production and price data to address the reasons behind the changes in production and demand, how the demand is likely to evolve, how the structure of the subsector might be affected, and what will be the implications for public sector investments and policies.

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ACRONYMS

AGRA	Alliance for a Green Revolution in Africa
BNDA	Banque Nationale de Développement Agricole
BRAMALI	Brasseries du Mali
CAE	Centre Agro-Entreprise
CFA	Communauté Financière d'Afrique
CMDT	Compagnie Malienne de Développement des Textiles
CP	Consumers' price
CPI	Consumer Price Index
CPS	Cellule de Planification et de Statistique
CSA	Commissariat à la Sécurité Alimentaire
CV	Coefficient of Variation
DNSI	Direction Nationale de Statistique et de l'Informatique
ECOFIL	Economie des Filières
ECOWAS	Economic Community of West African States
FAO	Food and Agriculture Organization
GAM	Général Alimentaire du Mali
GDP	Gross Domestic Product
GMM	Grands Moulins du Mali
IER	Institut d'Economie Rurale
MSU	Michigan State University
NGO	Non-Governmental Organization
OHVN	Office de la Haute Vallée du Niger
OMA	Observatoire de Marché Agricole

OPAM	Office des Produits Agricoles du Mali
PDAM	Projet de Développement de l'Aviculture au Mali
PDES	Programme de Développement Economique et Social
PP	Producers' Price
PNIP-SA	Plan National d'Investissement Prioritaire dans le Secteur Agricole
PRMC	Programme de Restructuration du Marché Céréalier
PROMISAM	Projet de Mobilisation des Initiatives en Matière de Sécurité Alimentaire au Mali
SCP	Structure-Conduct-Performance
SODOUF	Société Doucouré et Frères
SOMACO	Société Malienne des Conserves
SOMAPIL	Société Malienne des Piles
UEMOA	Union Economique et Monétaire Ouest Africaine
UMPP	Usine Malienne de Produits Pharmaceutiques
UNDP	United Nations Development Programme
UPA	Unités de Production Agricole
WFP	World Food Programme
WP	Wholesalers' Price

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CHAPTER 1: INTRODUCTION

Subsector analysis is the analysis of the firms, channels, and markets of a product or a service; value chain analysis examines the value adding activities required in the production and marketing of a product or service. Both analyses look at the vertical relationship between actors in the chains and how to improve vertical coordination among them. The main difference between the two terms is that value chain analysis is more about a single vertical chain and more focused on firms than subsectors. Subsector analysis focuses more on relationships between chains and emphasizes on policy (as well as firm-level) constraints to system coordination. Nevertheless, like in most study documents, the two terms will be used interchangeably in this paper.

In most developing countries, historically, the main strategy for improving the food sector has focused on increasing farm-level production. But in recent years, with the emphasis on value chain analysis, there has been much more focus on subsector studies, demand-driven approaches, and improving vertical coordination to assure product quality to final consumption markets. This is the case for Mali, where the government and other agricultural stakeholders are promoting efficient institutional measures, agro-industrialization, infrastructure development, and modern and competitive marketing practices to accompany farm-level production in an effort to achieve a sustainable agricultural development.

Mali is a 1,241,238 km^2 country located at the heart of West Africa, with a population of more than 13 million. Like most Sub-Saharan African countries, agriculture is the most important sector in Mali's economy. In fact, agriculture accounts for employment of 56 percent of Mali's active population, 37 percent of its gross domestic product (GDP), and 28 percent of its export revenues (CSA, 2009). With limited industrialization and having a large

rural population, Mali's economic growth and future development successes depend on the development of its agricultural sector. However, farming in Mali is still more oriented towards subsistence farming than a commercial agriculture.

Cereals are at the heart of Mali's agriculture, as they represent 72 percent of Mali's cultivable area, with around 805,200 farms, mostly family-owned (CSA, 2009). Cereals also constitute the most important food consumption item for households in terms of provision of calories. A key policy challenge has always been to provide farmers with remunerative revenues and to maintain affordable consumer prices for households. Faced with these two competing objectives, the government has generally opted for holding down consumer prices at the expense of farm incomes. Nevertheless, the two objectives can be conciliated in the long run, by increasing productivity, which allows farmers and traders to produce at lower unit costs while still making profit, thus, reducing consumer prices relative to consumer cash incomes. Various projects have been undertaken and more are going on to reduce unit production costs through providing improved production techniques to farmers, improving agricultural lands and irrigated areas in the main production zones, thus building farmers' capacity to meet local demand. However, Mali faces constraints such as unstable rainfall that affects cereal production, lack of credit for inputs and fertilizers, and being geographically landlocked with less advanced road systems to favor trade. This has made Mali vulnerable to cereal crises (e.g., production shortfalls, high financial risks for farmers and traders, and price spikes for consumers) that have exacerbated the country's food insecurity and slow down its economic growth.

Cereal production in Mali currently amounts to more than 4 million tons. Maize is one of the most important cereals in the world. In West Africa, it has been traditionally more of a

coastline crop than a Sahelian or Sudano-Sahelian[1] zone crop. Thus, millet, sorghum, and later rice were the traditional leading three cereal crops produced and consumed in Mali. Maize has trailed them for more than two decades, but from mid 1990s on, it has been produced and consumed in much larger quantities. Maize has a high yield and agro-industrial processing potentials. These traits give further importance to maize in meeting food deficits, capturing export markets, and boosting processing and food industries. However, like other cereals, the maize subsector is constrained by various production and marketing issues that will be discussed in this paper. Given the potentials of maize, developing and better organizing its subsector has the potential to not only increase revenues for maize farmers, but also create profitable opportunities for other actors in the subsector (traders, marketers, processors, industries, and consumers).

1.1. Problem statement

Past research documents and ongoing projects that will be discussed in this paper confirm the growing interest of Malian producers and consumers in maize. Demand gives a strong incentive for production and marketing, and drives the behavior of all participants in a subsector. Therefore, it will be important to study the demand side in addition to supply of the maize subsector in order to measure the current state and future potentials of the maize subsector in Mali, and then, identify problems in the functioning of the value chains that have to be corrected so as to better respond to the changing demand. More precisely, the paper will address the following research questions and policy concerns:

- *What are the factors driving the supply and demand for maize in Mali?*
- *How is demand likely to evolve in the next 5 to 10 years?*

[1] Geographically, the Northeast and much of the West and Center of Mali are in the Sahel zone; Southern Mali is in the Sudanian zone

- *What are the anticipated impacts of the changes in demand on the structure of the maize subsector?*
- *What are the implications for public sector investments and policies?*

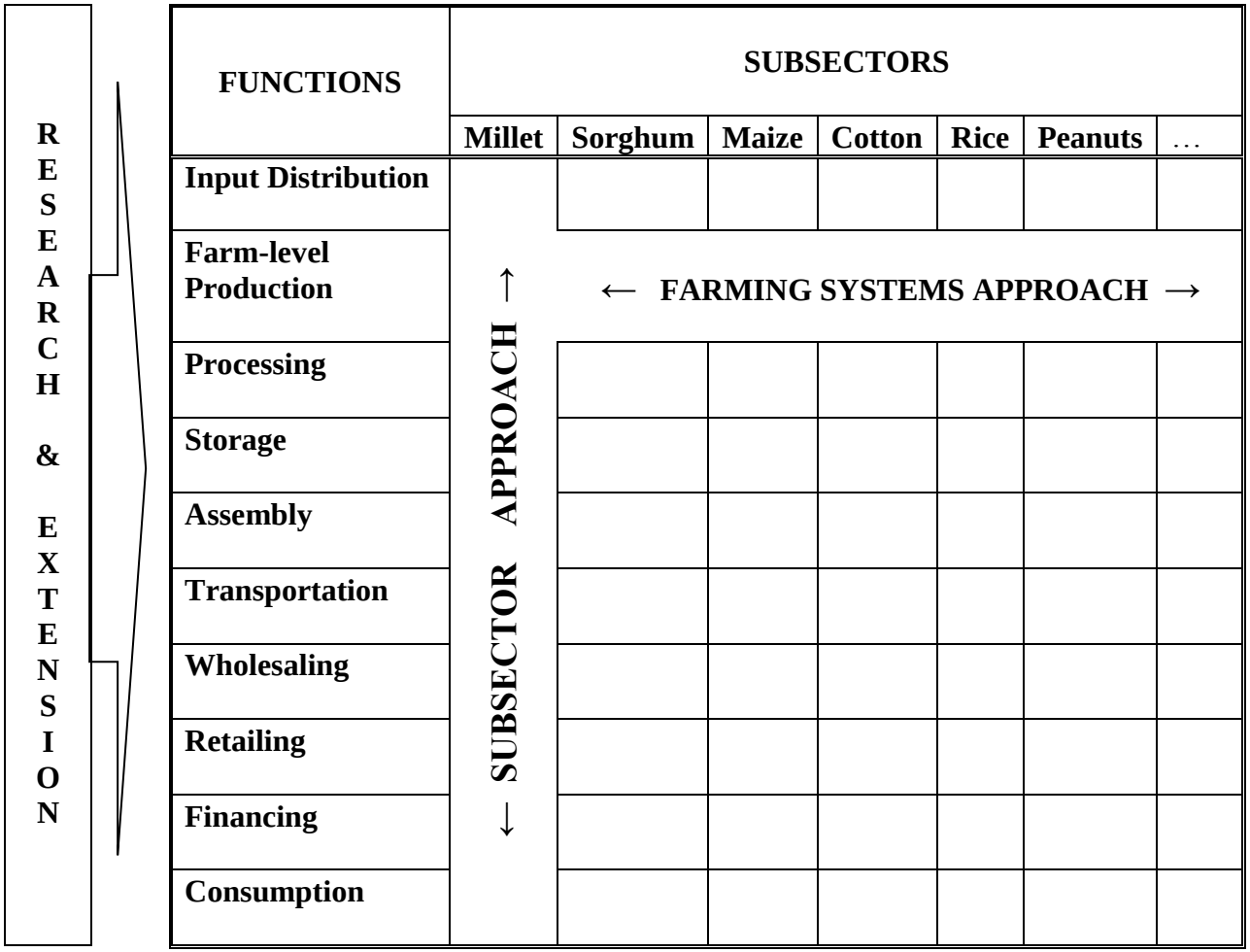
1.2. Objectives and organization of the paper

This paper seeks to provide a description of the changing supply and demand dynamics for maize in Mali, the organization of the marketing channels and players, and the characteristics of the main consumption markets. The paper first outlines the conceptual framework to be used in analyzing the subsector's functioning and major channel problems. The following step will consist of familiarizing the reader with the maize subsector through a historical description of its technological and institutional adoption, the different production and marketing practices, and the various accompanying policy measures. Then, the next chapter will review the structure of the production, marketing, and processing of the maize subsector. This will be followed by the core demand analysis divided into two parts: current and anticipated future trends of the main consumption markets (both internal and external). An important attention will be put on the poultry industry, which is currently contributing greatly to the change in the demand for maize. The latter analysis will focus on several performance dimensions, notably price levels and stability, followed by discussion of future implications of the identified marketing bottlenecks. Finally, conclusions will be drawn with respect to the reasons behind the changes in production and demand, how the demand is likely to evolve, how the structure of the subsector might be affected, and what will be the implications of the findings for public sector investments and policies.

CHAPTER 2: CONCEPTUAL FRAMEWORK

The main conceptual tools to be used are subsector analysis and the structure-conduct-performance (SCP) approach. Subsector analysis is a study of a subsector in order to understand the dynamics and the behavior of its players at each stage and the coordination of activities across different stages, and thus observe the problems in the channels. According to Staatz (1997), the subsector approach is a way of viewing a "vertical slice" within the food system matrix. As shown in Figure 1, the food system matrix is the representation of different commodities and their related production and distribution activities; the subsector approach is thus studying the activities of actors involved in one commodity and the rules governing those activities. Staatz (1997) identified five key concepts as guiders of subsector analysis: i) verticality, as the conditions in one stage affect other stages; ii) effective demand as the pump that pulls goods and services through the system; iii) coordination between channels, which affects the incentives to invest in the subsector improvements; iv) competition between channels to see how it can be modified to improve performance; and v) leverage, which is about identifying areas where targeted action on one problem in the subsector can affect the welfare of a large number of participants.

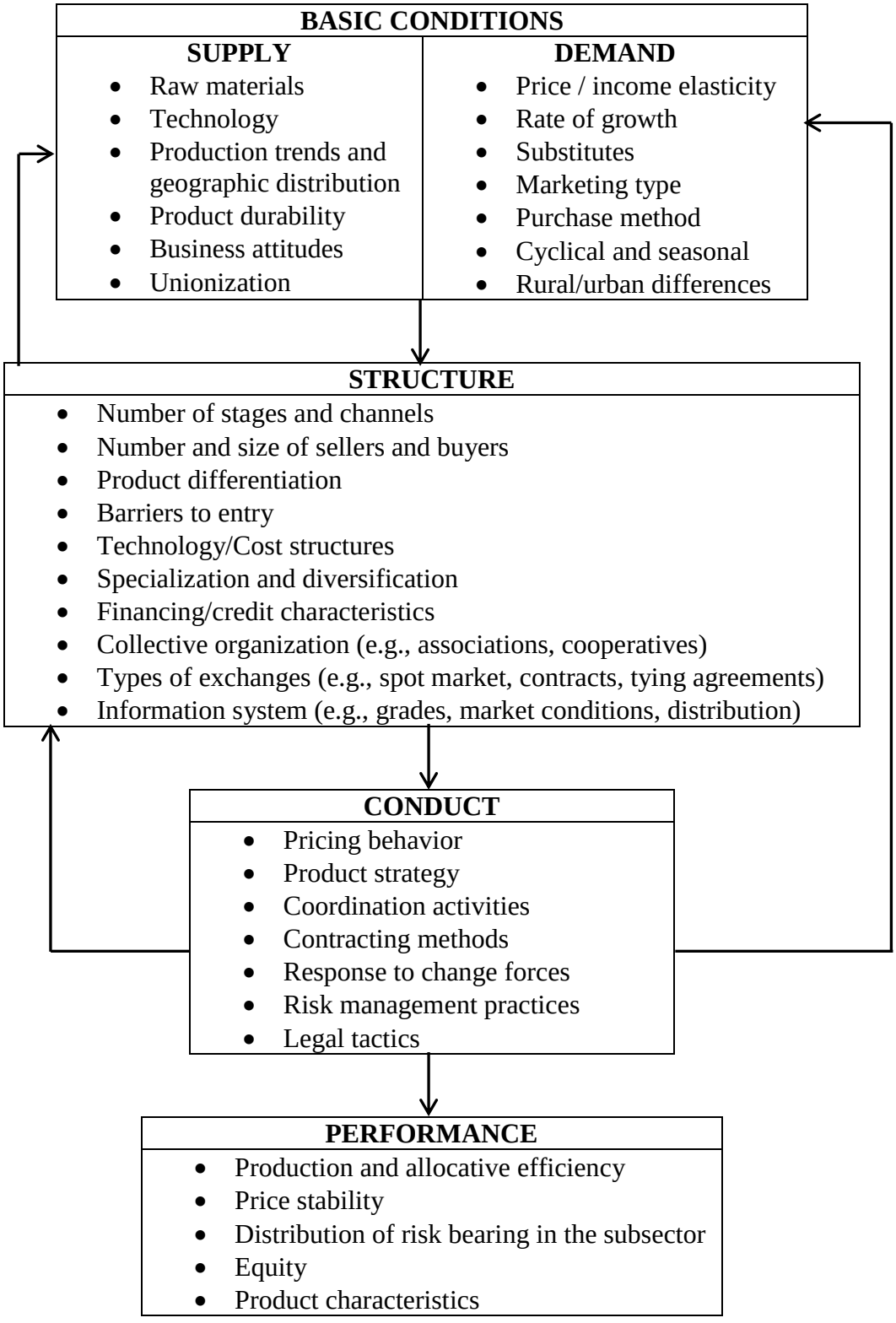
Figure 1: The food system matrix



Source: Boughton et al. (1995)

The SCP approach hypothesizes that the structure of an industry or a subsector influences actors' conduct, which in turn influences the performance. For a commodity subsector such as maize in Mali, in applying a definition by Holtzman (2002), it can be said that the basic production, consumption, regulatory, and macroeconomic conditions shape the opportunities and limits that face actors operating in the subsector; the structure or organization of the subsector influences how actors behave within and across stages of the system, which in turn leads to performance consequences. In summarizing the SCP paradigm as in Figure 2, the basic conditions include mainly the trends in domestic and foreign markets, prices, incomes, policies and regulations, technology availability, and other macroeconomic situations whether favorable or unfavorable. The structure of a subsector organization consists in general of the stages and channels, the number and size of the actors at each level in the chain, cost structures, types of exchanges (spot market, contracts, etc.), barriers to entry, financing and credit characteristics, and the information system. The conduct is, in short, about the behaviors of the actors. The most important of these are pricing practices, product differentiation, coordination activities, and contracting practices. Finally, performance is reflected primarily by the extent to which demand is satisfied; specifically, the stability of output and prices, the product characteristics and consumers' valuing of those characteristics, and the price of products relative to consumer incomes. Other performance dimensions include efficiency of production, progressiveness in the sense of speed of adoption of technologies and institutions, and equity. For the maize subsector analysis in Mali presented in this paper, performance will be measured through mainly production trends and price levels across the years, price stability, and the distribution of risk bearing in the subsector. The paper will draw on literature reviews, the author's personal interviews with value chain participants, and tabular and graphical analysis of production and price data.

Figure 2: model of subsector and industrial organization



Source: adapted from Holtzman (2002) and Scherer (1980)

CHAPTER 3: BACKGROUND INFORMATION ON MAIZE IN MALI

Maize production in Mali has for two decades recorded the fastest growth of any of the rainfed coarse grains[2] in Mali. As shown in Figure 3, maize production has increased from about 200,000 tons in 1991 to close to 700,000 tons in 2009 thanks to agronomic research and rural development projects as well as increasing maize price levels. Beside rice, maize has been the most rapidly growing and promising cereal crop. As shown in Table 1, the share of maize in the total cereal production in early 1990s was about 11 percent compared to millet and sorghum, which were 37 and 32 percent, respectively. By late 2000s, maize's share increased to 17 percent, while the shares for millet and sorghum fell to 30 and 22 percent, respectively. The increasing share of maize in cereal production showed the growing importance of maize subsector in Mali.

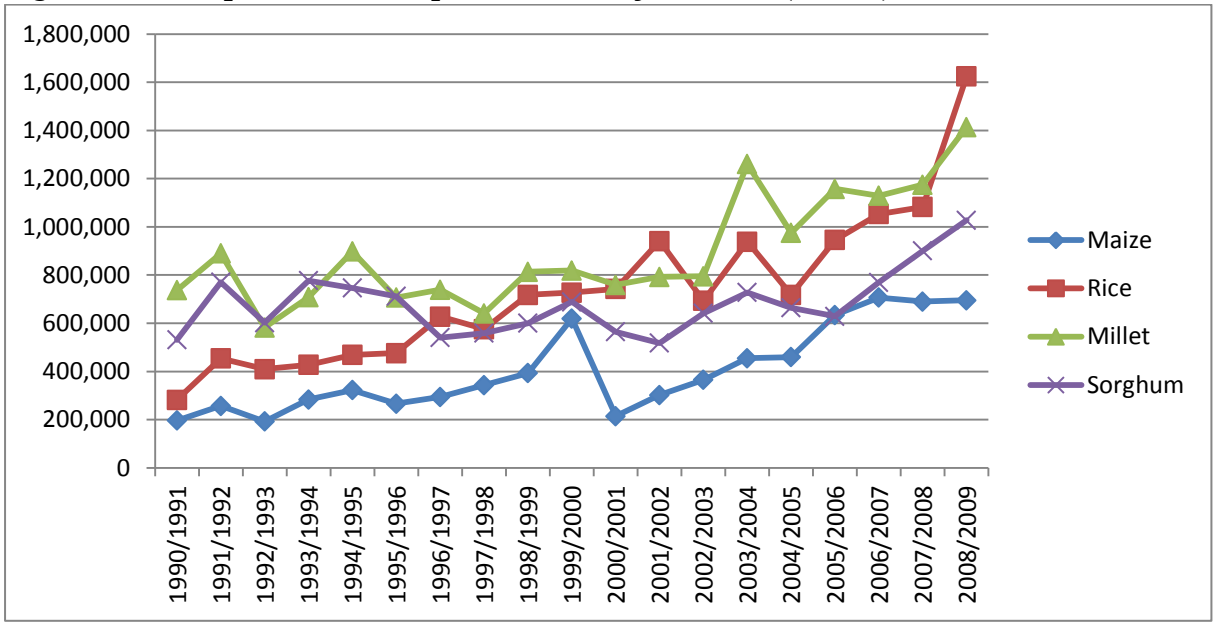
Table 1: Shares of the major cereal crops in Mali

Crop	Mean Annual Prod (tons) 1990/91 – 1992/93	Share %	Mean Annual Prod (tons) 2006/07 - 2008/09	Share %
Millet	736,400	37	1,239,263	30
Sorghum	634,577	32	899,224	22
Maize	215,295	11	697,242	17
Rice	382,244	19	1,253,289	30
Total cereals	1,997,473		4,131,173	

Source: Calculated from CPS Database

[2] Millet, sorghum, and maize are also known as coarse grains or dry cereals.

Figure 3: Maize production compared to the major cereals (in tons)



Source: Calculated from CPS Database

After a low level cultivation during the first two decades after independence, maize was adopted by farmers in late 1970s following the severe droughts as an important crop for lean seasons and for crop diversification. According to Boughton (1994), there were two main reasons for the takeoff of maize. First, the push came from government parastatals, the *Compagnie Malienne de Développement des Textiles* (CMDT) and the *Office de la Haute Vallée du Niger* (OHVN) in Southern Mali, which were involved in rural agricultural development activities. These parastatals, whose primary focus was cotton, engaged in the promotion of maize production in order to face the national chronic food shortages, but also to help ensure household food security in compensation for extra labor needed for cotton. The second reason was government policy toward cereal production and marketing to achieve self-sufficiency in cereal production in order reduce food deficits. Also, the government's focus on maize was due to the availability of more fertilizer-responsive varieties for maize than other cereals. Thus, major maize production expansions were undertaken in Southern Mali, the rainiest region of Mali, through maize projects like *Projet Mali Sud* in mid-1970s, and then *Projet Maïs* in early 1980s. Maize adoption was supported by the mechanization and

the fertilizer residuals from cotton; maize is the most fertilizer-responsive of the rainfed cereals.

It is important to understand the institutional trends that were affecting the maize subsector and the whole cereal sector in early 1980s. Following independence, the government of Mali first pushed heavy state intervention in its cereal sector. The government set producer and consumer prices through the office for price regulation and the *Office des Produits Agricoles du Mali* (OPAM), the official grain marketing agency, in an attempt to increase income for farmers, ensure cheap prices for urban areas, and use the surplus to finance other state interventions (Keita, 2006). Due to the increasing costs and financial deficits generated by this and other government policies, the structural adjustment program in the early 1980s initiated the PRMC, a program for restructuring the cereal market, mainly aiming at: i) raising cereal prices at the farm level to increase farmers' purchasing power and encourage production; ii) liberalizing the cereal trade in order to create a more flexible market supply and efficient distribution; and iii) reorganizing trade functions by allowing more private participation in the trade along with OPAM (Aubert, Bignebat, and Egg, 2006).

Following the transfer of cereal purchase functions from OPAM to the private sector, CMDT first applied to maize an integrated approach to technology delivery similar to its cotton activities. This consisted of coordinating all stages from farm-level production (inputs and fertilizers, seed distribution, credit, extension advice) to post-harvest operations, including assembly, storage, and trade activities (Boughton, 1994). Cotton allowed access to inputs (provided on credit to cotton farmers, with the credit recovered in kind at the cotton harvest) that were essential to realizing the potential of maize, as well as credit and equipment, which created conditions for higher yields. It was also cotton that helped secure cash income that created a market-oriented behavior for farmers and provided farmers with the cash flow that allowed them to sell their products later in the season at better prices (Egg

and Wade, 2006). However, the integrated approach was not financially sustainable for CMDT after 1986, following the PRMC-mandated withdrawal of OPAM from cereal marketing and price support. Thus, guaranteed prices for maize and credits for inputs were removed; this brought about a fall in producers' prices (Teme, Sanogo, and Boughton, 1993).

Despite this dramatic change, maize production and areas quickly resumed their growth. Maize was planted after cotton in crop rotation and benefited from cotton fertilizers. Also, according to Diakité (1997), farmers adopted new technical choices in order to adapt to the new market realities. These were mainly i) the reduction of costs with less use of chemical fertilizers and more use of organic fertilizers; ii) the use of varieties tolerant to low soil fertility in intermediate-level rainfall zones, and millet-maize intercropping (since millet was sold at higher prices) in heavy rainfall zones; and iii) new marketing strategies, for instance: if the maize harvest was good and if there were good prospects for millet and sorghum as well, farmers would sell millet and sorghum when prices were high and consume maize. These strategies turned out to be sustainable and helped keep alive farmers' continuing interest in maize production.

Thus, maize production expansion was accompanied also by area expansion. Maize has become the second crop in areas sown after cotton in both CMDT and OHVN zones (Sissoko, 2003). In addition, maize has the highest yield potentials among all rainfed cereals, with a yield that can attain about 5 tons per hectare in certain southern production zones (Coulibaly et al., 2007).

Currently, total national maize consumption in Mali is about 704,000 tons (Teme et al., 2010). The main markets for maize are rural and urban households, poultry producers, agro industries, and export. Mali has also been importing maize during lean seasons (June-August, before the Malian maize harvest begins in September), especially from neighboring Côte d'Ivoire. The import quantities in the 2000s varied considerably, ranging from around

2,000 to above 11,000 tons (CPS), depending on national consumption needs and trade conditions on the borders.

Given its higher productivity and diverse consumption opportunities, maize has a major role to play in Mali's agriculture, particularly in the cereal sector. Hence, the government has stepped up efforts to support cereal production, including maize, in order to cover domestic demand, reduce dependence on imports, and become a net exporter. Government plans call for total cereal production in Mali to increase from 3.6 million tons in 2007 to 10 million in 2012, with a 40 percent increase anticipated for maize alone (Coulibaly, 2008). First, an *Initiative Riz* (Rice Initiative) was launched in 2008 for rice production intensification through fertilizer subsidies, supporting producers' organizations with credit and equipment, and also supporting post-harvest trade (Plan d'Opération de l'Initiative Riz 2008-2009). Then, another initiative for maize and wheat, aiming at enhancing maize and wheat production, basically with similar measures, was undertaken the following year. Nevertheless, the fertilizer subsidies for the maize initiative were in addition to the existing ones under the CMDT system (Projet de Plan de Campagne 2010-2011). CMDT allocates a part of its campaign budget to offering fertilizers to most farmers (more than 90 percent in the cotton zone) and also has a seed division that provides maize farmers with selected seed varieties[3]. All of these give more potential to maize production.

According to the Ministry of Agriculture, a total production of more than 2 million tons of maize grain is expected for the 2010-2011 campaign. However, this projected production target is unrealistic because it is inconsistent with the ongoing price and consumption trends. Although an increase in production from under 700,000 tons in 2008/09 to 2 million tons two years later is technically possible, it would lead to a large fall in prices unless it was offset by a more than doubling of demand over a period of two years. There is

[3] Personal interview

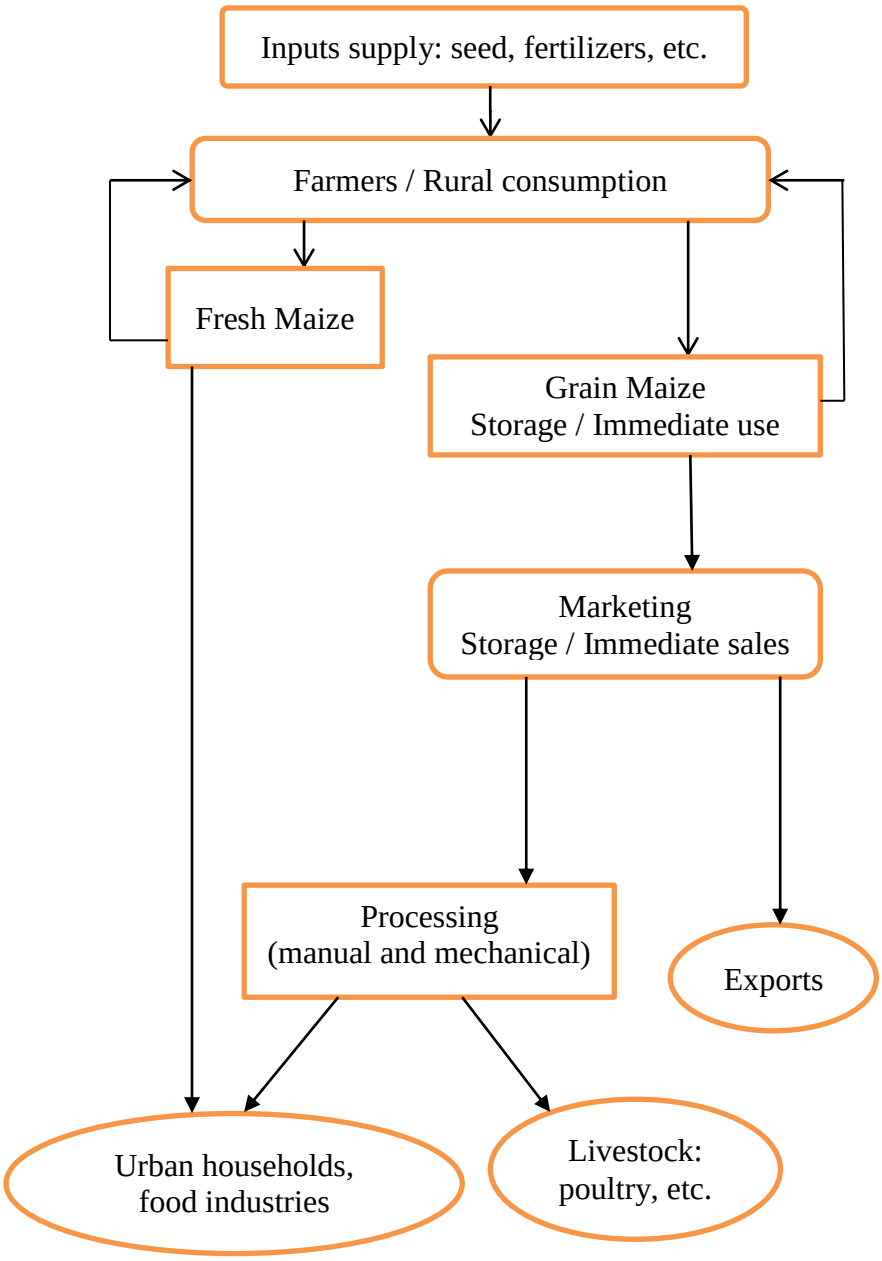
no evidence that this huge demand increase has happened, and that prices have not fallen. Nevertheless, with the continuing production increase, the potential excess of domestic production above domestic consumption for maize could exceed a million tons in the upcoming years. Therefore, the challenge for the sustainability of vibrant maize production environment in Mali will be having large market opportunities for producers and better and efficient market conditions for the major actors.

CHAPTER 4: MALI'S MAIZE SUBSECTOR - DESCRIPTIVE ANALYSIS

The Mali maize sub-sector has five main production and marketing stages. The first stage is the supply of inputs (seed and fertilizers) to farmers. This stage is followed by the farm-level production of both fresh and grain maize, the two product components of the subsector as shown in Figure 4. Fresh maize has a clear and straight distribution circuit since it does not require much intermediary services besides being transported to consumption markets. For rural consumers, it is an important crop for food security because it can be harvested as early as mid-July, which is during the "hungry season" before the main cereal harvests begin in September. Its leaves are also valuable because they serve as feed for cattle. For urban consumers, fresh maize is consumed mainly as a roasted corn on the cob.

Grain maize is harvested at the end of September, which is earlier than millet and sorghum. The next stage after farm-level production and storage is marketing. Like other cereals, much of the maize production is for own consumption (Figure 4). Latest studies estimated the cereal quantity marketed to be approximately 10 and 25 percent annually on average (Samake et al., 2008). The marketed grain maize goes through the cereal marketing system with different markets and actors; these market types and actors will be thoroughly reviewed in section *4.2*. The latter stages are manual and mechanical processing, and lastly final consumption markets. Households are the primary and most important consumption market for grain maize. Cereals, including maize, are used in making breakfast, lunch, and dinner. Rural households mainly process their grain manually, while urban households largely use mechanical processing. Other consumption markets include the poultry sector and exports. All of these stages and activities will be analyzed in the upcoming sections and chapters.

Figure 4: A simplified map of Mali's maize subsector (only nationally produced maize)

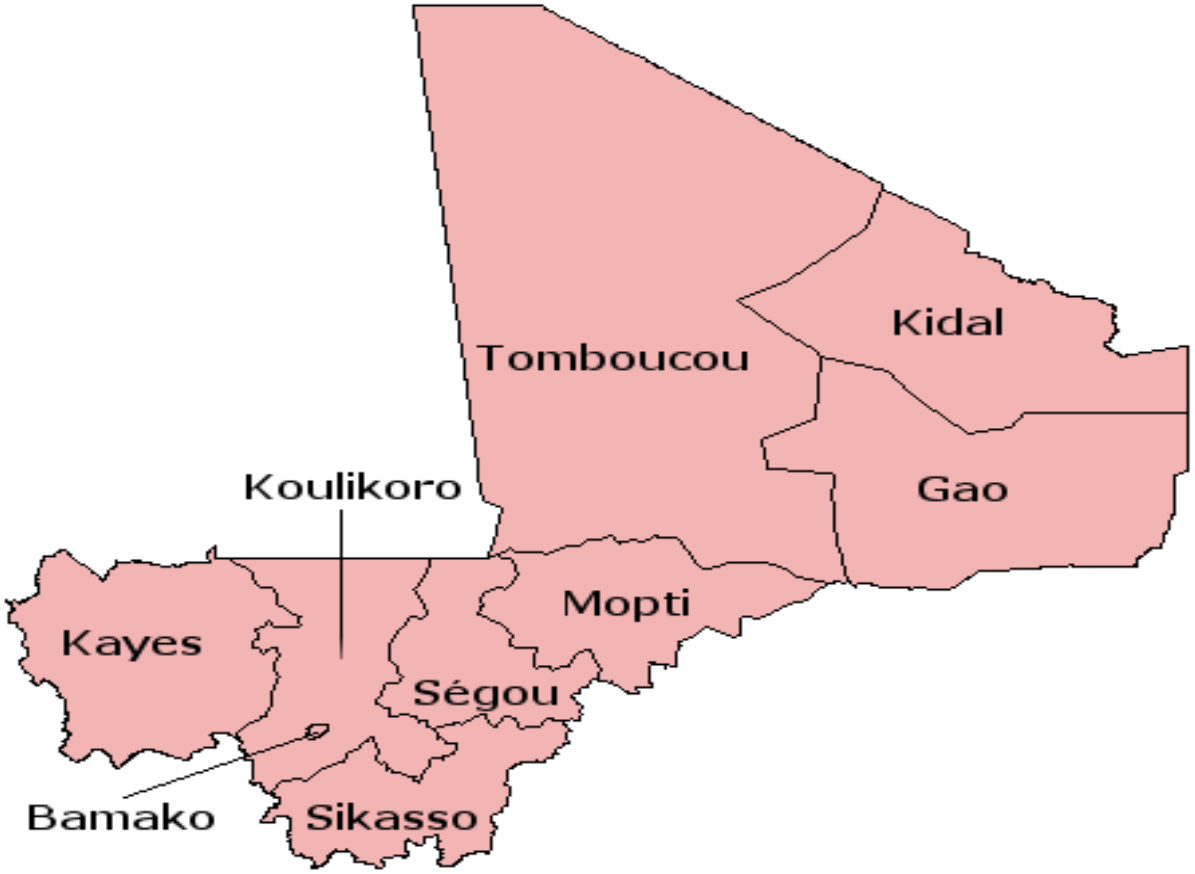


Source: Revised from Boughton (1994) and Afrique Verte (2004)

4.1. Production

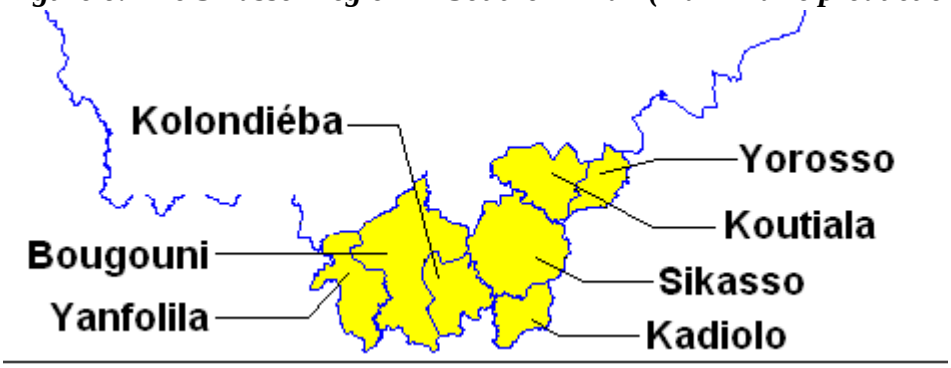
Although other Malian regions, such as Segou (home of rice production), have also adopted maize, maize producers are mainly in the Sikasso region in the South (see Figures 5 and 6), also known as the CMDT and OHVN zones, where 70 percent of the production takes place. In Southern Mali, maize is not produced as a monoculture, but is part of the whole cereal and cotton production system managed by the *Unités de Production Agricole* (UPAs). A UPA is an agricultural production unit made up of farmers, mostly members of the same family group, whether living or not in the same household. NGOs, seed growers, private sector actors, and various technical service officers provide farmers with inputs. CMDT defines four types of farmers in its zone: i) Type A: highly equipped with at least two complete yokes of oxen, a planter, a cart, and a herd of cattle with at least ten steers; ii) Type B: moderately equipped with at least one unit of yoke; iii) Type C: partially equipped with one incomplete unit of yoke; and finally iv) Type D: unequipped and operating manually. Major maize production farms are by and large fairly well equipped; by the end of the 1990s, Type A accounted for 26 percent of UPAs and Type B accounted for 69 percent within the CMDT zone (Diakité, 1997).

Figure 5: Mali map with different regions



**Bamako is the country's capital*
Source: adapted from maptune.net

Figure 6: The Sikasso* region in Southern Mali (main maize production zone)



**In Mali, regions are named after their capital and largest cities. In this case, the city of Sikasso gave the name for the Sikasso region.*
Source: adapted from Keita (2008) cited by commons.wikipedia.org

As seen in the previous chapter, maize production has been steadily increasing over the past 20 years. The increase in maize production resulted from both area expansion and higher yields. Maize production area almost doubled from 1980 to 1993, and has also increased quite significantly by48 percent from 1996 to 2009 (Table 2). Compared to millet and sorghum, maize has also had the highest increase in yields, with an increase of around 25 percent from 1980 to 1993, and 11 percent from 1996 to 2009 (Table 3). As illustrated in Figure 7, maize production followed areas closely until the early 2000s, then, the increases in yield began to account for more of the production growth; this suggests the process of intensification and its important impacts. Also, it is important to note the big spike in maize area in the 1999/2000 period (Figure 7) due to the cotton strike, when cotton production fell by half as many, farmers refused to plant cotton and turned to maize production as an alternative income source.

Table 2: Change in areas of the major cereals, 1979/80 to 2008/09

Crop	Mean Area (ha) 1979/80 - 85/86	Mean Area (ha) 1986/87 - 92/93	Change	Mean Area (ha) 1995/96 - 01/02	Mean Area (ha) 2002/03 -08/09	Change
Millet	785,239	1,002,059	28%	1,023,467	1,539,089	50%
Sorghum	443,089	656,840	48%	670,551	866,460	30%
Maize	75,381	148,412	97%	240,438	355,240	48%
Rice	156,582	208,160	33%	347,969	396,301	14%

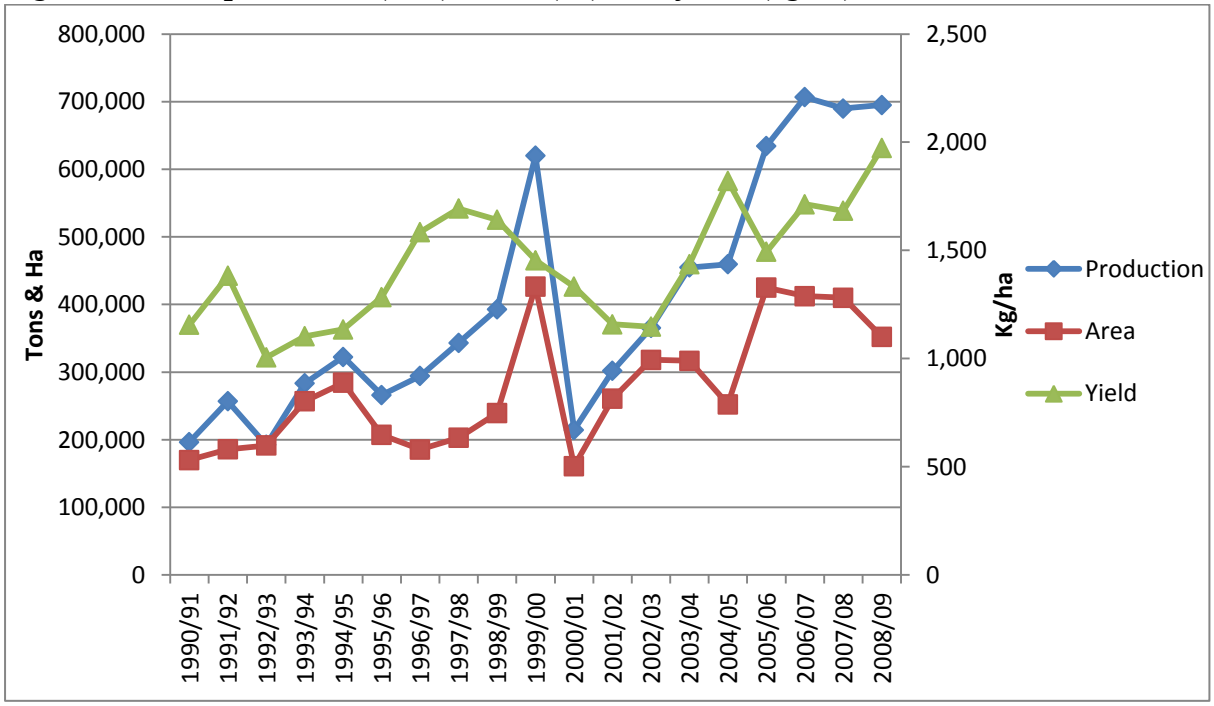
Source: Calculated from CPS database

Table 3: Change in yields of the major cereals, 1979/80 to 2008/09

Crop	Mean Yield (kg/ha) 1979/80 - 85/86	Mean Yield (kg/ha) 1986/87 - 92/93	Change	Mean Yield (kg/ha) 1995/96 - 01/02	Mean Yield (kg/ha) 2002/03 - 08/09	Change
Millet	701	771	10%	748	739	-1%
Sorghum	899	923	3%	900	897	0%
Maize	1,054	1,320	25%	1,450	1,610	11%
Rice	1,124	1,423	27%	1,967	2,504	27%

Source: Calculated from CPS database

Figure 7: Maize production (tons), areas (ha), and yields (kg/ha)



Source: Calculated from CPS database

Although it has the highest yield capacity among all coarse grains, maize is heavily dependent on good rainfall as well as fertilizers. During the 1980s and 1990s, tropical varieties like *TZESR-W*, which are tolerant to low rainfall, were adopted by farmers. In late 1990s, agronomic research and extension brought about the adoption of new improved varieties (Table 4) such as *Sotubaka*, *Niéléni*, *Appolo*, and especially *Dembanyuman* (for large-scale production) that have helped increase yields and are well appreciated in Malian markets. In fact, according to Diakité and Mariko (1998), the improved varieties can increase the average yield by up to 70 percent. Their field research and opinion polls also concluded that higher yields, early harvest (for food security), and good taste are the reasons behind producers' adoption of improved varieties. Finally, the increased in demand, since maize has become both a lean season and cash crop, in addition to farmers' increased spending on fertilizers and inputs, have pushed up the production.

Table 4: The most used maize varieties in Mali

Varieties	Year	Maturity (days)	Yield (tons/ha)	Milling (%)	Grain type	Weight of 1000 grains (g)
Tiématié	1970	110 – 115	4 – 5	84	yellow	235
Kogoni B	1970	80	3 -4	80	yellow flint	235
TZESR-W	1983	80 – 90	3 – 5	80	white dent	235
EV8422SR	1984	100 – 120	4 – 5	79	white dent	235
Sotubaka	1995	115 – 120	5 – 7	85	yellow flint	250
Niéléni	1995	80 -90	4 – 5	84	yellow flint	250
Appolo	1996	65 -75	3 – 4	80	yellow flint	213
Dembanyuman	1998	105 – 110	4 – 5	80	white dent	310
Jorobana	2008	70 – 80	3 – 5	Not available	white dent	Not available
Mali hybrid 7	2008	100 – 110	6 – 7	84	white flint	350

Source: IER-Programme Maïs (2008) and Afrique Verte (2005)

The increase in production through higher yields could help increase maize farmers' revenue. In both CMDT and OHVN zones, improved varieties have proved to offer substantially higher net returns to farmers than local varieties clearly because of higher production yields (Tables 5 and 7). However, intensification might also create additional per unit production costs. Therefore, for a yield-increasing technology to be profitable, it needs to either reduce unit costs of production or produce a product that receives a premium price. Currently, government subsidies have relieved some costs to farmers. The 50kg bag of NPK, urea, cereal complex, cotton complex, and DAP fertilizers currently costs 12,500 FCFA[4], compared to 20,000 FCFA before the *Maize and Wheat Initiative*; the price for seeds is also being subsidized by 50 percent (Coulibaly, 2010). Nevertheless, the overall increase in net returns from the subsidies is modest. For the improved varieties, at least, there seems to be very little need for the subsidies, as the changes in net returns to farmers are about 15 percent for CMDT zone and 14 percent in OHVN zone (Tables 6 and 8). Thus, much focus should rather be put on yield increase and unit cost reduction for profitability in the long run. Appendixes 1A, 1B, 2A, and 2B do a little sensitivity analysis about productivity versus subsidies: a 10 percent increase in production yield for the improved varieties in the unsubsidized CMDT case, for instance, would increase net returns by 16 percent, compared to a 15 percent increase from the subsidy. For the local varieties, the change is 18.4 percent, compared to 18.6 percent for the subsidy (which is about the same). Given a 20 percent increase in yield for both improved and unimproved varieties, the net returns would be much higher in both CMDT and OHVN zones. However, the impact of fertilizer subsidies should not be seen only in terms of increase in net returns, but in terms of reduction of cash costs, as farmers are very cash constrained. Thus, subsidies are useful to them in lessening cash flow

[4] CFA or CFA Franc (FCFA), African Financial Community (XOF), is the common currency for Mali and fourteen other West and Central African countries; $ 1 = 400-500 FCFA.

constraints and risks of monetary losses if production is not as successful as they have anticipated.

Table 5: Maize production budget estimate in CMDT zone at unsubsidized prices for fertilizer and seeds

	Unit	Improved varieties			Local varieties		
		Quantity	Price/unit	Value (FCFA)	Quantity	Price/unit	Value (FCFA)
Production	Kg/ha	2,496.0	120	299,520	1,458.0	120	174,960
Seeds	Kg/ha	19.0	200	3,800	21.0	180	3,780
NPK	Kg/ha	94.0	400	37,600	62.0	400	24,800
Urea	Kg/ha	76.0	400	30,400	43.0	400	17,200
Organic manure	Carts/ha	20.0	750	15,000	15.0	750	11,250
Herbicides	Liter/ha	2.5	4,500	11,250	2.1	3,300	6,963
Harvesting bags	No/ha	8.0	300	2,400	0.0	300	
Total				100,450			63,993
Financial expenses				8,000			6,000
Amortization animals				10,000			10,000
Grand total				118,450			79,993
Return before amortization	FCFA/ha			191,070			104,967
Net return to family, labor, land, and management				181,070			94,967
Net return per person-day of family labor*				1,906			1,117

**Estimated labor days are 95 for improved varieties, and 85 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*
Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Table 6: Maize production budget estimate in CMDT zone given seed and fertilizer subsidies

	Unit	Improved varieties			Local varieties		
		Quantity	Price/unit	Value (FCFA)	Quantity	Price/unit	Value (FCFA)
Production	Kg/ha	2,496.0	120	299,520	1,458.0	120	174,960
Seeds	Kg/ha	19.0	***100****	***1,900***	***21.0***	***90***	***1,890***
NPK	Kg/ha	94.0	***250****	***23,500***	***62.0***	***250***	***15,500***
Urea	Kg/ha	76.0	***250****	***19,000***	***43.0***	***250***	***10,750***
Organic manure	Carts/ha	20.0	750	15,000	15.0	750	11,250
Herbicides	Liter/ha	2.5	4,500	11,250	2.1	3,300	6,963
Harvesting bags	No/ha	8.0	300	2,400	0.0	300	
Total				73,050			46,353
Financial expenses				8,000			6,000
Amortization animals				10,000			10,000
Grand total				91,050			62,353
Return before amortization	FCFA/ha			218,470			122,607
Net return to family, labor, land, and management				208,470			112,607
Net return per person-day of family labor**				2,194			1,325
Change in net return to family, labor, land, and management resulting from the input subsidies				***15.1%***			***18.6%***

**Reflect current (2010/11) government subsidies*

***Estimated labor days are 95 for improved varieties, and 85 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Table 7: Maize production budget estimate in OHVN zone at unsubsidized prices for fertilizer and seeds

	Unit	Improved varieties			Local varieties		
		Quantity	Price/unit	Value (FCFA)	Quantity	Price/unit	Value (FCFA)
Production	Kg/ha	2,262.7	120	271,524	1,252.0	120	150,240
Seeds	Kg/ha	20.0	200	4,000	18.0	180	3,240
NPK	Kg/ha	80.0	400	32,000	68.0	400	27,200
Urea	Kg/ha	50.0	400	20,000	43.0	400	17,200
Organic manure	Carts/ha	20.0	900	18,000	15.0	900	13,500
Herbicides	Liter/ha	4.0	6,000	24,000	4.0	6,000	24,000
Harvesting bags	No/ha	20.0	300	6,000	0.0	300	
Total				104,000			85,140
Financial expenses				7,000			5,000
Amortization animals				10,000			10,000
Grand total				121,000			100,140
Return before amortization	FCFA/ha			160,524			60,100
Net return to family, labor, land, and management				150,524			50,100
Net return per person-day of family labor*				1,771			668

**Estimated labor days are 85 for improved varieties, and 75 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*
Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Table 8: Maize production budget estimate in OHVN zone given seed and fertilizer subsidies

	Unit	Improved varieties			Local varieties		
		Quantity	Price/unit	Value (FCFA)	Quantity	Price/unit	Value (FCFA)
Production	Kg/ha	2,262.7	120	271,524	1,252.0	120	150,240
Seeds	Kg/ha	20.0	***100****	***2,000***	***18.0***	***90***	***1,620***
NPK	Kg/ha	80.0	***250****	***20,000***	***68.0***	***250***	***17,000***
Urea	Kg/ha	50.0	***250****	***12,500***	***43.0***	***250***	***10,750***
Organic manure	Carts/ha	20.0	900	18,000	15.0	900	13,500
Herbicides	Liter/ha	4.0	6,000	24,000	4.0	6,000	24,000
Harvesting bags	No/ha	20.0	300	6,000	0.0	300	
Total				82,500			66,870
Financial expenses				7,000			5,000
Amortization animals				10,000			10,000
Grand total				99,500			81,870
Return before amortization	FCFA/ha			182,024			78,370
Net return to family, labor, land, and management				172,024			68,370
Net return per person-day of family labor**				2,024			912
Change in net return to family, labor, land, and management resulting from the input subsidies				***14.3%***			***36.5%***

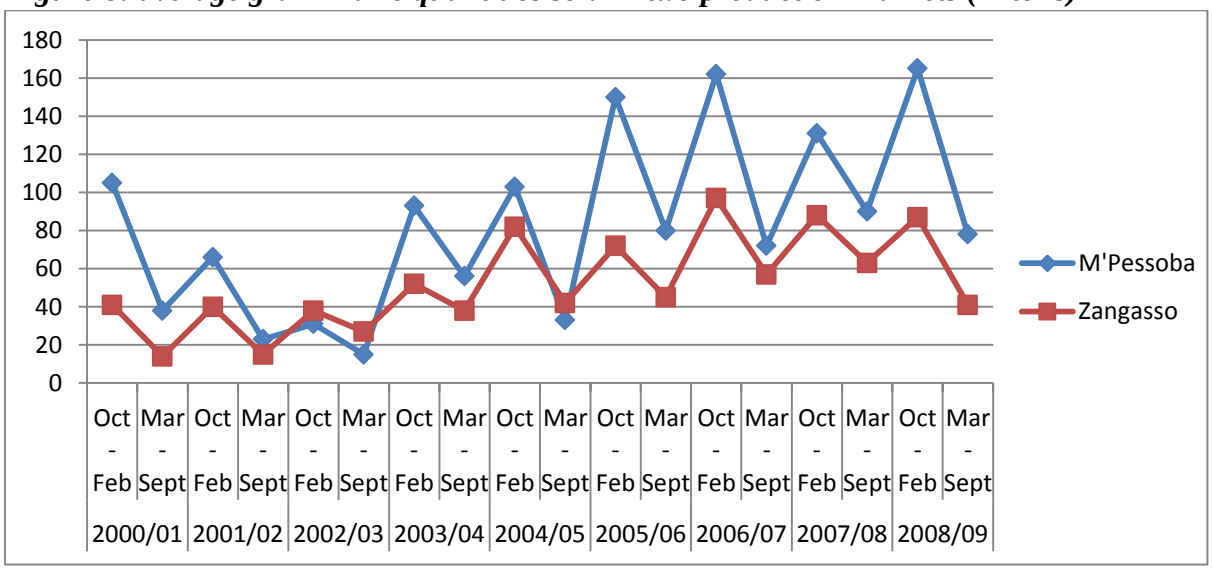
**Reflect current (2010/11) government subsidies*

***Estimated labor days are 85 for improved varieties, and 75 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Maize production in Mali is subject to some constraints. The traditional constraints are rainfall instability; the lack of reliable market information for farmers; the issues related with natural resource management creating soil degradation; and access to financing for farmers. Farm-level storage was not a big problem in the early takeoff period of maize in Mali since most of the crop was consumed in a short period; thus, insect penetration and other wastes were not major worries (Boughton, 1994). However, the expansion of production made storage become a key issue for both traders and farmers. Not only do most farmers lack larger and more advanced storage infrastructures, but also they sell much of their grain maize during the periods directly after harvest (October to February, see Figure 8) for liquidity purposes. Finally, one of the major constraints for producers is their lack of organization for group action. For instance, although most UPAs are part of farmers' associations, they suffer from poor literacy among their members, which undermines the functioning and performance of those associations (Diakité, 1997). Furthermore, the author's discussions with members of farmers' organizations and cooperatives indicated that members often believe that these organizations are not properly functioning to the satisfaction of their members.

Figure 8: average grain maize quantities sold in two production markets (in tons)



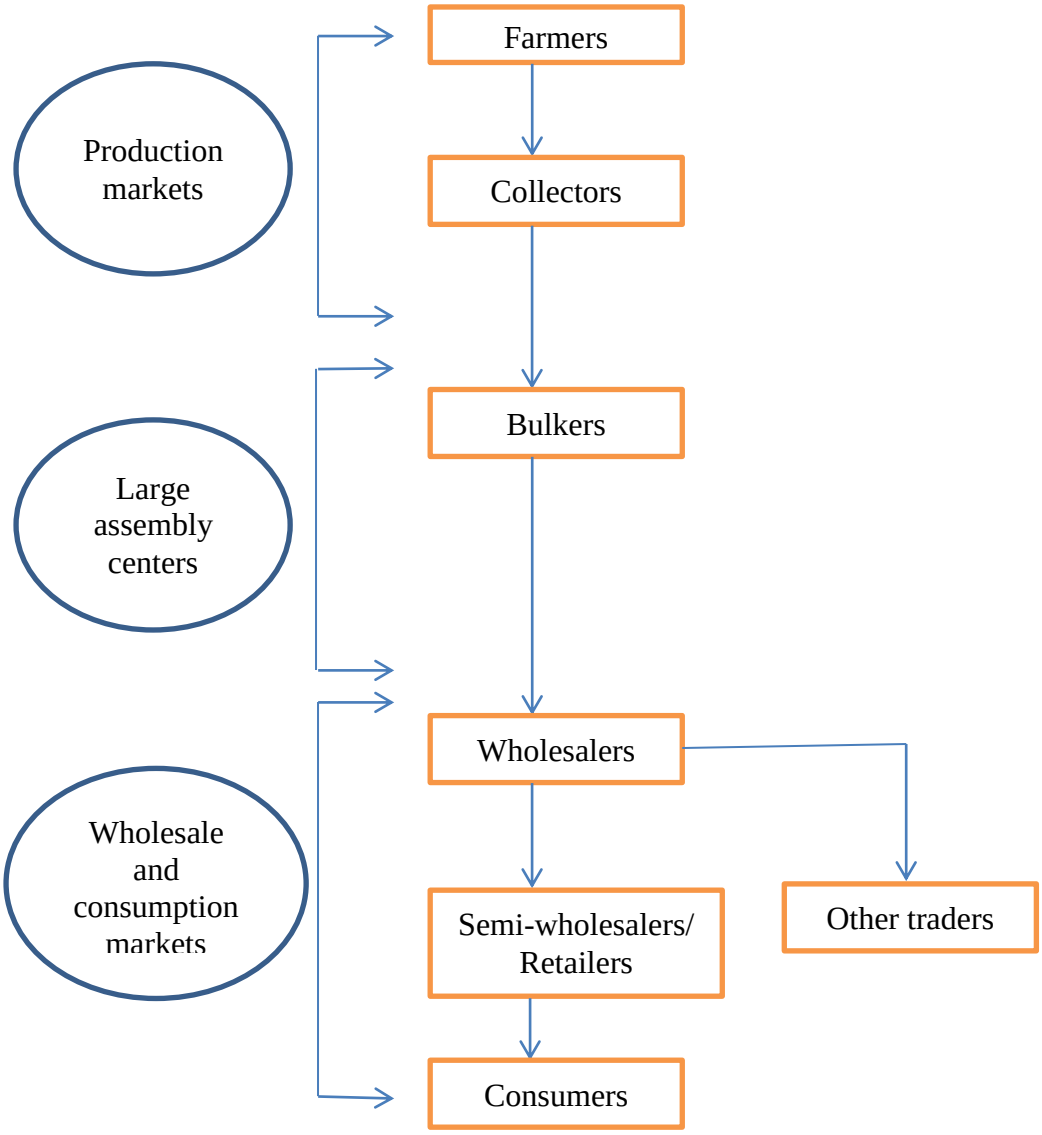
Source: Calculated from OMA's data

4.2. Marketing

Following the cereal market reform of the early 1980s, which liberalized the cereal market, the marketing of grain maize, like that of other coarse grains, had several marketing channels, the longest and most important being the transactions from farmers to urban consumers through several intermediaries (Figure 9). The main marketing functions are exercised by farmers, collectors, bulkers, wholesalers, semi-wholesalers, retailers, and other agents providing services such as transport and storage. Collectors are intermediaries who buy from farmers; they can be independent or dependent (meaning they operate as agents of bulkers, wholesalers, etc.). Bulkers are traders who assemble cereal quantities either for storage or for large assembly and regional markets. Some of them also work for wholesalers, while others operate independently. Wholesalers and semi-wholesalers are cereal traders based in urban centers and large assembly centers with storehouses. The difference between the two comes from their financial ability, the cereal quantity they buy and sell, and the size of their activities. Finally, retailers are traders who buy small cereal tonnages from semi-wholesalers and wholesalers for final sale to consumers (Diarra, 2008). It is possible to find one actor exercising two or more functions in the channel. It is also important to note that OPAM, which were the sole grain marketing agency prior to the cereal reform, is now running the national security stock[5]. It, therefore, is sometimes active in the market buying for this stock and selling (as part of technical rotation of inventory), but it is not engaged in the volume of purchases and sales, as it was prior to the cereal market reforms of the 1980s.

[5] Mali's national security stock's aim is to prevent prices from skyrocketing during a period of crisis, until such time that commercial imports can be arranged to help down prices. Other Sahelian countries created national security stocks in order to face grain deficits resulting from emergency situations and natural disasters.

Figure 9: Simplified scheme of Mali's cereal marketing channel



Source: adapted from Traoré et al. (1994) cited by Tall et al. (2007)

As illustrated in Figure 9 above, there are three main types of cereal markets: i) production markets, ii) assembly markets, and iii) consumption markets. According to Diarra (1993), production markets are weekly markets held at the village level. The agents involved in these markets are "producer sellers" and "producer buyers" of cereals. Also, independent collectors, collectors working for a wholesaler, and sometimes wholesalers who come to get price and supply information or negotiate with collectors operate in these markets. The large numbers of buyers and sellers make most of these markets competitive. Assembly markets are in the capitals of *cercles*[6]; they also have a competitive structure (Diarra, 1993). The majority of the cereals traded in these markets come from the production markets. Thus, the main function exercised by the agents operating in assembly markets is bulking. The third and last cereal market types are consumption markets. They are found in urban areas. These daily consumption markets ensure the distribution of cereals to retailers and urban consumers. Wholesale and semi-wholesale markets located in regional capitals and the capital city, in which trucks deliver cereals from production and assembly markets, are also counted among this market category.

Wholesalers are the actual engine of the marketing system, as they buy quantities of grain from intermediaries and supply consumption markets. They do not buy directly from farmers except from very large producers who are able to supply them directly. Wholesalers also have the highest financial capacity in the marketing system, and they actually provide financing to the other marketing participants. It is important to make the distinction between wholesalers based in production zones and those in urban areas. Wholesalers in the production zones provide financing for cereal collections and assembling as well as transport to consumption markets, whereas the ones in urban areas do not have a collection network and get supplied from production-zones' wholesalers (Samake et al., 2008). The most

[6] Cercle is like a county in Mali's administrative structure. Mali is divided in regions, regions are divided in cercles (counties), and cercles are divided in communes (townships). Like regions, cercles are named after their capital and largest cities.

important sources of financing for cereal marketing in Mali are the *Banque Nationale de Développement Agricole (BNDA)*, Mali's National Agricultural Development Bank, the NGOs and development organizations, and some local credit unions (e.g., Kafo Jiginew).

However, there have been important changes to the structure of the cereal marketing system in Mali. The internal market is much more competitive, with higher trade volumes and lower margins due to better market information thanks to the introduction of mobile phones, the improvement in transportation infrastructure, and the improvement in the banking system (Boughton and Dembele, 2009). Also, according to Samake et al. (2008), wholesalers' influence is diminishing, as there is an increase in competition from importers in neighboring countries, from which collectors and bulkers get higher margins, and also OPAM's practice of sourcing cereals from a broader range of marketing actors to satisfy the purchases for the national security stock. In addition to the decrease in their influence and power, data collections from MSU and OMA conducted in 1986 and in 2007, respectively, showed that the number of Malian wholesalers has decreased in all regions expect in the capital city Bamako, which had an increase of 32 percent. The decrease was significant in the South, Mali's maize basket, with a negative 71 percent change in the city of Sikasso and a negative 29 percent change in Koutiala. It is important to note that it is actually in the Southern markets that the presence of buyers from neighboring countries is highest. So, while Mali-based wholesalers have decreased there, foreign buyers have increased. On the other hand, semi-wholesalers, which are sometimes considered "large retailers", are increasing in numbers.

The main coordination tools in cereal marketing in Mali are trade partnerships, spot markets, and various trade networks. In summarizing Mighell and Jones (1963), vertical coordination is the analysis of how the various vertical stages of production and marketing are harmonized. According to Diarra (2008), the various links in the marketing channels form

networks whose leaders are usually wholesalers, semi-wholesalers and distributors on wholesale markets. The leaders of these networks, in agreement with their collectors, determine the nature and quantity of products to purchase, and set the purchase price taking into account the supply and demand conditions. However, their proposed price is subjected to competition from competing networks. So, the number of actors involved and the relative magnitude of the demand quantity are the real determinants of prices. In large assembly centers, the existing market opportunities from institutions such as the World Food Programme (WFP), OPAM, and other NGOs also influence prices. Horizontal coordination generally involves subcontracting with other wholesalers. Wholesalers, in times of difficulties, do resort to their counterparts in completing their orders. It is very frequent when wholesalers have formal contract with large-scale buyers, such as the WFP or OPAM, to see wholesalers subcontract with other wholesalers to get the volume of product they need to meet the contract.

Coordination in Mali's cereal marketing is greatly influenced by the level of contracting practices and the quantity demanded. Once the purchased grain arrives at the network leaders, they are responsible for reselling it. Then, they re-inject money into the network. To minimize the risks, the financing of the network by its leaders is cyclical and depends on the quantity demanded. The amount injected increases significantly only if there is a formal contract. The volume of collection is unstable across the year. It is slow to almost nothing from May to August; then, there is a slow recovery of activities from September to November, and continuing activities from December to April.

Although some forms of contracting are happening in the marketing network such as written purchase documents between wholesalers and collectors within the same network, and formal contracts with other buyers (Samake et al., 2008), most transactions between farmers and other actors in the value chain involve spot markets. There are practically no

formal contracts between farmers and marketers in Mali. Some wholesalers[7] do engage in formal purchase orders and advance purchase payments with farmers, but the practice remains very limited because of the weak regulatory environment, which leads purchasers to be unsatisfied with the qualities of the cereals they receive and the frequent delivery of underweight sacks of grain. In addition, low access to credit and high interest rates still remain issues to wholesalers. Other major constraints for marketers include transport (poor road system and high fuel costs), storage (due to costs and poor infrastructure), lack of information sharing, and insufficient organization (despite the existence of associations and cooperatives).

4.3. Processing

Most maize is sold in grain form, as low costs of household labor limits demand for processing services. Traditional household maize processing is done using pestle and mortar to get maize flour, milled and crushed maize, maize meal, and husked grain. According to Boughton (1994), there are four main stages in the traditional processing: i) threshing to remove grains from the ear or cob, ii) dehulling to separate the pericarp from the endosperm, iii) milling to reduce endosperm to flour and grits, and iv) sieving to grade the milled endosperm into particles of different sizes. This system is very demanding for house cooks. The amount of time and physical efforts required for soaking and dehulling are a major disadvantage for maize compared to millet and sorghum, and it slowed down its demand in some regions in the past. In urban areas, on the other hand, mechanical processing by *moulins du quartier* (small-scale urban mills) is the most common. Many women, however, find the traditional pestle and mortar system to give better quality and tasting maize than the mechanical system. In fact, according to Diakité (1997), the *Engleberg* dehulling operator brands, which are used by most urban mills, not only have some quality issues with maize,

[7] Personal interview at Bamako's Bagadadji wholesale market

but also create 20 to 25 percent grain losses. Thus, technical researchers advised mill operators to adopt brands like the Brazilian *Maquina d'Andrea* that work well with *Tiémanitié, Sotubaka*, and *Niéleni* varieties.

At the industrial level, there is an increasing number of small and semi-industrial processing units in Bamako producing processed maize products (from flour, grits, and steamed flour) such as pre-cooked flours, couscous, and other maize meals. Nevertheless, these industrial processing units still have a small capacity. In fact, the processing of coarse grains in Mali is constrained by issues related to technology and equipment, training, credit and financing, marketing, competition from imported flours, and return on investments. In late 1980s, a dozen milling units for women were launched in the CMDT zone for grain processing. However, this was not a successful experience due to not only the poor quality of the flour produced (with degerming and peeling problems), but also marketing and management issues. Even the *Grands Moulins du Mali* (GMM), a large processing unit that produces industrial flours and poultry feeds, struggled with high marketing costs and high prices; it had to seek help from the government for its promotional activities (Tall et al., 2007). Given the increasing maize production and other changing demand factors, it will be critical for the industrial processing sector to develop.

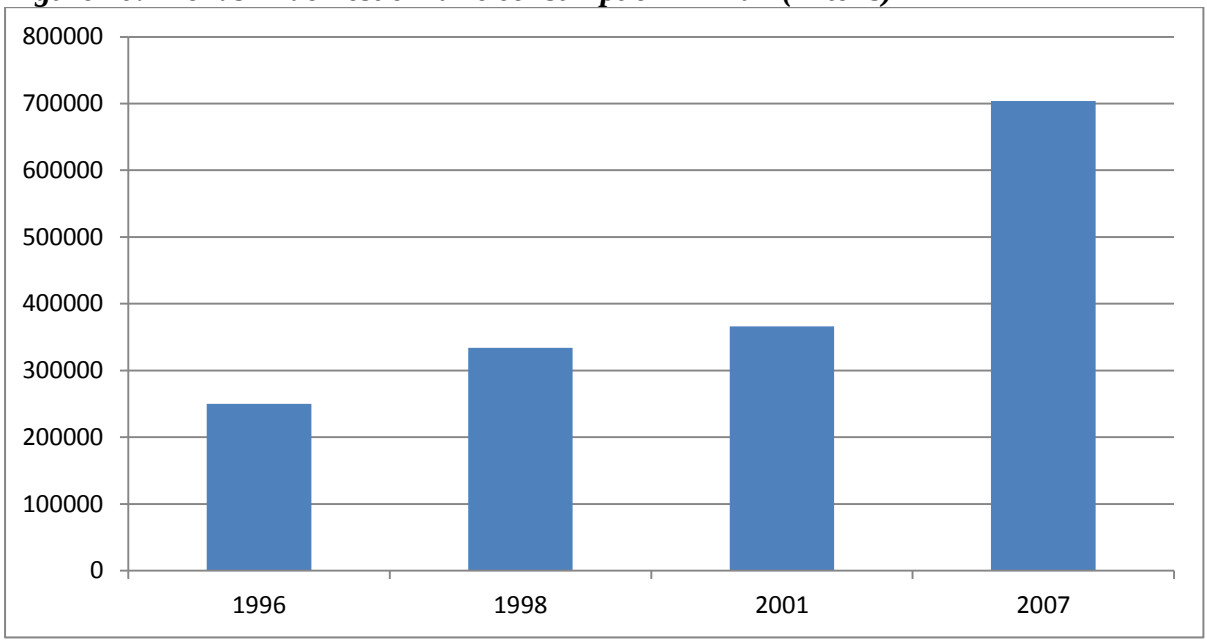
CHAPTER 5: CHANGING DEMAND FOR MAIZE

5.1. Current trends

The demand for Mali's grain maize can be divided into several main segments: human consumption, livestock feed, industrial processing, and exports. Boughton (1994) recalled the periods when maize was only consumed in the form of boiled or roasted ears, and that maize was perceived to be a "difficult-time cereal" because Malians' historical encounter with it was during the famines of the early 1970s. However, the demand for maize in Mali has shifted considerably. From a little over 250,000 tons in mid 1990s, the total quantity of maize consumed in Mali has almost tripled to more than 700,000 tons in late 2000s, as shown in Figure 10. Human consumption is by far the largest segment, as it accounts for up to 90 percent of the total. Nowadays, maize has completely fit into households' cereal consumption habits and it is being consumed in the form of traditional millet and sorghum-based dishes for breakfast, lunch, and dinner. This change is confirmed by the statistics of Mali's national office for statistics (DNSI), which estimated the average annual grain maize consumption per person to be 13 kg in 1988/89, then 27 kg in 1994, and lastly 43.1 kg in early 2000s. Given that grain maize was modestly consumed in rural areas, especially in the Sikasso region, another important reason behind the expansion in human maize consumption is the change in demography. Mali's urban population, which now accounts for 35 percent of the total population with an annual growth of 5 percent (Table 9), has an increasing demand for maize-based processed products. The demand for processed maize appears to have considerably increased in the last decade, although there are no available data to back up this claim. There are more and more mills that are shelling and grinding grain maize for urban households. Many women in Bamako are running *Unités de Transformation* (processing units), producing semi-processed grain maize (couscous, baby foods, etc.). The urban

population, with increasing spending on pre-cooked and away-from-home foods, is also providing market boost to food industries such as restaurants, local stores, and *alimentations* (small neighborhood supermarkets), offering secondary processed maize products (biscuits, cakes, etc.).

Figure 10: Trends in domestic maize consumption in Mali (in tons)



Source: DNSI cited by Sissoko (2003), FAO/PDES/UNDP (2007)

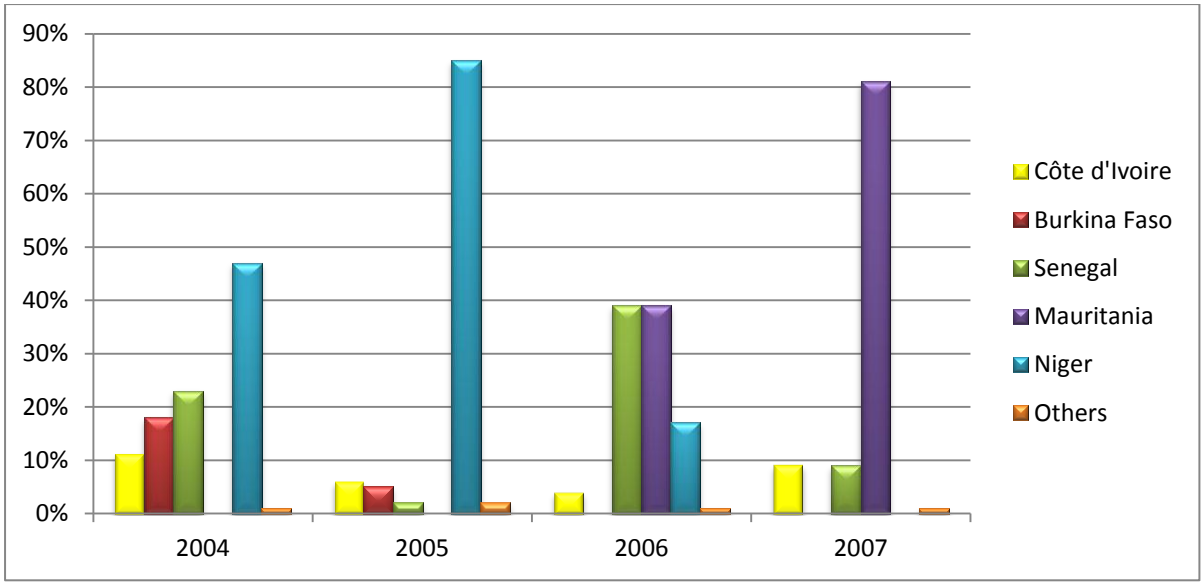
Table 9: Estimated and projected Mali's urban and rural population trends

Year	1998	2005	2010	2015	2024	Average annual growth
Rural population	7,112,138	8,025,103	8,649,035	9,275,709	10,411,243	2%
Urban population	2,595,596	3,707,315	4,766,170	6,098,423	9,408,919	5%
Total population	9,707,734	11,732,418	13,415,205	15,374,132	19,820,162	3%
Urban pop/rural pop.	27%	32%	36%	40%	48%	

Source: adapted from DNSI cited by Farvacque-Vitkovic et al. (2007)

Besides industrial demand, export represents another market. Mali's exports of maize ranged officially from around 5,000 to close to 11,000 tons from 2002 to 2006 (DNSI). However, most cross-border trade, especially in the South, is informal and not quantified. Both the import and export quantities vary considerably across the years, depending on the demand and supply conditions. The main export market was historically Côte d'Ivoire, but recently, as illustrated in Figure 11, new export markets (Senegal, Mauritania, and Niger) have emerged and could further develop, although the total export quantities fell from above 10,000 tons to below 1,000 tons over the 2004 to 2007 period (DNSI). Thus, the increasing relative importance of Mauritania in Figure 11 represents more a fall in exports to other countries, such as Niger, than an absolute increase in exports to Mauritania.

Figure 11: Share of maize's exports to neighboring countries (officially quantified data only)



Source: Calculated from DNSI's data cited by Diakité (2010)

Although having currently by far a lower share in domestic demand compared to human consumption, the total quantity of grain maize used as livestock feed, especially for poultry, has also played an important role in the current shift of maize demand in Mali. Grain maize accounts for 60 to 70 percent of poultry feed rations. The *Direction Nationale des*

Industries de Production Animale, Mali's Department of Animal Production Industries, estimated in early 2000s that more than 30,000 tons of grain maize were used yearly as feed for cattle and poultry; other statistics from mid 2000s cited by Samake et al. (2008) showed an increase in this number to up to 42,300 tons for poultry alone. Latest estimates by Teme et al. (2010) showed further increase, with a current grain maize consumption quantity of close to 70,000 tons (50,000 for poultry and 20,000 for cattle). The rapid urbanization has also increased the demand for meat, particularly chicken; the demand for eggs is also helping drive poultry production. The increase in demand for chicken has brought about a boom to the feed milling sector. Traore (2006) estimated a dramatic increase in the number of feed mills in Mali from around 5 to 18 in a relative short period (from early 2000s to 2005); their average daily production also increased from 10 to 42 tons over the same period. Their demand for grain maize is more and more important. For instance, AVI-PRO, a medium-sized mill in Bamako, used to consume monthly around 20 tons of maize in early 2000s; currently, its monthly maize consumption could reach up to 100 tons[8].

Poultry feed mills get supplied in grain maize mainly from wholesalers. However, the maize demand expansion in the poultry sector has several structural constraints and organizational problems. First, according to the *Programme de Développement de l'Aviculture au Mali* (PDAM), Mali's Poultry Development Program, the poultry sector in Mali is still informal (80 percent of poultry meat producers are operating traditionally). Among the 326 poultry farms censused by PDAM in 2005, fewer than 10 percent were considered "big producers", engaging in larger and more professional business activities with more than 10,000 chickens. Also, big producers buy processed grain maize, while smaller ones process their grain manually or semi-manually themselves. This is because big producers have more ability and need for buying large quantities and better quality feeds than

[8] Personal interview

small producers, and also it is due to the fact that small producers are also sellers of feeds (an important income-generating activity for them). There is little contracting taking place in the poultry sector. Transaction relationships between poultry producers, feed mills, and grain suppliers are by and large on the spot market. The only formal practices are grouped purchases, through cooperatives, and purchase orders with advance payments. In addition to little contracting, there are deficits of information between grain maize producers and poultry actors, mainly on prices and grain quantity availability, which constitute a major constraint for poultry actors, not only in terms of procurement but also stable prices. Due to these various supply unreliability factors, some major poultry producers like SODOUF moved toward more integrated approach in their activities by engaging in the production and processing of minor grain maize quantities for their needs.

5.2. Anticipated future trends

The demand for maize in Mali will likely keep expanding in the upcoming years. Beyond quantitative expansion, the change in demand will also involve the need for more quality and food processed products because of urbanization and income growth. According to Samake et al. (2008), there is an important demand for cleaned, re-packed, and reconditioned coarse grains in Bamako and other cities in Mali, and that cleaning and reconditioning have become important value adding activities in the marketing channels. Another important demand change may be the grain maize color differentiation. Consumers in Bamako and Kayes prefer yellow maize, whereas the consumers in Segou and Sikasso prefer white grain. Poultry actors also prefer yellow grain, as it confers a brighter color to the egg yolk. Most cereal bags used to contain mixed color grains, but recently more marketers are differentiating them in order to comply with quality and competitive standards. Besides, maize chips and other maize-based processed food products sold in urban areas are increasing and could represent an annual demand of more than 23,500 tons (CAE, 2001).

The consumption from animals, especially poultry, will also grow rapidly, boosted by the continuing demographic and economic changes. Urban dwellers are more and more consuming chicken meats and broilers. The annual growth rate of grain maize consumption for poultry and cattle feeds has been around 10 and 15 percent in recent years. At that pace, the current grain maize consumption quantities of 70,000 tons as animal feed could reach up to 120,000 tons by 2017; given stable prices, an additional 60,000 tons can be added to this number, which will represent an average annual growth of 20 percent (Teme et al., 2010).

Important market opportunities already exist from the industrial processing and the export sectors. Industries like *SOMACO* (canning factory), *GAM* (manufacturer of biscuits, creams, etc.), *SOMAPIL* (battery plant), *UMPP* (pharmaceutical factory), and paint factories had annual needs of 6,000 tons of quality flour or starch in 2001 (CAE, 2001). *BRAMALI*, Mali's beverage company, also had a yearly demand of 1,080 tons of maize grits. Various studies showed that bakeries were ready to substitute 5 percent of their wheat flour into maize flour; given reliable supply and stable prices; this represents an estimated potential demand of more than 15,000 tons per year (Kone, 2005). The supply of primary processed grain maize could further increase with GMM, which has ambitions to process 5,000 to 10,000 tons per year, and also with the coming of a new milling unit, *Moulins du Sahel*, with planned grain maize processing capacity of 120 tons per day and storage of 12,000 tons[9]. In addition, the *Zones Greniers* program, which was launched by the Ministry of Agriculture and the Alliance for a Green Revolution in Africa (AGRA) for an integrated sustainable transformation of the cereal sector, plans to create or rehabilitate 10 to 20 milling units (each one having a processing capacity of 300 to 600 tons per year) in villages in the Sikasso region. Some of those women-operated milling units in the CMDT zones could get back on their feet through this program. Lastly, there is an increasing demand from the neighboring countries of

[9] Personal interview

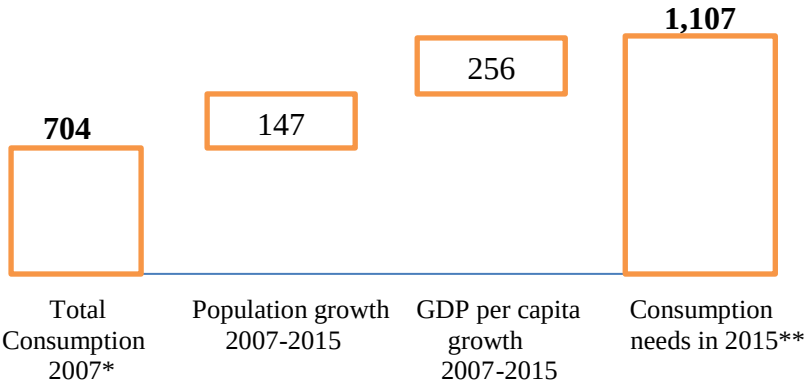
Mauritania, Niger, Burkina Faso, and especially Senegal that also have growing grain maize demand for poultry feed. The export opportunity is large, as the annual total maize import in West Africa was about 298,819 tons in 2008 (FAOSTAT).

In terms of estimates, there are large market prospects for Malian produced maize. FAO/PDES/UNDP (2007) projected a domestic demand quantity of around 1,107,000 tons in 2015 using population and GDP per capita growths as basis for making this projection (Figure 12). Given the various potential consumption needs, from human consumption, animal feed, industrial processing, to exports, Table 10 projects a total potential quantity demanded in 2015 of close to 1,300,000 tons. However, there are some weaknesses in the industrial processing and export sectors that may limit these promising demand statistics. First, the industrial processing sector has a low capacity to respond to a potential demand due to various technological and financial constraints as recalled in *Section 4.3*. A potential market for Malian maize for producing biofuels has been identified. But, the estimated high costs of production at the pump (compared to gas), the investment requirements, and a probable competition between food and biofuel give a low attractiveness and feasibility to this project as well[10]. Finally, with respect to exports, despite an increasing demand from neighboring countries and free trade agreements involving Mali under ECOWAS and UEMOA, traders usually complain about several border issues, such as the large number of checkpoints and custom harassments, the amount of time lost with loading and unloading of goods for custom checks, and the poor governance resulting in the non-implementation of existing laws (PROMISAM, 2008). Thus, unless policy changes and further infrastructure is developed, the various trade costs will limit the competitiveness of Malian maize across the borders. Hence, after human consumption, the demand pressure for Malian maize in the next

[10] Personal interview

five to ten years is expected to come more from poultry (not only from domestic poultry, but also in neighboring countries).

Figure 12: Projected Mali's domestic maize demand quantity by 2015 (in '000 tons)



*Including animal feed
**Based on the current average per capita cereal production

Source: adapted FAO/PDES/UNDP (2007)

Table 10: Potential Malian maize consumption quantities by 2015

(1)*	*Total domestic consumption including animal feed (in tons)*	1,107,000
(2)**	*Potential industrial needs (in tons)*	87,000
(3)***	*Potential export quantities (in tons)*	100,000
Total: (1) + (2) + (3)	**Total potential quantity demanded in 2015 (in tons)**	**1,294,000**

*Estimated from Figure 12
**Potential industrial needs listed in the text (may not be exhaustive)
***Based on the latest total West Africa's maize import quantities of close to 300,000 tons; the most optimistic estimate is that Mali could meet a third of that import

CHAPTER 6: PERFORMANCE AND FUTURE IMPLICATIONS

With a current production of more than 700,000 tons, maize production has had an impressive increase since its adoption period. Maize represents the highest growing rainfed cereal with more than a tripling production from early 1990s to late 2000s and an average annual growth rate of 15 percent (Table 11). Also, it is striking that maize production, which was mainly supported by cotton, has continued to increase despite the crisis in the cotton sector. This is because maize is no longer a complement for cotton as it was before, but is now an alternative to cotton for farmers in terms of revenue. Moreover, maize has become more valuable in Mali's agriculture. Maize currently accounts for around 7.7 percent in Mali's total agricultural GDP; it was 5.7 percent in 1991. Overall, the total value of maize production in food crop production rose from 16.7 FCFA billion in 1991 to about 42 FCFA billion in 2008 (CPS).

Table 11: Growth of rice and maize compared to millet and sorghum in Mali

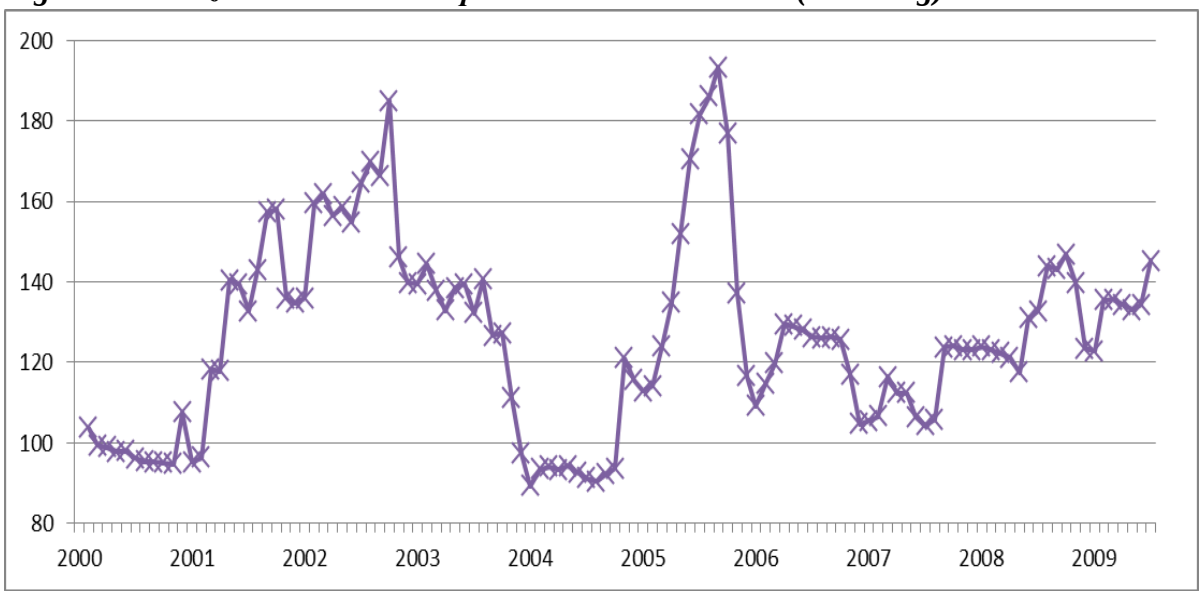
Crop	Mean Prod (tons) 1990/91 – 1992/93	Mean Prod (tons) 2006/07 - 2008/09	Change 1990/91 - 2008/09	Annual Growth
Millet	736,400	1,239,263	68%	5%
Sorghum	634,577	899,224	42%	3%
Maize	215,295	697,242	224%	15%
Rice	382,244	1,253,289	228%	15%
Total cereals	1,997,473	4,131,173	107%	7%

Source: Calculated from CPS Database

In terms of prices, real consumers' prices for grain maize in 2009 are higher than in 2000. In *Bamako Medine* market, for instance (Figure 13), the real consumers' prices increased dramatically from 2000 to 2005, and moderately between 2006 and 2009. Although other factors affect prices, the increase in prices while supply is also increasing may suggest a demand pressure and the competitiveness of maize compared to other coarse grains. Also, in *Bamako Medine*, recent real consumers' prices for millet and sorghum have been the same as grain maize, whereas maize used to be cheaper (Figure 14). This further implies more

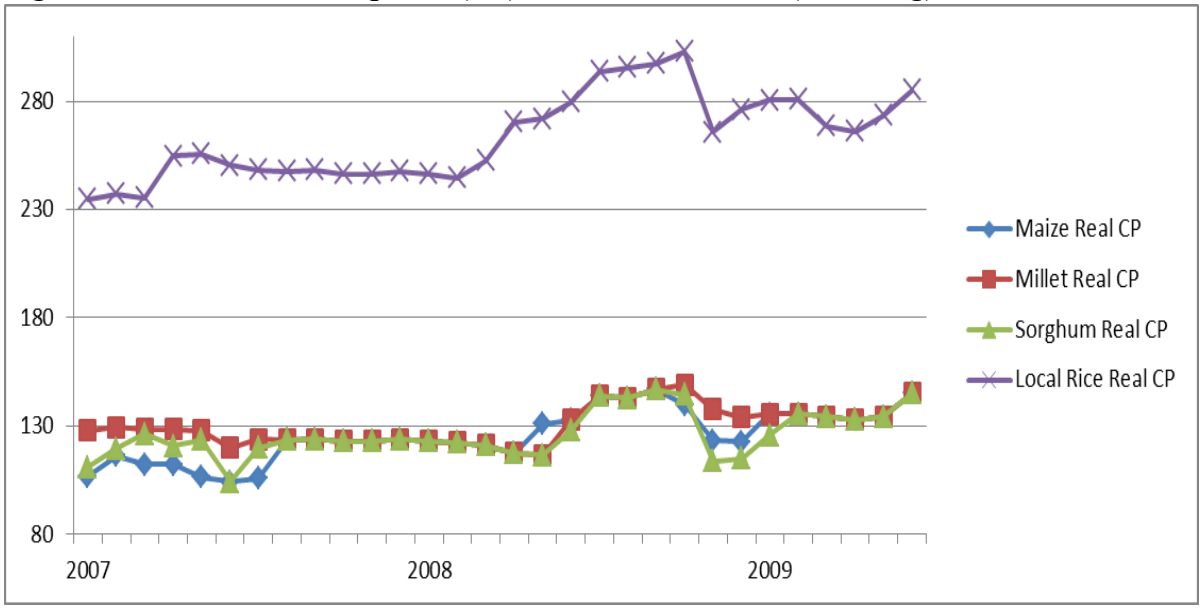
competitiveness and substitutability of grain maize with other coarse grains in urban areas. Millet used to be by far the most consumed cereal in Mali and is still the primary commodity consumed in rural areas. Rice, which has the highest consumers' price, is a superior commodity and econometric studies have not found a high cross-elasticity of demand between rice and maize in the past (Camara, 2004). Even so, the author's causal observations and discussions with other market observers indicate that during the last cereal (especially rice) price spikes of 2008, some households readapted their cereal consumption to include more grain maize, which was relatively cheaper.

Figure 13: Maize real consumers' price in Bamako Medine (FCFA/kg)



Source: Calculated from OMA's data; nominal prices were deflated by the CPI and are expressed in 2000 price levels

Figure 14: real consumers' prices (CP) in Bamako Medine (FCFA/kg)

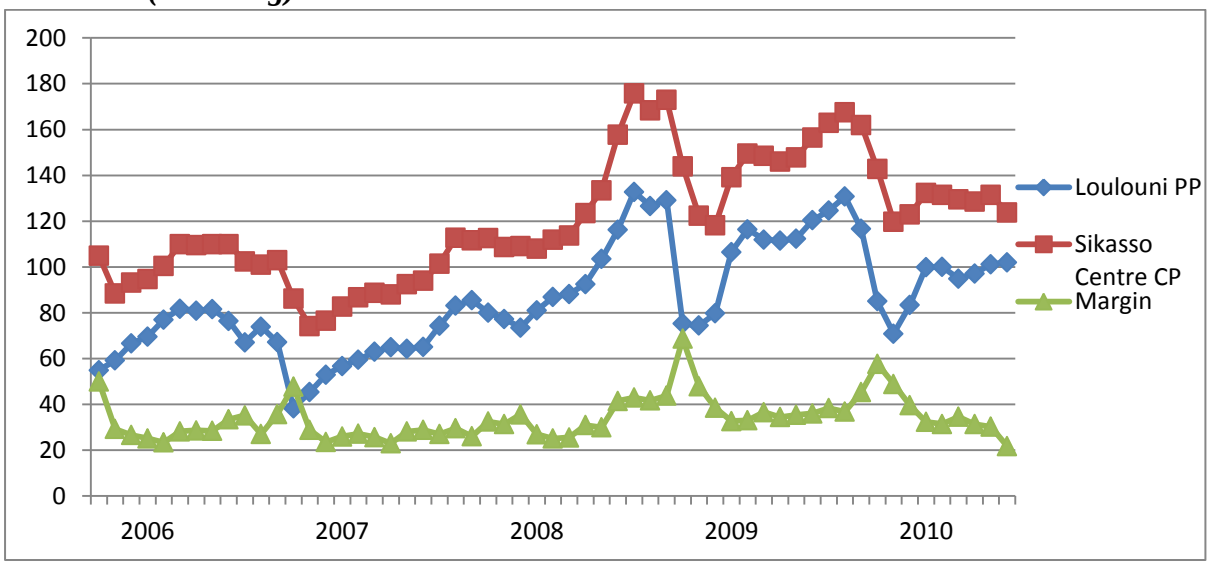


Source: Calculated from OMA's data; nominal prices were deflated by the CPI and are expressed in 2000 price levels

Among the important pricing trends for grain maize, there is the fact that the nominal prices for producers and consumers in different production and consumption markets are evolving together, for instance Loulouni and Sikasso or Koutiala and Bamako (Figures 15 and 16). This suggests that these markets are integrated, although it is also interesting to note that, despite frequent fluctuations, the margins between the two prices have fallen overall in the last four years. Margins were high at harvest when both consumers' and producers' prices are low, and low or stable when prices are high. Another important trend is the fact that the margins between consumers' prices in the city markets of Sikasso and Segou, closer to the production, have narrowed in the last decade, with other important maize consumption cities like Kayes that are distant from the production zone (Figure 17). This is likely primarily due to recent road construction in Mali, since Kayes used to rely only on the railroad for trade, and the train system was going through series of crises. Nevertheless, the margins between the consumers' prices of Bamako and Sikasso have widened. This suggests the impact of the latest high fuel prices on transport costs for marketers. Lastly, as in Figure 18, the share of producers' prices in both wholesales' and consumers' prices in the Sikasso region is high (80

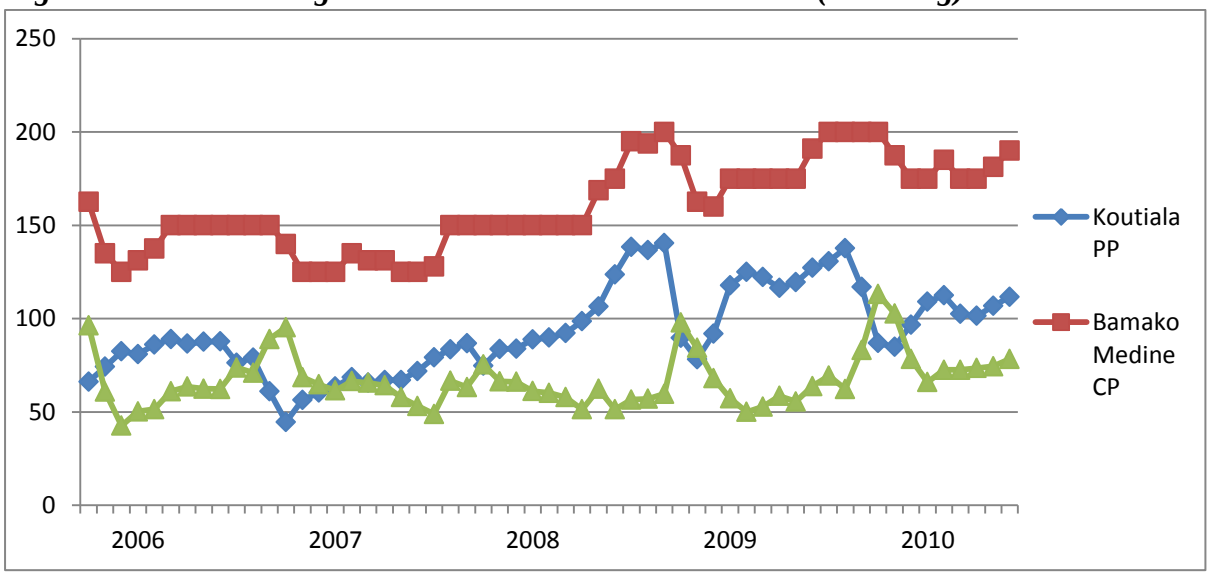
to 90 percent and 70 to 80 percent, respectively). Although this share could be lower in other zones, it still shows that farmers are gaining high share of the consumption value.

Figure 15: Maize average producers' prices (PP) in Loulouni and consumers' prices (CP) in Sikasso (FCFA/kg)



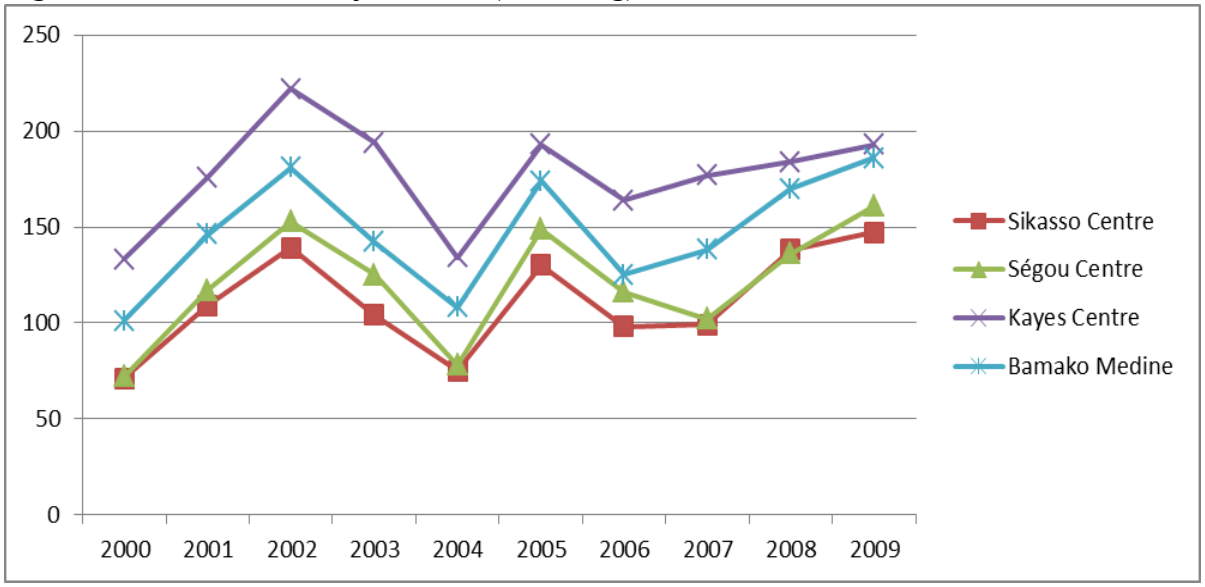
Source: Calculated from OMA's data

Figure 16: Maize average PP in Koutiala and CP in Bamako (FCFA/kg)



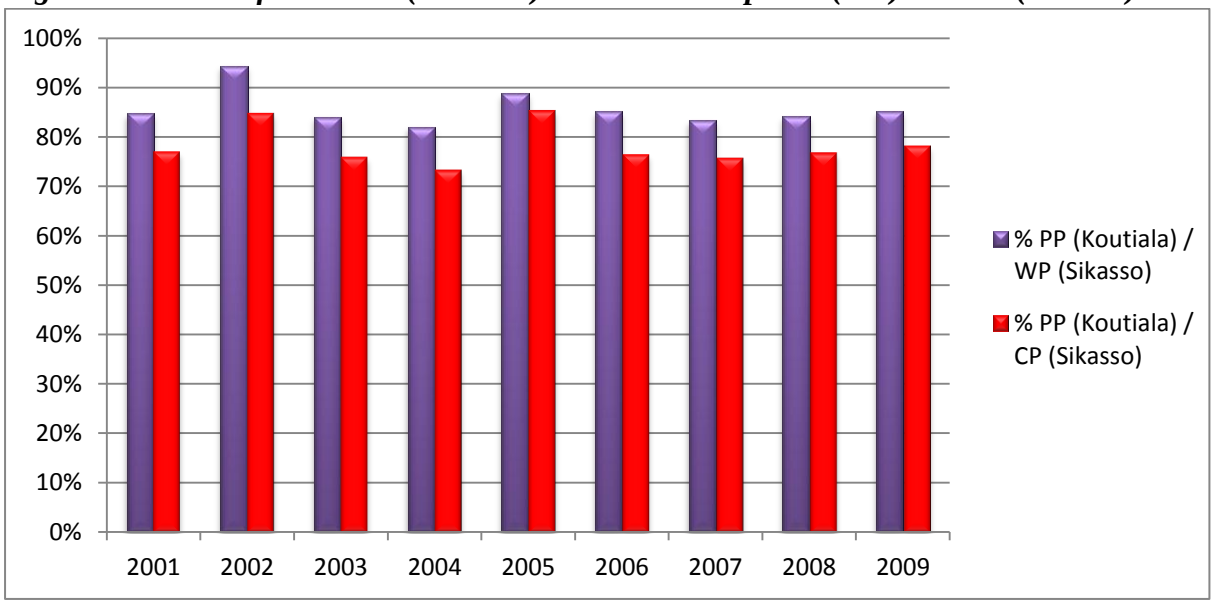
Source: Calculated from OMA's data

Figure 17: Maize CP in city markets (FCFA/kg)



Source: Calculated from OMA's data

Figure 18: Share of maize PP (Koutiala) in wholesales' prices (WP) and CP (Sikasso)



Source: Calculated from OMA's data

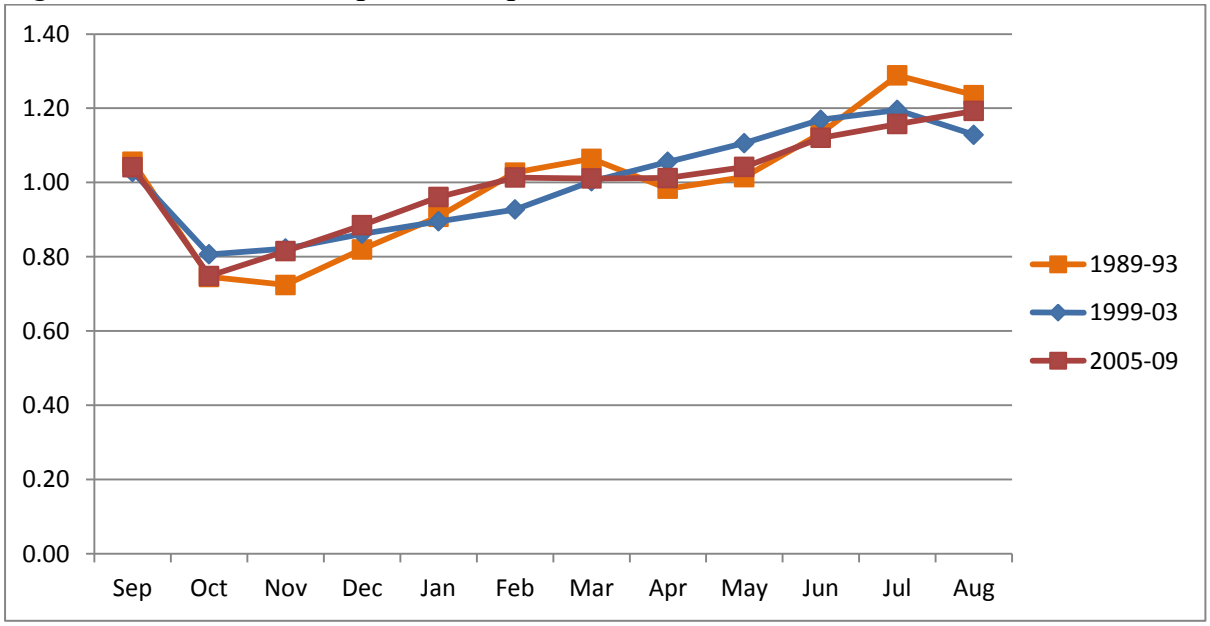
On the other hand, maize prices still remain volatile. As shown in Table 12, prices currently follow a fairly predictable seasonal pattern: they are low during the first five months after harvest (October-February) and high toward the lean season. As discussed in Section *4.1.*, liquidity for credit payments or further family spending and low storage capacity are the main reasons why most producers sell much of their maize during the periods directly after harvest. Some farmers even oversold their stocks and had to buy back cereal quantities at later months, causing them financial losses. However, as maize becomes more and more of a cash crop, the markets should become less thin and, therefore, volatility will likely decrease, as it has for the past two decades (Figure 19). That is, the amplitude of within-year price variation has, on average, decreased between 1989-93 and 2005-09, albeit with considerable variation within each time period. Looking at annual average prices, however, as shown in Tables 13-14-15, there has been an increase in year-to-year volatility, as indicated by the within-period coefficients of variation (CV), over the 21-year period covered by the analysis. While the seasonal price patterns remained the same or became highly less volatile, the CVs in late 2000s are much higher than the ones in late 1980s to mid-1990s. This may reflect greater regional integration of Malian markets with those of neighboring countries, so that demand and supply shocks from those countries (particularly countries like Niger where production is more volatile) now spill over more onto Malian markets. It further suggests that managing inter-annual price risk may have become more challenging for farmers and traders over the past 20 years.

Table 12: Average nominal maize PP in Koutiala (FCFA/kg)

	2001/02	**2002/03**	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**	**2008/09**
Oct-Feb PP	87	100	40	76	78	59	84	101
Mar-Sept PP	128	90	53	135	81	74	119	120
Difference	41	-10	13	59	3	15	35	19

Source: Calculated from OMA's data

Figure 19: maize seasonal producers' price indices in Koutiala



Source: *Calculated from OMA's data*

Table 13: 1989-93 maize seasonal price indices at producers' level in Koutiala

	1989-90		1990-91		1991-92		1992-93		
	PP (CFA)	Index*	PP (CFA)	Index	PP (CFA)	Index	PP (CFA)	Index	1989-93 indices
Sep	30	0.86	63	0.91	59	1.37	42	1.08	1.06
Oct	27	0.77	38	0.55	36	0.84	32	0.83	0.75
Nov	25	0.71	44	0.64	31	0.72	32	0.83	0.72
Dec	27	0.77	55	0.79	36	0.84	34	0.88	0.82
Jan	29	0.83	64	0.92	42	0.98	35	0.90	0.91
Feb	33	0.94	80	1.16	47	1.09	36	0.92	1.03
Mar	37	1.06	76	1.10	47	1.09	39	1.01	1.06
Apr	36	1.03	69	1.00	42	0.98	36	0.93	0.98
May	36	1.03	78	1.13	42	0.98	36	0.93	1.01
Jun	41	1.17	86	1.24	44	1.02	42	1.09	1.13
Jul	47	1.34	95	1.37	46	1.07	53	1.37	1.29
Aug	52	1.49	83	1.20	44	1.02	48	1.24	1.24
Mean	35.0		69.3		43.0		38.8		**CV** = 3.88**

**Index = monthly price / mean annual price*

***CV of average annual prices over the period = STD (standard deviation) / Mean*

Source: *calculated from OMA's data*

Table 14: 1999-03 maize seasonal price indices at producers' level in Koutiala

	1999-00		2000-01		2001-02		2002-03		
	PP (CFA)	Index*	PP (CFA)	Index	PP (CFA)	Index	PP (CFA)	Index	1999-03 indices
Sep	72	1.48	49	0.63	73	0.69	134	1.32	1.03
Oct	49	1.01	54	0.70	62	0.58	95	0.94	0.81
Nov	47	0.96	54	0.69	75	0.70	95	0.93	0.82
Dec	48	0.98	52	0.68	80	0.76	106	1.04	0.86
Jan	40	0.81	55	0.71	110	1.04	104	1.02	0.90
Feb	36	0.74	72	0.93	110	1.03	101	0.99	0.93
Mar	39	0.79	89	1.15	114	1.07	102	1.00	1.00
Apr	48	0.99	87	1.13	116	1.10	103	1.01	1.06
May	50	1.03	91	1.18	126	1.19	104	1.03	1.11
Jun	54	1.11	97	1.25	136	1.29	104	1.02	1.17
Jul	52	1.07	115	1.49	144	1.36	88	0.86	1.20
Aug	50	1.03	113	1.47	126	1.19	85	0.83	1.13
Mean	48.8		77.4		105.9		101.6		**CV** = 6.57**

**Index = monthly price / mean annual price*
***CV of average annual prices over the period = STD (standard deviation) / Mean*
Source: calculated from OMA's data

Table 15: 2005-09 maize seasonal price indices at producers' level in Koutiala

	2005-06		2006-07		2007-08		2008-09		
	PP (CFA)	Index*	PP (CFA)	Index	PP (CFA)	Index	PP (CFA)	Index	2005-09 indices
Sep	96	1.17	61	0.93	87	0.86	140	1.21	1.04
Oct	66	0.80	45	0.68	75	0.74	90	0.77	0.75
Nov	74	0.90	56	0.86	84	0.83	78	0.67	0.82
Dec	82	1.00	60	0.92	84	0.84	92	0.79	0.89
Jan	81	0.98	64	0.97	89	0.89	118	1.01	0.96
Feb	86	1.04	69	1.04	90	0.90	125	1.07	1.01
Mar	89	1.08	66	1.00	92	0.92	122	1.05	1.01
Apr	86	1.05	67	1.02	99	0.98	116	1.00	1.01
May	88	1.06	67	1.02	106	1.06	119	1.03	1.04
Jun	88	1.06	72	1.09	124	1.23	127	1.09	1.12
Jul	76	0.92	79	1.21	138	1.38	131	1.12	1.16
Aug	79	0.96	83	1.27	137	1.36	138	1.18	1.19
Mean	82.7		65.7		100.3		116.4		**CV** = 5.48**

**Index = monthly price / mean annual price*
***CV of average annual prices over the period = STD (standard deviation) / Mean*
Source: calculated from OMA's data

Given that maize is an important input for poultry producers and feed mills, which are predicted to play a major role in the demand for maize, the level of maize prices is an important factor that will influence poultry producers' and grain millers' buying behavior and future strategies. In fact, looking at a sample budget in Table 16 for a medium-sized feed mill, the net margin is very sensitive to changes in maize prices: an increase per unit of maize price from 100 FCFA/kg to 130 FCFA/kg, for example, decreases the net margin of the mill by 24 percent, while an increase in the maize price to 150 FCFA/kg decreases the net margin by 39 percent.

Table 16: Production budget for a 100 kg poultry feed at a medium-sized feed mill

Ingredients	Total unit (kg)	Price per kg (FCFA)	Value (FCFA)	Value (FCFA) *Maize at 130 FCFA/kg*	Value (FCFA) *Maize at 150 FCFA/kg*
Maize (60%)	60	**100**	6,000	***7,800***	***9,000***
Fish (15%)	15	175	2,625	2,625	2,625
Oil cake (6.3%)	6.3	200	1,260	1,260	1,260
Bran (10%)	10	100	1,000	1,000	1,000
Salt (0.5%)	0.5	200	100	100	100
Shell (8%)	8	75	600	600	600
Mineral vitamin (0.2%)	0.2	500	100	100	100
Handling (700 FCFA for each 100 kg bag)			700	700	700
Gross revenue (sell 100 kg bag for 20,000 FCFA)			*20,000*	*20,000*	*20,000*
Gross margin*			***7,615***	***5,815***	***4,615***
Change in gross margin with maize price increase				***-24%***	***-39%***

**Gross margin = gross revenue minus the variable costs shown in the table (it does not include deduction for fixed costs)*

Source: Personal interview

Finally, it is important to note the possible effect of sorghum. Sorghum is the closest substitute for maize as grain input for poultry. But, the latest sorghum-to-maize price ratios at wholesales are close to 1 or slightly lower (Table 17). Low-tannin sorghum varieties have 95 to 97 percent the feed efficiency for poultry as maize; therefore, to be competitive with maize as a feed ingredient, the prices of these varieties need to be 95 to 97 percent the price of maize (Sanders and Ouendeba, 2010). As shown in Table 17, however, those percentages have been higher for the past months in 2010 and 2009. Thus, while sorghum is close to competitive in a biological sense with maize as poultry feed, maize remains more competitive among poultry producers. Moreover, price is not the only factor at work. Egg producers prefer yellow maize to sorghum, because yellow maize leads to a yellower yolk in the eggs. On the other hand, producers of broilers may be more open to the use of sorghum as poultry feed.

Table 17: Maize (M) to Sorghum (S) WP ratios in Bamako Medine and sorghum PP as a % of maize PP in Koutiala

Periods		**Maize WP**	**Sorghum WP**	**S/M WP Ratio**	**Maize PP**	**Sorghum PP**	**S/M % (PP)**
2009	*January*	153	136	***0.89***	118	109	***92 %***
	February	151	142	***0.94***	125	114	***91 %***
	March	150	143	***0.95***	122	114	***93 %***
	April	149	139	***0.93***	116	110	***94 %***
	May	151	149	***0.98***	119	119	***99 %***
	June	160	161	***1.01***	127	131	***103 %***
	July	162	171	***1.06***	131	140	***107 %***
	August	165	178	***1.07***	138	148	***108 %***
	September	160	177	***1.11***	117	144	***123 %***
	October	143	149	***1.04***	87	105	***121 %***
	November	125	139	***1.11***	85	86	***101 %***
	December	133	131	***0.99***	97	97	***100 %***
2010	*January*	141	140	***0.99***	109	109	***100 %***
	February	145	144	***1.00***	112	113	***100 %***
	March	139	139	***1.00***	102	104	***101 %***
	April	138	136	***0.98***	101	100	***99 %***
	May	139	137	***0.98***	107	105	***98 %***
	June	144	146	***1.01***	112	113	***102 %***

Source: Calculated from OMA's data

Using the SCP approach to analyze the current performance issues of the Malian's maize subsector, we notice that the main structural trends are the important shift in the number and sizes of grain buyers, the lack of organization of actors, the various transaction costs and inefficient information sharing, but above all the low level of coordination, especially coordination involving farmers. Given the increasing urbanization, the share of grain maize production that is marketed, which is currently between 10 and 25 percent as noted in Section *4.2*, will likely expand considerably. Therefore, the challenges, for both farmers and marketers, will be to increase the volume produced and marketed, improve their existing capabilities such as storage infrastructure (which is currently fairly poor) and build better and formal contractual relationships in order to better respond to this demand.

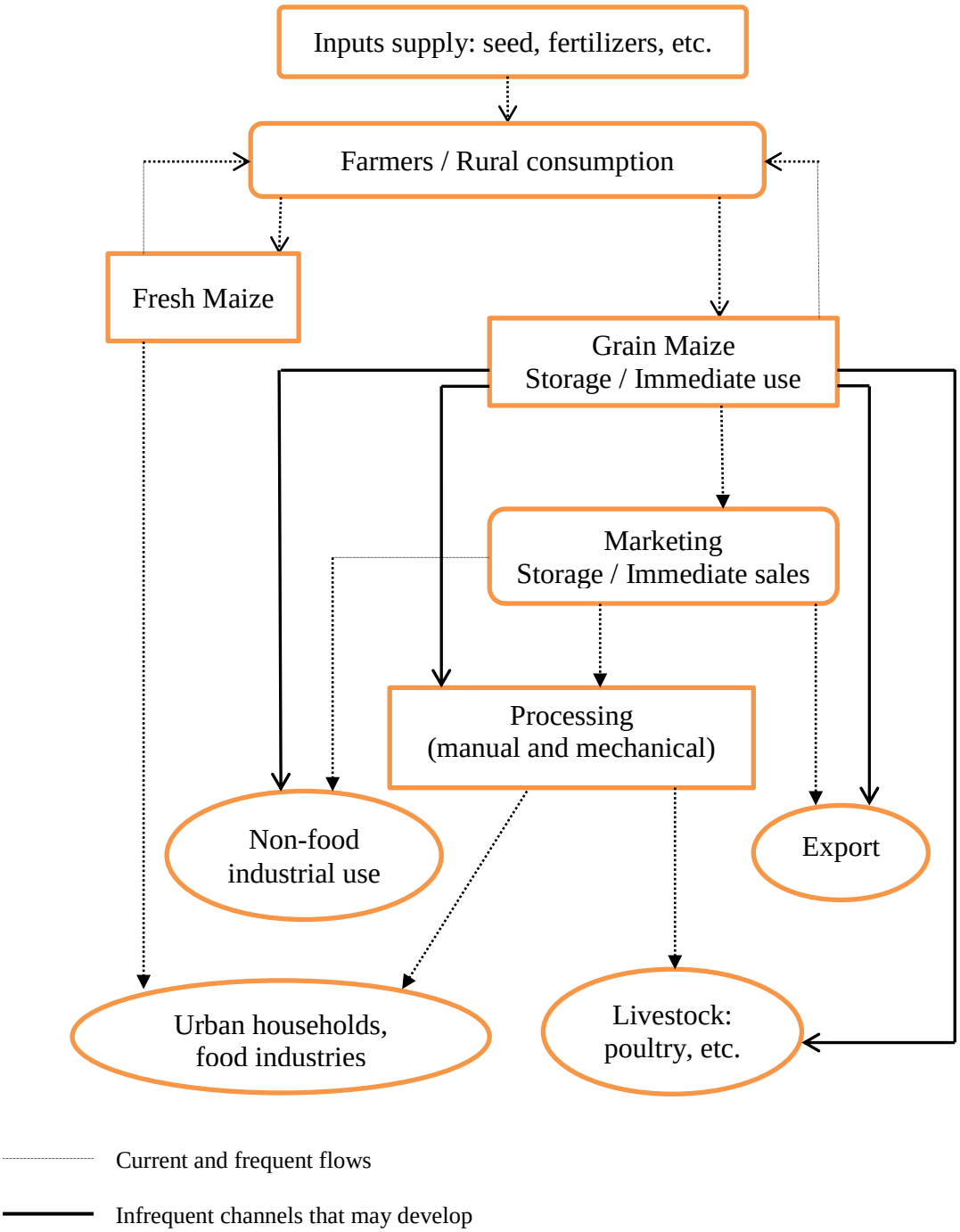
As discussed in previous chapters, current formal contracting arrangements are very few, and most of them involve only marketers operating in the same network. If reliable contract enforcement incentives could be designed into agreements, a movement towards contracting with major users of grain maize would reduce the market risk for both buyers and sellers, as sellers would have a more secure market and buyers would have more assurance that they could meet their obligations to deliver grain to their clients downstream in the marketing chain. In addition, as the system increases the amount of investment in processing equipment, processors will have incentives to ensure a reliable supply in order to ensure sufficient capacity utilization to amortize the equipment. Thus, an increased grain buying cycle and financing activities, infrastructure development, and engaging in formal purchase agreements could help reduce some risks.

The changing demand for maize, especially the growing urban demand and the strong pull from the poultry sector, will bring about several important changes into the structural organization of the maize subsector. There are already noticeable changes, with the growing interest in formal coordination practices such as purchase orders and advance purchased

payments between marketers and farm and merchant suppliers, as recalled in previous chapters, and also in some cases premium prices that institutions and industries give to farmers for quality and reliable supply. These changing trends will further consolidate in addition to more structural changes. For instance, poultry producers and feed millers are more and more interested in sourcing maize directly from the farm level, as they believe that wholesales' prices are too high and their earnings are very sensitive to the price of maize. Thus, some larger mill units do invest in large farms, either for production by themselves or through partnership agreements, for reliable supply and stable prices. In other cases, marketers and poultry cooperatives engage in grouped purchases in the production zone. This will be a strong incentive to improve the organization inside various farmer and marketer cooperatives.

Furthermore, there are increasing numbers of foreign buyers, whether private traders or institutional investors, interested in buying in the production zones, as they aim at diversifying their import sources and guaranteeing stable prices. As a result of this increasing production-level demand, there may be a concentration in the wholesaling sector. The numbers of wholesalers in urban areas might decline further in favor of wholesalers in the production zones. Therefore, channels directly linking farmers to end users in the maize subsector, which were not frequent in transactions before, will likely develop and gain importance (Figure 20).

Figure 20: Mali's maize subsector map with infrequent channels that may grow



Overall, the growing demand for maize from various agribusinesses will necessarily imply more coordination involving farmers because buyers face uncertainties. The maize subsector will, thus, likely evolve along the vertical coordination continuum, shown in Table 16. According to previous works cited by Peterson et al. (2001), the vertical coordination continuum can be defined as the alignment of direction and control across segments of a production and or marketing system; the aligned and controlled factors being price, quantity, quality, and terms of exchange. Movement along the vertical coordination continuum is one of the most important changes for the food industry because it is about strategic management decisions aiming at efficiency control, cost reduction, and profit increase. The continuum is the movement along the five formal coordination strategies: from spot market, specification contract, relation-based alliance, and equity based alliance to vertical integration. Vertical integration is a form of vertical coordination, but it requires that all the stages in the production, marketing, and processing of a product be owned and controlled by a single organization. With the continuum, the intensity of control changes from being low in spot markets to high in vertical integration.

Table 18: Vertical coordination continuum and control intensity

	Sport market	Specification contract	Relation-based alliance	Equity-based alliance	Vertical integration
Intensity of control	Low (Ex ante dominate)	Moderately low (Ex ante dominate)	Moderate (mixed ex ante & ex post) relationship	Moderately high (ex post dominate)	High (ex post dominate)
Focus of control	Immediate transaction	Contract terms	Relationship	Property rights of stakeholders in limited joint entity	Property rights of stakeholders in full entity
Ex ante control process	Price discovery	Setting specifications	Relationship building	Negotiating the formal decentralized ex post governance structure	Negotiating the formal centralized ex post governance structure
Ex post control process	Yes/no decision transact	Setting incentives	Setting informal parameters		
	Yes/no decision to repeat the transaction	Decision to renew/renegotiate contract, or seek third party enforcement	Mutual resolution or dissolution	Execution of governance policies and procedures in the limited entity	Execution of governance and procedures in the full entity

Source: Peterson et al. (2001)

Given low assets and medium to smaller business sizes in most cases, moving toward vertical integration will not be immediate in the Mali context; but, advanced formal contract terms (specification contract and relation-based alliance) will likely grow with setting specifications, relationship building, higher control intensity, and stricter contract enforcement. Besides supply and demand shocks, the most important impediments to Mali's maize value chain moving along the continuum might be the costs of coordination, which affect risks and returns for both buyers and sellers, and the lack of organization in the decision and control structure. Thus, in order to lessen these constraints and avoid inefficiencies, coordination should not be limited to contracts and incentives, but there should also be more sharing of information as well as advanced quality and marketing coordination.

Moreover, in order to improve the coordination performance between various actors and stakeholders, there should be improvements in the financial services to different actors (e.g., mill operators), as the system will require more financing. This will require further cooperation between channel participants and stakeholders in form of value chain participant councils or *interprofessions, which are* joint analysis and problem-solving planning organizations, composed of a broad spectrum of key participants in a specific value chain from input suppliers, farmers, traders, marketers, processors, exporters, government officials, to even research institutes (Staatz and Ricks, 2010). Effective coordination by these organizations will be needed in order to promote cooperation between various actors, firms, and cooperatives; address broader value chain and market performance issues; and possibly promote access to credit by actors' capacity to prepare "bankable" business plans to financial institutions.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

Looking at its different paths in the last three decades, maize has definitely succeeded in being counted as a major cereal subsector in Mali. The primary factors behind maize production increase in Mali were the liberalization of the cereal trade, the research that led to the adoption of new varieties, the various maize production and area expansion projects through the cotton sector, and the growing demand for maize associated with rising population and changing consumer habits, including increased consumption of processed products and of poultry products that use maize as a major input. Later in early 2000s, maize was able to develop independently from cotton thanks to the process of intensification, through the use of improved varieties, and the increasing demand from newer consumption markets that has induced more production. Thus, the processing and poultry sectors have also become important consumption markets and contributed to the demand expansion for maize. In the next five to ten years, the quantity of maize demanded will further increase to well above one million tons. This demand will come first from human consumption, but also more importantly, it is expected to come from the booming poultry sector (both in Mali and in neighboring countries, such as Senegal) that has stronger and stronger demand for maize as feed.

The expected increase in the quantity demanded, in addition to the new marketing realities, will require new behaviors from marketing actors, and will likely bring about important changes to the structural organization of the maize subsector. Maize consumption units, especially larger ones, both from domestic and export markets, are in need of quality products and stable prices. Given the increase in the scale of their activities and their need for reliable supply, they will have strong interest in farm-level supply. This will necessarily require a more advanced coordination system between farmers and other marketing actors

than the existing ones that are mostly spot market. Therefore, more contracting practices and large grouped purchases using formal procedures with producers will further develop.

The demand for large quantity, quality, and processed products implies important investments and policy actions. The Government of Mali, along with the private sector, civil society, ECOWAS, and its development partners, has elaborated a National Agricultural Sector Priority Investment Plan (PNIP-SA) for 2011-2015. The PNIP-SA calls for improvements in the maize subsector such as investments in technology and storage infrastructures, the development of maize processing, improvement of fertilizer supply and the extension of improved varieties, land development and management, supporting trade through the organization of trade circuits and marketing outlook studies, the acquisition of adequate post-harvest and trade equipment, and the training and building capacity of various actors. Nevertheless, the PNIP-SA might consider also focusing on further supporting farmers and marketers in accessing credit and financial services and in facilitating collaboration frameworks of various value chain stakeholders. Farmers and marketers have to be more professionally organized and focus more on grades and standards that reflect the characteristics of the grains that are important for the different users. In order to successfully capture and maintain important export markets, supply reliability and stability have to be accompanied by the reduction of non-tariff trade barriers (e.g., roadblocks, border harassments, bribes), which make Mali an unreliable trade partner and make its potential trade clients in neighboring countries turn elsewhere (likely the international market) for maize supply. The Government has to promote smooth export procedures and ensure the effective implementation of existing trade agreements and policies.

In short, there will definitely be an important demand for maize that will have to be satisfied. Hence, it is up to the farmers, marketers, and policymakers to adapt and respond to it because the current supply chain weaknesses and vulnerabilities leave gaps for imported

maize that would compete with local farmers. Thus, further research questions and concerns come up:

i) What are the measures needed to ensure that farmers are able to meet a faster increasing demand?

ii) Will the unit-cost reduction technology and development be scale neutral or biased toward large scale farmers?

iii) If production increases faster than demand, how to ensure demand markets for producers and guarantee that farmers sell their cereals at lower unit-cost of production?

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APPENDIX: COMPARISON OF THE IMPACT OF INPUT SUBSIDIES AND INCREASE YIELDS ON NET RETURNS TO MAIZE PRODUCTION IN THE CMDT AND OHVN ZONES

Appendix 1A: Maize production budget estimate in CMDT zone given a 10 percent increase in production yield

		Improved varieties			Local varieties		
	Unit	**Quantity**	**Price/unit**	**Value (FCFA)**	**Quantity**	**Price/unit**	**Value (FCFA)**
Production	Kg/ha	***2,745.6***	120	***329,472***	***1,603.8***	120	***192,456***
Seeds	Kg/ha	19.0	200	3,800	21.0	180	3,780
NPK	Kg/ha	94.0	400	37,600	62.0	400	24,800
Urea	Kg/ha	76.0	400	30,400	43.0	400	17,200
Organic manure	Carts/ha	20.0	750	15,000	15.0	750	11,250
Herbicides	Liter/ha	2.5	4,500	11,250	2.1	3300	6,963
Harvesting bags	No/ha	8.0	300	2,400	0.0	300	
Total				100,450			63,993
Financial expenses				8,000			6,000
Amortization animals				10,000			10,000
Grand total				118,450			79,993
Return before amortization	FCFA/ha			221,022			122,463
Net return to family, labor, land, and management				211,022			112,463
Net return per person-day of family labor*				2,221			1,323
Change in net return to family, labor, land, and management relative to the base case (Table 5 in the text)				***16.5%***			***18.4%***

**Estimated labor days are 95 for improved varieties, and 85 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Appendix 1B: Maize production budget estimate in OHVN zone given a 10 percent increase in production yield

	Unit	Improved varieties			Local varieties		
		Quantity	Price/unit	Value (FCFA)	Quantity	Price/unit	Value (FCFA)
Production	Kg/ha	***2,489.0***	120	***298,676***	***1,377.2***	120	***165,264***
Seeds	Kg/ha	20.0	200	4,000	18.0	180	3,240
NPK	Kg/ha	80.0	400	32,000	68.0	400	27,200
Urea	Kg/ha	50.0	400	20,000	43.0	400	17,200
Organic manure	Carts/ha	20.0	900	18,000	15.0	900	13,500
Herbicides	Liter/ha	4.0	6,000	24,000	4.0	6,000	24,000
Harvesting bags	No/ha	20.0	300	6,000	0.0	300	
Total				104,000			85,140
Financial expenses				7,000			5,000
Amortization animals				10,000			10,000
Grand total				121,000			100,140
Return before amortization	FCFA/ha			187,676			75,124
Net return to family, labor, land, and management				177,676			65,124
Net return per person-day of family labor*				2,090			868
Change in net return to family, land, labor, and management relative to the base case (Table 7 in the text)				***18.0%***			***30.0%***

**Estimated labor days are 85 for improved varieties, and 75 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Appendix 2A: Maize production budget estimate in CMDT zone given a 20 percent increase in production yield

		Improved varieties			Local varieties		
	Unit	**Quantity**	**Price/unit**	**Value (FCFA)**	**Quantity**	**Price/unit**	**Value (FCFA)**
Production	Kg/ha	***2,995.2***	120	***359,424***	***1,749.6***	120	***209,952***
Seeds	Kg/ha	19.0	200	3,800	21.0	180	3,780
NPK	Kg/ha	94.0	400	37,600	62.0	400	24,800
Urea	Kg/ha	76.0	400	30,400	43.0	400	17,200
Organic manure	Carts/ha	20.0	750	15,000	15.0	750	11,250
Herbicides	Liter/ha	2.5	4,500	11,250	2.1	3300	6,963
Harvesting bags	No/ha	8.0	300	2,400	0.0	300	
Total				100,450			63,993
Financial expenses				8,000			6,000
Amortization animals				10,000			10,000
Grand total				118,450			79,993
Return before amortization	FCFA/ha			250,974			139,959
Net return to family, labor, land, and management				240,974			129,959
Net return per person-day to family labor*				2,537			1,529
Change in return to family, labor, land, and management relative to the base case (Table 5 in the text)				***33.1%***			***36.8%***

**Estimated labor days are 95 for improved varieties, and 85 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010

Appendix 2B: Maize production budget estimate in OHVN zone given a 20 percent increase in production yield

		Improved varieties			Local varieties		
	Unit	**Quantity**	**Price/unit**	**Value (FCFA)**	**Quantity**	**Price/unit**	**Value (FCFA)**
Production	Kg/ha	***2,715.2***	120	***325,829***	***1,502.4***	120	***180,288***
Seeds	Kg/ha	20.0	200	4,000	18.0	180	3,240
NPK	Kg/ha	80.0	400	32,000	68.0	400	27,200
Urea	Kg/ha	50.0	400	20,000	43.0	400	17,200
Organic manure	Carts/ha	20.0	900	18,000	15.0	900	13,500
Herbicides	Liter/ha	4.0	6,000	24,000	4.0	6,000	24,000
Harvesting bags	No/ha	20.0	300	6,000	0.0	300	
Total				104,000			85,140
Financial expenses				7,000			5,000
Amortization animals				10,000			10,000
Grand total				121,000			100,140
Return before amortization	FCFA/ha			214,829			90,148
Net return to family, labor, land, and management				204,829			80,148
Net return per person-day of family labor*				2,410			1,069
Change in net return to family, labor, land, and management relative to the base case (Table 7 in the text)				***36.1%***			***60.0%***

**Estimated labor days are 85 for improved varieties, and 75 for local varieties. Labor estimate is taken from Diakité and Mariko (1998) and modified slightly by the author based on discussions with Duncan Boughton of MSU.*

Source: Revised from Diakité and Mariko (1998)/ECOFIL; updated to 2010