Determinants of Seed Maize Pricing in Kenya

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Abstract

Kenya has been experiencing declining use of certified seed maize. About 30 percent of Kenyan maize farmers use either traditional seeds or recycled hybrids, mainly due to high cost of certified seed maize and other inputs. Seed has the greatest ability of increasing on-farm productivity and enhancing food security. It largely influences the upper limit of crop yields and the productivity of all other agricultural inputs.

The major factors determining seed maize retail price are the overhead costs of seed companies and cost of raw seed purchased from growers. Other important cost components include seed company's profit margins and margins going to seed merchants (agents, sub-agents and stockists). Seed companies control growers and seed retail prices. The study indicates that the Kenyan seed maize market is still characterized by oligopolistic market tendencies. Although there are 55 registered seed companies, 13 are actively engaged in seed maize business, with Kenya Seed Company controlling over 86 percent of the seed maize market share. The company generally acts as a price setter for the rest of the industry, particularly for local seed companies. Any efforts towards reducing cost of seed must necessarily focus on restructuring this public institution.

Although the government liberalized the seed sector in 1996, many of the laws and regulations have not been revised to reflect changes in the seed industry. The regulatory body, Kenya Plant Health Inspectorate Services (KEPHIS), is still heavily involved in seed testing, inspection and certification services at all levels of seed production, marketing and processing. This has in some cases introduced inefficiencies in the seed maize industry. There is need to revise the Seeds and Plants Varieties Act (Cap 326) in order to accommodate accreditation of private seed inspectors to facilitate self-regulation of the seed industry and to complement activities currently being carried out by KEPHIS; reduce unnecessary bureaucracy in seed variety release procedures; remove cumbersome import restrictions on seed; harmonize seed regulations within the region; and allow for compensation of farmers to whom may have been sold poor quality seed. There is also need for the government to revitalize the Seed Regulation Committee and establish the Seeds and Plants Tribunal, as per the requirements of the Seeds and Plants Varieties Act (Cap 326), for arbitration of any disputes arising within the industry.

Abbreviations and Acronyms

ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
C & F	Cost and Freight
CBC	Convention on Biological Convention
CBOs	Community Based Organizations
CIF	Cost, Insurance and Freight
CIMMYT	International Maize and Wheat Improvement Center
DAP	Di-Ammonium Phosphate
DfiD	Department for International Development
DUS	Distinctiveness, Uniformity and Stability
EAC	East African Community
FAOSTAT	Food Agriculture Organization Statistics
IARCs	International Agricultural Research Centres
IDF	Import Declaration Form
IPPC	International Plant Protection Convention
ISTA	International Seed Testing Association
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KFA	Kenya Farmers Association
KNTC	Kenya National Trading Corporation
KSC	Kenya Seed Company
MoA	Ministry of Agriculture
NARS	National Agricultural Research System
NCPB	National Cereals and Produce Board
NGOs	Non Governmental Organizations
NIB	National Irrigation Board
NIE	New Institutional Economics
NPT	National Performance Trial
NTBs	Non-Tariff Barriers
NVRC	National Variety Release Committee
OCD	Oil Crops Development Company
OECD	Organization for Economic Co-operation and Development
OPVs	Open Pollinated Varieties
PBAK	Plant Breeders Association of Kenya
PBR	Plant Breeders Rights
SRC	Seed Regulation Committee
SRC	Seed Regulations Committee
STAK	Seed Traders Association of Kenya
Tegemeo	Tegemeo Institute of Agricultural Policy and Development
UPOV	International Union Protection of new plant Varieties
WSC	Western Seed Company
WTO-SPS	World Trade Organization-Sanitary and Phytosanitary Agreement

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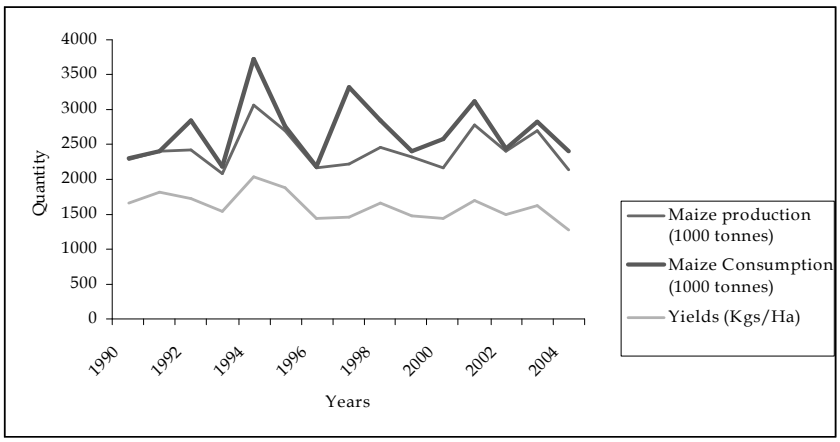
1. Introduction

Maize is the primary staple food crop in Kenya. It is the most frequently produced and marketed crop, grown by 90 percent of households and sold by more than 30 percent of the households in areas where the crop is grown. Maize dominates all national food security considerations and accounts for more than 20 percent of all agricultural production and 25 percent of agricultural employment in Kenya. However, maize production has been on the decline over the last decade, reducing from 2.7 million tonnes in 1995 to 2.1 million tonnes in 2004 (Figure 1). Similarly, maize yields have declined by over 30 percent during the same period.

The decline in yields is largely attributed to reduced use of certified seed maize, and low and inefficient usage of fertilizer. Other reasons for the decline in yields include drought, inadequate credit facilities, poor extension services, diminishing farm sizes, inadequate use of new technologies, inefficiencies in production and high costs of production.

Seed has great ability to increase on-farm productivity and enhance food security. Access to high quality inputs, especially seed and fertilizer, is a prerequisite for high maize productivity. Unfortunately, non-availability of high quality seed of suitable varieties at affordable prices is a common constraint for small-scale farmers in the developing world. Improved high quality seed plays a pivotal role in increasing

Figure 1: Maize production, yields and consumption



Source: Ministry of Agriculture Annual reports (various); and FAOSTAT database, 2006

productivity in Kenya's agriculture. It largely influences the upper limit of productivity of all other agricultural inputs applied in the farming system. The challenge, therefore, is to encourage wider use of hybrid and other certified seeds by improving seed quality throughout the marketing chain. This, in turn, will win back farmers' confidence in use of certified seed.

The seed maize industry in Kenya experienced considerable breakthroughs and phenomenal expansion in the 1970s, especially in the spheres of varietal seed maize development following the establishment of maize research programmes in the country. These research programmes started way back in 1955 when the Kitale maize breeding programme, which focused on production of late maturing hybrids, was initiated. This was followed by the establishment of the Katumani programme in 1957, which concentrated on production of Open Pollinated Varieties (OPVs) for the dry mid-altitude zones. The Embu and Mtwapa programmes followed later, producing seed maize varieties for the moist mid-altitude and lowland coastal areas, respectively. So far, the maize-breeding programme supported by the Government of Kenya has released more than 20 modern seed maize varieties that have been adopted by both large-scale and small-scale farmers over the last four decades. However, according to household surveys (Gamba *et al*, 2004), use of certified seed maize in Kenya has been on the decline. In the high potential maize zone, adoption rate declined from 93 percent to 88 percent over the 1997–2004 period. Significant drops in seed maize adoption rates have also been observed in other zones such as Western Transitional Zone, which has recorded a drop from 85 percent to 57 percent. Similarly, adoption rates in Central Highlands reduced from 91 percent to 57 percent.

The use of improved seed maize varieties, supplemented by purchased inputs, especially inorganic fertilizers, increased maize yields between late 1960s and mid 1970s. During that period, the Kenya Seed Company (KSC), a quasi-private company inherited from the colonial government, undertook seed maize multiplication and distribution. The KSC had the legal monopoly to grow, process and distribute certified seed maize. It was reputed to have developed an extensive and elaborate network of seed marketing that, together with aggressive agricultural extension staff, caused rapid diffusion and adoption of hybrid and composite seed even among the small-scale farmers in remote areas. Today, the seed market has been liberalized and is

regulated by the Kenya Plant Health Inspectorate Service (KEPHIS), which is empowered to inspect and enforce the Seeds and Plant Varieties Act. KEPHIS has so far registered about 35 seed companies, 13 of which are dealing with seed maize. Of these seed maize companies, 7 companies are dealing with about 50 maize varieties.

It is evident that hybrid maize varieties are readily available in Kenya, even though their cost is high relative to traditional varieties. This results in significant financial hardships for many farmers. Worse still, traditional systems of seed selection and savings have been compromised by introduction of hybrid seeds, which have nearly eliminated the ability of many farmers to save their own seed. As a result, majority of the poorest farmers, who cannot afford to buy certified seeds, have now been turning to recycled hybrid seed and inferior traditional varieties, therefore suffering significant losses in yield potential.

The declining use of hybrids is a major concern especially in light of diminishing yields and the subsequent reversal of previous productivity gains. From the early 1990s, Kenya became a net maize importer to meet its food demand requirements (Figure 1). It is, therefore, important that a critical analysis of the seed maize industry be conducted to examine possible intervention measures that could assist in reversing this trend.

The aim of this study is to analyze the pricing of seed maize in Kenya in order to determine how this has affected the use of certified seed maize by farmers. The specific objectives of the study were to:

(i) Study and characterize the seed maize industry

(ii) Establish the cost structure for locally-produced seed maize

(iii) Determine price constraints and non-price factors influencing the pricing of seed maize in Kenya.

This study is presented in five sections. Section one is the introduction, which provides background information on seed maize industry in Kenya. Section two provides a conceptual framework for examining the performance of the seed maize industry. Section three provides an overview of the seed maize industry in Kenya while section four provides findings of the main factors influencing the pricing of seed maize in Kenya. Section five provides the conclusion and recommendations to the study.

2. Seed Maize Industry and Pricing: A Conceptual Framework

This section provides a conceptual framework that introduces a common approach and establishes a set of standardized concepts and analytical tools that can be used in examining the performance of the seed industry, organization and pricing.

2.1 Conceptual Framework

Attributes of seed maize

Seed maize is an intermediate input that farmers combine with other inputs (for example land, labour, water, fertilizer, pesticides) to produce a crop. It is also a source of germplasm—a store of genetically encoded information—that determines how other inputs combine and become transformed into useful products. Morris *et al* (1998) identify two attributes that shape the incentives for seed organizations to produce seed and for farmers to consume seed: the attributes of subtractability and excludability.

Subtractability refers to the degree to which use of a good or service by one person precludes use by another person. As an intermediate input, seed maize has high subtractability since two farmers cannot use the same bag of seed. Seed maize, however, has low subtractability when considered as a source of germplasm, since use of a bag of seed, whether Open Pollinated Variety (OPV) or hybrid, by one farmer does not prevent other farmers from using the same OPV or hybrid.

Excludability refers to the ease with which the seller of a good or service can deny access to non-authorized users. When considered as a consumable input, seed maize has high excludability, as it is cheap to exclude non-authorized users. Seed maize, germplasm has low excludability since non-authorized users can gain access to germplasm by obtaining a few kernels of seed. Due to the different nature of reproduction, OPVs germplasm have low excludability while hybrids have high excludability.

The attribute of transparency also affects production and consumption incentives of seed. *Transparency* refers to the degree to which the characteristics of a product are clearly evident. Seed maize is non-transparent in the sense that potential users cannot easily make quality determinations. Information asymmetry exists between buyers and

sellers. The buyer is never certain of the quality of seed. Buyers often reassure themselves of seed quality by purchasing seed only from companies whose seed is known to have been good in the past and on the assumption that these companies will continue producing good seed in future.

The non-transparency characteristic of seed maize, its subtractability and excludability have important implications for the optimal organization of national seed maize industries, because they affect the economic incentives facing producers and consumers.

New institutional economics

The New Institutional Economics (NIE) is a vast and relatively new multidisciplinary field that includes aspects of economics, history, sociology, political science, business organization and law (Kherallah *et al*, 2001). This new direction of economics considers that the cost of transacting —determined by institutions and institutional arrangements —is the key to economic performance. It is, therefore, argued that the institutions of a country or industry—such as its legal, political, and social systems—determine its performance, and it is this that gives the new institutional economics its importance for economists (Coase, 2000).

The NIE acknowledges the important role of institutions but argues that one can analyze institutions within the framework of neo-classical economics. In other words, under NIE, some of the unrealistic assumptions of neo-classical economics (such as perfect information, zero transaction costs, full rationality) are relaxed, but the assumption of self-seeking individuals attempting to maximize an objective function subject to constraints still holds (Kherallah *et al*, 2001). The purpose of the NIE is, therefore, to explain both the determinants of institutions and their evolution over time and to evaluate their impact on economic performance, efficiency and distribution (Nabli and Nugent, 1989).

The main contribution of the NIE school of thought is its emphasis on learning and change and the recognition that economic agents (households, firms, industries, and even entire economies) learn from change and adjust accordingly (McCormick *et al*, 2002). The value chain analysis, which borrows from NIE's theoretical paradigm, is useful in the analysis of seed maize pricing in Kenya. It has previously been

successfully used in analysing the operating environment of the cotton-textile industry in Kenya (Ikiara and Ndirangu, 2003).

Value chain analysis

The value chain describes the full range of activities required to bring a product or service from conception through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky and Morris, 2000). These activities include design, sourcing of raw materials and all other inputs, production and distribution. Some of these activities may be located in different countries or different parts of the same country.

Value chain analysis overcomes a number of important weaknesses of traditional sectoral analysis, which tends to be static and suffers from the weakness of its own bounded parameters. Kaplinsky and Morris (2000) observe that use of value chain analysis as an analytical tool has the following advantages over traditional sectoral analysis:

- By restricting itself to sectoral analysis, it struggles to deal with dynamic linkages between productive activities that go beyond that particular sector, whether they are of an inter-sectoral nature or between formal and informal sector activities.
- Its concentration on inter linkages allows for an easy uncovering of the dynamic flow of economic, organizational and coercive activities between producers within different sectors even on a global scale.
- Value chain analysis is particularly useful for new producers—including poor producers and poor countries—who are trying to enter global markets in a manner which would provide for sustainable income growth.
- Value chain analysis is also useful in understanding the policy environment, which provides for the efficient allocation of resources within the domestic economy, in addition to its primary use in understanding the way in which firms and countries participate in the global economy.

Value chain analysis is, thus, considered to be a suitable approach for analyzing the pricing of seed maize and organization of the seed maize industry in Kenya.

Seed maize price policy

Policies designed to influence the structure of national maize industries ultimately seek to ensure the production of high quality seed. If high quality seed is produced, then an important question that arises is: At what price should the seed be sold? And, is there an optimal price for improved seed?

Improved seed maize embodies technology that can increase the productivity of other inputs, thus, raising both production and revenues. Whether the farmer is able to get additional yields and revenue depends on the cost of seed and whether the farmer is able to use complementary inputs such as fertilizer.

Economic theory suggests that the most efficient price is the price at which supply exactly equals demand, or the market-clearing price (marginal factor cost equals marginal benefits or price). Market-clearing prices may, however, be non-optimal from a public policy perspective if they result in production and consumption of socially undesirable quantities of improved seed. According to Pray and Tripp (1998), this is often the case in the presence of market failures, which in the case of seed maize may be brought about by the following factors:

- Low subtractability and excludability attributes of seed, which undermine incentives for private firms to invest in socially-optimal levels of seed research.
- Restricted entry of new firms into the industry by economy of scale considerations or manipulation of the licensing system.
- Information asymmetry (non-transparency attribute of seed) that disadvantages seed buyers and discourages farmers from adopting improved seed.
- Market structural conditions, which give rise to transaction costs that prevent the seed from being distributed to all potential users.

There are also instances where the market-clearing prices may be non-optimal, from a public policy perspective, if they result in distribution of benefits that society perceives to be inequitable. This could occur in

a situation where the barriers to entering into the seed industry are present and seed companies are able to restrict their supplies and drive up prices. In such cases, markets may clear at higher prices but poor farmers will be unable to afford improved seed, meaning that they will be prevented from sharing the benefits attributable to the technology.

Due to market failures, governments sometimes choose to impose price controls to keep seed prices low in order to give farmers easier access to improved germplasm. There is substantial empirical evidence that suggests the price controls particularly during the early stages of seed industry development. Low seed prices may be an efficient way to encourage initial adoption of improved OPVs and hybrids. Price controls could, however, increase demand and dampen supply to such an extent that seed organizations will no longer be willing to produce sufficient supplies to meet effective demand. Generally, the use of price controls is expected to decline as seed industries develop and mature.

2.2 Methodology

This study uses primary data collected from 13 districts, East and West of the Rift Valley, in line with the intensity and type of seed maize production activities, level of commercial maize production and the location of seed maize processors, importers and the regulating institutions. The districts covered were: Trans Nzoia, Uasin Gishu, Kakamega, Nakuru, Nyando, Baringo, Machakos, Embu, Nyeri, Kirinyaga, Meru Central, Taita Taveta and Kwale.

A random sample of 29 growers was drawn from the list of seed growers provided by the Kenya Plant Health Inspectorate Service (KEPHIS) in the main seed maize growing areas. The growers were distributed as follows: 22 growers from Kenya Seed Company (KSC), 2 from Western Seed Company (WSC), 4 from Lagrotech and 1 from Faida Seeds. Besides, 99 seed maize consumers (farmers), 50 from East of the Rift Valley and 49 from the West of Rift Valley, were interviewed. The study was operationalized through formal interviews with seed maize growers, commercial maize producers, seed maize traders, seed maize processors, and seed maize importers and institutions within the seed maize industry. A combination of structured questionnaires and checklists were used to elicit relevant responses from the different categories.

The study utilized the value chain analysis to establish the costs at various stages of the seed maize production, processing and marketing. This concept entails an analysis of all activities that take place from the time a product is conceived to the time it reaches the final consumer. At each stage of the value chain, the analysis involved: Identification of chain players or stakeholders, their function, role and relationships; determination of chain governance or leadership; and identification of value activities in the chain. This analysis enables a clear picture to emerge on the contribution of each stage to the final seed maize cost and allows for intervention measures to be precisely located.

3. Overview of Seed Maize Industry in Kenya

This section provides an overview of Kenya's seed maize industry development and the institutions involved. The section lays the foundation for analysis of factors influencing the pricing of seed maize in Kenya.

3.1 Evolution of the Seed Maize Industry

Research on maize in Kenya started in 1955 when the Kitale programme, which focused on the production of late maturing hybrids, was initiated. This was later followed by the establishment of programmes for the development of varieties for the dry mid-altitude zones (Open Pollinated Varieties—OPVs), moist mid-altitude and lowland coastal areas.

The seed industry has over the years enjoyed support from local public research institutions in collaboration with the International Agricultural Research Centres (IARCs). The Kenya Agricultural Research Institute (KARI) has for a long time been the main source of improved varieties while multiplication, processing and marketing was mainly done by the Kenya Seed Company (KSC). At the same time KSC had, up to 1995, exclusive rights to the KARI hybrid materials while the other local seed companies, for example, Oil Crops Development (OCD) and Western Seed Company (WSC), were only dealing with the OPVs.

By early 1990s, it had become apparent that the various Acts of Parliament governing the seed sector were fragmented and their administration inefficient. Food production, especially maize, was declining due to factors such as poor quality seed, pests, diseases and use of poor quality fertilizer. At this time, several institutions under KARI, then under the Ministry of Research, Science and Technology and other institutions under the Ministry of Agriculture were responsible for agricultural regulatory functions. This led to duplication of roles and in some cases conflict of interest, which greatly weakened the enforcement mechanisms intended to regulate the quality control of inputs, import and export of seeds and plant materials, release and protection of new plant varieties and general aspects of plant health. This necessitated policy review to consolidate regulatory Acts and strengthen enforcement mechanisms. The seed industry was, therefore, liberalized and KEPHIS established as an autonomous regulatory body

in 1996. By 2004, a total of 49 seed companies had been registered, several of which were multinationals. Among the seed maize companies registered were: KSC, KARI Seed Unit, WSC, Lagrotech, Pioneer, Pannar, Faida Seeds, Freshco, Monsanto and SeedCo Company.

Most of the principal laws governing the seed industry have not been reviewed in line with the current liberalized environment. The legal framework supports government controls while the policy framework, still in draft form though in operation since 1996, supports liberalized markets. There have been instances where the laws are inconsistent with each other or where they constrain development of the seed industry. The need to review and harmonize the laws is clearly spelt out in the Economic Recovery Strategy for Wealth and Employment Creation (Government of Kenya, 2003), and in the Strategy for Revitalization of Agriculture (Government of Kenya, 2004).

3.2 Seed Maize Industry Players and their Roles

The Kenyan certified seed maize market is characterized by a wide array of participants. The major players include: Ministry of Agriculture, Kenya Agricultural Research Institute (KARI), Kenya Plant Health Inspectorate Service (KEPHIS), seed companies, seed growers, seed agents and stockists, seed maize farmers, and others. The roles of the major players are discussed below.

Ministry of Agriculture

The Ministry of Agriculture strives to attain food security through, among others, provision of good quality seed and the control of crop pests and diseases. The Ministry has the major responsibility of creating an enabling environment for the players in the seed industry through development of effective policies and strategies.

The Ministry plays an important role in facilitating research, providing advisory and information services, and undertaking review of policies and regulatory framework. It also facilitates collaboration among various stakeholders such as researchers, seed merchants, farmers, NGOs, CBOs and development partners.

Kenya Agricultural Research Institute

The Kenya Agricultural Research Institute (KARI) was established in 1979 following the collapse of the East African Community. The history

of the National Agricultural Research System (NARS) dates back to the beginning of the 20th century when agricultural research facilities were started in Nairobi, Njoro, Mariakani, Kibos and Naivasha. KARI, which was re-organized in 1989, has since played a key role in breeding seed maize hybrids and OPVs for different agro-ecological zones. The institution has also developed different varieties of beans, cowpeas, pigeon peas, sorghum, millet, wheat, barley, irish potatoes, sweet potatoes, roots and tuber crops, among others, in addition to undertaking research in livestock, natural resources, socio-economics and biotechnology. Moreover, KARI also collaborates in the dissemination of research findings through government extension officers, NGOs and CBOs.

Kenya Plant Health Inspectorate Service

The Kenya Health Inspectorate Service (KEPHIS) was established under the provisions of the State Corporations Act (Cap 446) Legal Notice No. 305 of 1996. Prior to this, there were several service units, within the Ministry of Agriculture and KARI, undertaking different functions such as seed quality control and certification, inspection, quarantine, plants breeders rights registration and related services. This period was, however, marked by incidents of intermittent seed shortages and poor quality seed, which necessitated liberalization of the seed industry and establishment of an independent regulatory body, KEPHIS, with the following consolidated functions:

- Coordination of all matters relating to crop pests and disease control
- Administration of Plant Breeders Rights (PBR) in Kenya and serve as a liaison office for the International Union for Protection of new Plant Varieties
- Inspection, testing, certification, quarantine control, variety testing and description of seeds and planting materials
- Grading and inspection of plants and plant produce at the ports of entry and exit
- Development and implementation of standards on both imported and locally-produced seeds
- Approving importation and exportation licenses for plants and seeds issued by the ministry responsible for commerce and industry before such importation or exportation is implemented

- Implementation of the national policy on the introduction and use of genetically modified plant species, insects and micro-organisms in Kenya

Seed maize companies

There are nine local seed maize companies that either breed their own seed or obtain bred seed from sources such as KARI or IARCs under a memorandum of understanding. The companies contract seed growers to multiply or undertake multiplication by themselves. Seed companies, therefore, play a major role in seed multiplication, processing, packaging, labelling and distribution of certified seed to agents, sub-agents and stockists (retailers) located in the main maize growing agro-ecological zones. On the other hand, multinational seed companies such as Pannar, Pioneer and Monsanto import certified seed from countries such as South Africa, Zimbabwe and Malawi. The seed is then sold either through local companies or distributors who supply the same to farmers through stockists.

In a liberalized market environment, seed companies are expected to play an active role of self-regulation, especially for assurance of quality. Other roles include provision of advisory services, promotion of new varieties and education of stockists on seed handling and basic agronomic management of the varieties.

Seed maize growers

Seed companies and NGOs contract seed maize growers to grow certified seed. They are provided with basic seed from the seed companies and NGOs for multiplication purposes. These growers undertake recommended agronomic practices including cleaning and sorting.

Seed agents and stockists

Seed maize is mainly distributed to farmers by seed agents, sub-agents and stockists. They ensure seed maize is available to farmers in various parts of the country. Trained stockists also provide basic advisory services to farmers on recommended agro-ecological zones for various seed varieties.

Seed maize farmers

Seed maize farmers are the ultimate consumers of seed maize. They purchase certified seed and use it to grow commercial maize.

Commercial maize farmers, therefore, have a role to play in detecting anomalies in seed quality.

Other major stakeholders

The other stakeholders who play a crucial role within the seed maize industry include:

- Plant Breeders Association of Kenya (PBAK), which brings together plant breeders to facilitate exchange of views and to articulate their concerns.
- Seed Traders Association of Kenya (STAK), which lobbies on behalf of member companies, ensures compliance to the code of ethics, and inculcates self-regulation in the industry.

PBAK and STAK also participate in the review and harmonization of the regulatory framework in the country and in the region. Other stakeholders who contribute to seed multiplication and distribution include local universities that carry out research and training on various fields, some NGOs, CBOs, and religious organizations.

3.3 Regulatory Framework

Several Acts of Parliament and various bodies regulate the seed industry. Out of the 32 Acts relevant to the seed industry, the key legislations include:

- The Plant Protection Act (Cap 324), which provides for the prevention of the introduction and spread of diseases destructive to plants.
- Suppression of Noxious Weeds Act (Cap 325), which provides for the suppression of noxious weeds.
- Agriculture Act (Cap 318), which aims at promoting and maintaining stable agriculture and the conservation of soil fertility.
- Seeds and Plant Varieties Act (Cap 326), which regulates transactions including provision for testing and certification of seeds and granting of proprietary rights to breeders. The Act also bestows powers to impose restriction on introduction of new varieties, control of importation of seeds and the

establishment of an index of names of plant varieties to KEPHIS. It also establishes a tribunal to arbitrate seed industry matters.

- Fertilizer and Animal Foodstuffs Act (Cap 345), which regulates importation, exportation and manufacture of fertilizer and animal foodstuffs.
- Pest Control Products Act (Cap 346), which regulates the importation, exportation, manufacture, distribution and use of products for the control of pests.

With liberalization of the seed industry in 1996, more local and international companies were registered to undertake seed production, processing and marketing, therefore calling for strengthening of the regulatory framework. This policy change was, however, not accompanied by the necessary review of the legal framework. As a result, most regulatory powers are still vested in one body, KEPHIS, which is perceived by other players as being too imposing in policing (especially in areas such as imports control, inspections and certification but weak in the distribution stages) the sector instead of playing a facilitative role. The regulatory framework also has a lot of bureaucratic procedures, which impact negatively on the efficiency of the seed industry.

However, review of these laws must take cognisance of international bodies, regulations and treaties that govern the seed industry both locally and internationally. Such bodies and agreements include: International Seed Testing Association (ISTA), International Union for Protection of new plant Varieties (UPOV), Organization for Economic Cooperation Development (OECD), International Plant Protection Convention (IPPC), Convention on Biological Diversity (CBD), World Trade Organization-Sanitary and Phytosanitary Agreement (WTO-SPS), and others that promote universal regulatory processes for trade in quality plant products.

Harmonization of these laws with the aim of improving service delivery has been ongoing, though at a slow pace. The establishment of KEPHIS was part of this process so that the regulatory Acts could be consolidated and their enforcement mechanisms strengthened.

The Ministry of Agriculture, together with stakeholders, through consultative fora, have been examining the existing laws and regulations that govern the seed industry with a view to reviewing

and amending them, where necessary, in order to keep pace with the dynamics of the industry.

3.4 Research and Development

The institutions that undertake maize research in Kenya include: KARI, universities, Kenya Seed Company, Faida Seed, Western Seed Company, Lagrotech and International Maize and Wheat Improvement Centre (CIMMYT). KARI is the main player in this field and undertakes maize research in various centres such as KARI-Kitale, KARI-Kakamega, KARI-Embu, KARI-Mtwapa, KARI-Katumani, KARI-Muguga, KARI-Kibos and KARI-Kisii. Between 1964 and 2003, over 80 maize varieties from both local and international companies have been officially released. However, seed companies have not taken up some of these varieties for multiplication.

As is evident in Table 1, a large number of seed maize varieties (71) were released between year 1994 and 2003. Currently, about 50 of these varieties are available in the market. It should also be noted that most of these varieties were hybrid, with limited research in the OPVs. Moreover, 17 of the released varieties mature within four months, while 60 mature within six months. In order to increase the adoption rates for research breakthroughs, the current policy emphasizes adaptive and participatory research to ensure increased involvement of beneficiaries in research. Consequently, various research organizations now involve and seek views of beneficiaries throughout the research process.

Table 1: Maize cultivars released by public and private sectors

Numbers released	Public sector	Private sector	Both sectors
1964-1973	6	0	6
1974-1983	2	0	2
1984-1993	2	1	3
1994-2003	11	60	71
Type of material			
Hybrid	16	55	71
Improved OPV	5	6	11
Average maturity period (days)			
60-90	1	-	1
91-120	4	12	16
121-150	3	24	27
151-180	4	12	16
181-210	6	12	18
>210	3	1	4

Source: KEPHIS, 2003

4. Seed Production and Marketing: Study Findings

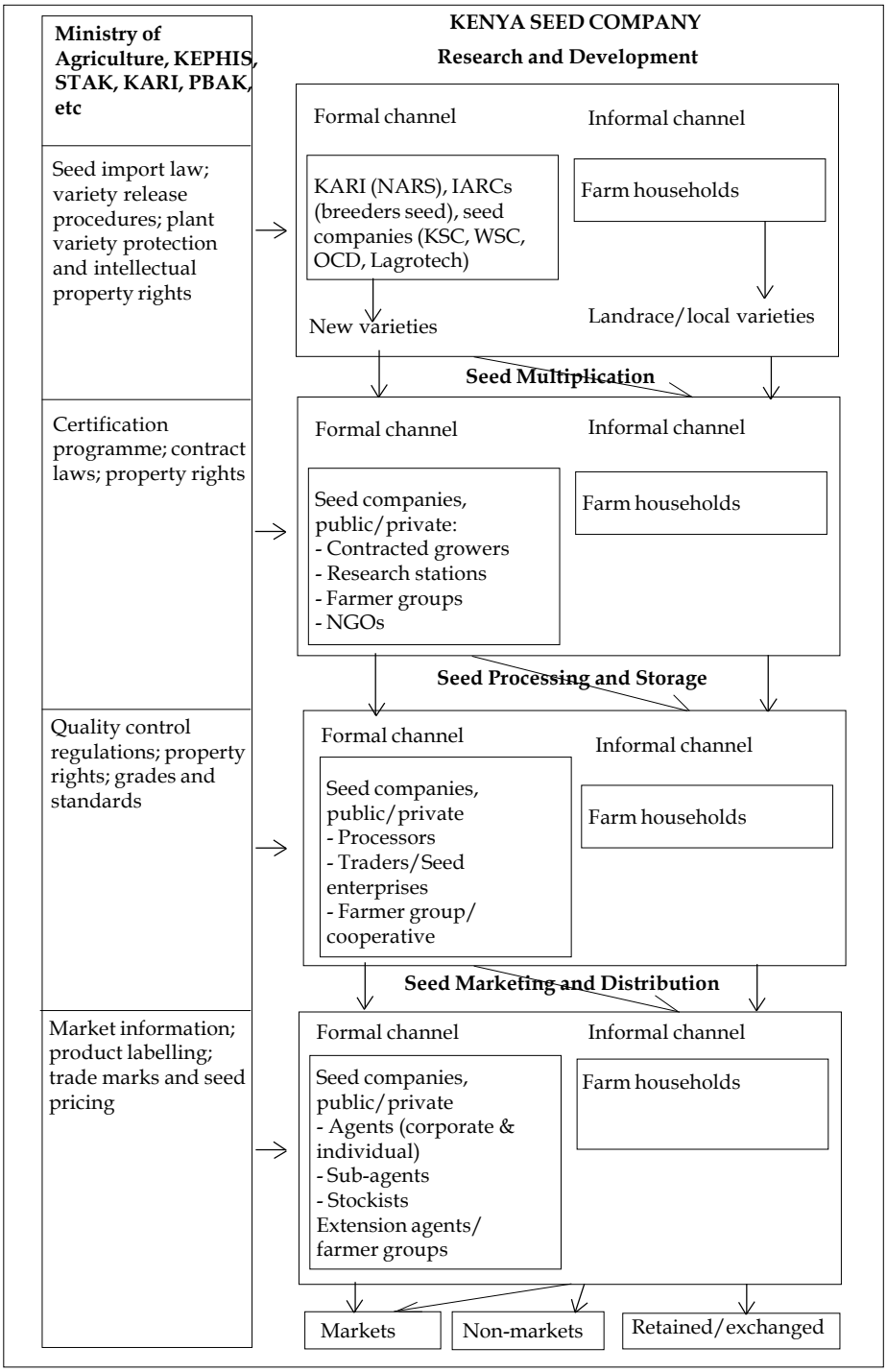
4.1 The Kenyan Seed Maize System

Seed systems are typically composed of organizations, individuals and institutions involved in performing different functions. The seed chain begins at the point of initial production, which encompasses research and development, and moves through various stages including: multiplication, processing, storage, distribution and marketing. The Kenyan seed maize system has evolved from predominantly informal systems where farmers selected their own seed or obtained it from neighbours through a slow varietal development—release, multiplication and adoption—to the present status where the industry is liberalized with many players. Seed maize flows from organizations or individuals from one stage of the chain to the next through separate formal and informal seed supply channels. Informal systems are composed of individual farm households, each carrying out certain functions with little or no specialization. The formal sector, by contrast, is composed of private and public organizations with specialized roles in supplying new varieties. Various players with specialized roles in variety release procedure, intellectual property rights, certification programmes, seed standards and contract rules regulate the system and influence the structure, coordination and performance of the system.

As indicated in Figure 2, the Kenyan seed maize system comprises many participants who can be categorized according to the functions they perform along the value chain. The stages along the chain can be specified basically as research and development, seed multiplication, seed processing and storage, and seed marketing and distribution. The initial step in seed research is bulking of the parental stock, commonly referred to as breeder's seed or foundation seed. Its progeny (pre-basic seed), or what is known as certified breeder's seed, is then bulked to basic seed and availed for multiplication into certified seed. Initially, breeding research was the preserve of KARI, who released its basic seed to KSC for multiplication. However, with liberalization, KARI releases its basic seed to any interested seed company who is expected to remit royalties in return. Currently, seed companies such as KSC, WSC, Faida Seeds and Lagrotech are also involved in breeding.

Seed companies usually contract farmers to multiply basic seed to certified seed. Other institutions involved in seed multiplication are KARI through its seed sub-units at different research centres and NGOs

Figure 2: An organizational and institutional framework for the seed system in Kenya



such as Winrock International, Plan International, GTZ, CARE Africa and religious organizations that also contract farmers to bulk OPVs. After multiplication, the seed companies purchase seed from farmers for processing, packaging and storage. Processing includes such operations as drying, sorting, sizing, grading and seed dressing. The seed is then marketed and distributed. The distribution channels for seed maize are tied to the company dealing in seed. KSC has an elaborate distribution channel that covers the entire country and extends to parts of Tanzania and Uganda. The channel is categorized into agents, sub-agents and stockists. Most of the other seed companies rely on stockists to distribute their seeds besides having their own retail outlets. Seed from the formal system often finds its way into the informal system, especially after breeding and processing. The seed then finally finds its way to final consumers. However, KEPHIS, STAK and PBAK regulate the system and ensure that the code of conduct is upheld.

4.2 Seed Production

In Kenya, seed maize is mainly produced in the western part of the country especially in Trans Nzoia, Uasin Gishu, Nakuru and Baringo districts. Some seed maize production, mainly of OPVs, also takes place in the eastern part of the country especially in Makueni and Machakos, and also in the western districts of Nyando and Siaya in Kenya. Seed companies contract growers to grow the seeds under agreed conditions. The growers, who are selected by the seed allocation panels, produce and sell their seeds to the seed companies at agreed prices. The seed companies provide the breeder seeds to the growers on credit and debit the same from the growers' proceeds.

Both large and small-scale growers are involved in seed production in Kenya. A typical seed producer in Trans Nzoia, Uasin Gishu and Nakuru cultivates between 104 and 333 acres (Table 2). Producers in the other regions are typically smallholders. The area under cultivation depends largely on the isolation distance. The average yield of clean seed maize for the sampled farmers was 3,262 kg/ha. There are, however, variations between the regions and the type of seed (whether hybrid or OPV). The average yield for OPVs and Hybrids was 2,405 kg/ha and 3,369 kg/ha, respectively. Yields for the sampled farmers from Baringo (Perkerra Irrigation Scheme) are comparatively higher than those in the other areas because of irrigation. Farmers in Perkerra

Table 2: Farm sizes and average yields by districts

District	No. of sampled growers	Av. farm size (Ha)	Av. area under seed maize (Ha)	Av. yield (Kg/Ha – clean seed)
Trans Nzoia (Hybrids – Rainfed)	15	1,652	333	3,003
Uasin Gishu (Hybrids – Rainfed)	3	1,134	183	2,989
Nakuru (Hybrids – Rainfed)	3	1,233	104	3,337
Baringo (Perkerra Irrigation Scheme – Hybrids)	4	3.2	2.5	4,199
Nyando (OPVs)	4	18	7	2,405
Total	29	1,082	203	3,233

Source: Field survey, 2004

Irrigation Scheme scored an average clean seed yield of 4,199 kg/ha as opposed to 3,058 kg/ha for rain-fed growers.

In almost all the cases, the mean yields were below the expected potentials (about 6,000-8,000 kg/ha for hybrids and 4,000-6,000 kg/ha for OPVs)[1] due to various factors such as diseases, costly inputs, lack of credit and delayed payments. About 17 percent of the respondents in this study indicated that they have been experiencing problems with diseases such as grey leaf spot, rust and smut. This escalates the cost of seed production and contributes to the probability of seed rejection. On average, about 8 percent of the farmers' seed is rejected for being of unacceptable quality.

Other problems cited for the low productivity include expensive inputs, delayed payment and lack of credit (Table 3). The cost of fertilizer was particularly cited as being prohibitive. It was noted that the price of fertilizer had, within one year, shot from Ksh 1,400 to Ksh 1,600 per 50kg bag. Of the sampled farmers, only 52 percent were receiving credit, mainly basic seed.

Gross margin analysis for seed growers

To gain insight into the costs and margins of seed growers, the growers were categorized into four groups based on whether they were

[1]Clean seed is on average two-thirds the total grain yields.

Table 3: Problems in seed maize production (according to farmers)

Problem	Percentage of farmers citing the problem (n=29)	Rank
Diseases	21	1
Expensive inputs	15	2
Delayed payments	14	3
Lack of credit	10	4
Drought	10	4
Wrong variety/poor seed	8	5
Poor producer prices	7	6
Insufficient isolation distance	7	6
Others (Insufficient labour, insecurity, etc)	5	7
KEPHIS regulations	3	8

Source: Field survey, 2004

producing for a public or private company and the mode of production (irrigated or rain-fed). The production costs were then estimated on a per acre/per kilogram basis. This categorization was based on the realization that different seed companies offered different prices to their seed growers and that costs of production differed widely with the mode of production.

The gross margin analysis shows profit margins of between Ksh 4.5 and Ksh 17.6 per kg of clean seed (Table 4). Profits were highest among growers contracted by private companies who, in general, offer higher prices than growers contracted by public firms. In addition, smallholder growers using irrigation had comparatively higher profit margins than some large-scale producers both in the public and private sectors. It is also evident that OPVs had generally lower profit margins than hybrids.

The results suggest that efficient growers are able to realize reasonable returns of over Ksh 50,000 per hectare. Moreover, opportunities still exist for increasing the returns as the growers average yield of varieties such as H614 are still below the potential yield of 6,000-8,000 kg/ha (KEPHIS, 2003).

The cost components for the seed growers outlined above have been re-organized and represented in Table 5. It is evident that the largest cost component for large-scale growers, both under public and private

Table 4: Gross margin analysis for various categories of growers

	1. Large scale (H6-series Ksh/acre	2. Small irrigated H5-series Ksh/acre	3. Large scale (WH502 Ksh/acre)	4. Small scale (MDC Ksh/acre)
A. Output				
Male rows	13,140.4	25,613.9	14,412.5	10,868.0
Clean seed	90,599.6	130,169.0	128,459.8	59,280.0
Female rows for stock feed	1,778.4	0	3,334.5	2,223.0
Total revenue (TR)	105,518.4	155,782.9	146,206.7	72,371.0
B. Total cost				
(i) Labour inputs				
Planting	98.8	3,630.9	284.1	2,470.0
Singling	247.0	0	123.5	0
De-suckering	247.0	2,124.2	432.3	790.4
Weeding	1,605.5	6,669.0	1976.0	8,892.0
Fertilizer application	197.6	864.5	160.6	345.8
Dusting	123.5	0	345.8	0
De-tassling	2,766.4	4,199.0	4,940.0	0
Irrigation	0	6,347.9	0	0
Harvesting	2,223.0	4,618.9	2,470.0	1,383.2
Guarding	1,976.0	1,482.0	1482.0	988.0
Loading	395.2	1,333.8	444.6	518.7
Hand shelling	0	0	1296.8	1,185.6
Sub-total	**9,880.0**	**31,270.2**	**13,955.5**	**16,573.7**
ii) Intermediate costs				
Basic seed	1,976.0	1,976.0	3,087.5	3,334.5
Land preparation	6,175.0	7,657.0	6,175.0	9,386.0
Planter hire	1,729.0	0	2223.0	0
Fertilizers - DAP/MAP	3,038.1	0	3,260.4	3,458.0
- CAN	5,928.0	5,928.0	5,928.0	2,964.0
Aerial spraying (Fungicides)	3,458.0	0	0	0
Insecticides	839.8	0	805.2	0
Herbicides	2074.8	0	5,804.5	0
Irrigation O & M fee	0	2,766.4	0	0
Supervision & Management	4,890.6	6,422.0	4,816.5	0
Gunny/Propopryene bags	988.0	2,223.0	1,840.2	1,976.0
Shelling costs	815.1	1062.1	0	0
Transport cost - to store	123.5	2,223.0	568.1	98.8
- to buyer	3,235.7	8,398.0	1,333.8	0
iii) KEPHIS levy	938.6	938.6	938.6	938.6
iv) Loan interest (15 %)	4,075.5	5,681.0	4,409.0	3,507.4
v) County council cess				
(1% clean value)	906.5	1301.7	1252.3	592.8
vi) Land rent fee	3,705.0	2,470.0	3,705.0	2,470.0
Sub-total	**44,897.2**	**49,046.8**	**46,147.0**	**28,726.1**
Total Cost (TC)	***54,777.2***	***80,317.0***	***60,102.5***	***45,299.8***
Net Profit (TR – TC)	***50,741.2***	***75,465.9***	***86,104.2***	***27,071.2***
Total kg of clean seed	***3,235.7***	***4,199.0***	***3,892.7***	***1778.4***
Cost of production per kg of seed	***16.9***	***19.1***	***15.4***	***25.5***
Selling price per kg of seed	***28.0***	***31.0***	***33.0***	***30.0***
Profit margin per kg (Kshs) of seed*	***11.1***	***11.9***	***17.6***	***4.5***

* Excludes profits accruing from male output

Source: Field Survey, 2004

* Growers contracted by: 1 Public agency: 2 Public agency: 3 Private national company (Hybrids + OPVs): 4 Private national company (OPVs)

Table 5: Cost components for growers

Item	Cost components (Ksh/Ha)							
	1*Large-scale		2*Small-irrigated		3*Large scale		4* OPVsmall scale	
	Ksh	%	Kshs	%	Kshs	%	Kshs	%
Planting	1,828	3	3,631	5	2,507	4	2,470	5
Singling/De-suckering and De-tassling	3,260	6	6,323	8	5,496	9	790	2
Weeding	3,680	7	6,669	8	7,781	13	8,892	20
Irrigation	0	-	9,114	11	0	-	0	-
Harvesting	3,433	6	7,015	9	4,211	7	3,088	7
Guarding	1,976	4	1,482	2	1,482	2	988	2
Basic seed	1,976	4	1,976	2	3,088	5	3,335	7
Land preparation	6,175	11	7,657	10	6,175	10	9,386	21
Fertilizer	9,164	17	6,793	8	9,349	16	6,768	15
Pesticides	4,421	8	0	-	1,151	2	0	-
Supervision and management	4,891	9	6,422	8	4,817	8	0	-
Transport	3,359	6	10,621	13	1,902	3	99	-
Levies (KEPHIS & Cess)	1,845	3	2,240	3	2,190	4	1,531	3
Gunny bags	988	2	2,223	3	1,840	3	1,976	4
Interest	4,076	7	5,681	7	4,409	7	3,507	8
Land rent	3,705	**7**	2,470	3	3,705	6	2,470	5
Total	**54,777**	**100**	**80,317**	**100**	**60,103**	**100**	**45,300**	**100**

Key: 1&2 – Contracted by public agent; 3&4 – Contracted by private company

Source: Reworked from Table 4

agencies, is fertilizer, which accounts for about 17 and 16 percent, respectively, of the total costs. The other important components are land preparation (11% and 10%, respectively), supervision and management (9% and 8%, respectively) and weeding (7% and 13%, respectively). As for the small-scale irrigation growers, the major cost components include transport (13%), irrigation (11%) and land preparation (10%). For the OPVs, the biggest cost components are land preparation (21%), weeding (20%) and fertilizers (15%). A possible explanation for high land preparation costs for OPVs is the fact that the seed is produced in regions (Nyando and Siaya districts) where the market for machinery services is not competitive. As a result, tractor operators charge as much as Ksh 7,410 per hectare for ploughing services as contrasted to a charge of Ksh 2,964 per hectare in Uasin Gishu District. The small-scale irrigated growers incur the lowest fertilizer costs because soils in Perkerra (Baringo District) do not require application of DAP fertilizer. These growers, however, incur the highest transport costs, Ksh 2 per kg of seed, owing to the fact that the seed has to be transported all the way to the KSC processing plant in Kitale.

4.3 Seed Processing

Once dry, the seed is cleaned, sorted, graded and then dressed with both fungicides and insecticides ready for packaging and marketing. The cost varies between Ksh 2 to Ksh 8 per kg of treated seed depending on the chemicals used. There are, however, isolated cases where some companies use very expensive chemicals such as Gaucho (Ksh 43/kg of seed) for treatment of seed against maize streak virus.

After treatment, the seed is packed in weights ranging from 1kg to 50kg. Packaging costs are inversely related to the size of the packet but in general, the costs vary between Ksh 1 to Ksh 3 per kg of packed seed. All packets containing certified seed must then be sealed by KEPHIS at a cost of 70 cents per kg. The seed is then marketed to seed users through a chain comprising of agents, sub-agents and stockists who must be registered and licensed by KEPHIS after having met conditions laid down by the Seeds and Plant Varieties Act (Cap 326).