NATIONAL POTATO COUNCIL OF KENYA

SEED POTATO SUBSECTOR MASTER PLAN




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Five Year Master Plan (2009-2014)

REVISED EDITION

SEED POTATO SUBSECTOR MASTER PLAN

FIVE YEAR MASTER PLAN (2009-2014)

Seed study team: The study leading to the formulation of this master plan was conducted by a team that comprised Wachira Kaguongo of CIP (Coordinator), Nancy Ng'ang'a (KARI-Tigoni), Nancy Muthoka (KARI-Thika), Francis Muthami (GTZ- PSDA), Francis Rimberia (Consultant) and Harrison Rware (Consultant), with the help of an advisory team comprising Juan Landeo (CIP), Ian Barker (CIP), Eberhard Krain (GTZ-PSDA), Gladys Maingi (GTZ-PSDA), Julius Nyangaga (ILRI), and Evans Sikinyi (KEPHIS) as well as invaluable inputs from the Potato Task Force chaired by John K. Mutunga (KENFAP). Authors would like to acknowledge the valuable contribution by Ricardo Labarta (CIP) and Nicholas Ndiwa (ILRI) in regression analysis of this study.

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ACKNOWLEDGEMENT

In the recent past, various initiatives have been undertaken by the Ministry of Agriculture (MoA) with a view to revitalizing the potato sector in the country. The initiatives have included formulation of a National Potato Policy, review of the legal framework culminating in legal notice No. 44 of 2005 on potato standards and the formation of a potato task force to look into factors affecting the industry and compile a report of its findings.

Upon submission of its report, one of the most limiting factors was found to be availability and accessibility of high quality seed potato. As a result the permanent secretary in the ministry of agriculture commissioned the potato task force to carry out a study and formulate a "Seed Potato Master Plan" that would guide implementation of measures identified as necessary to turn the potato crop into a profitable sector and a food security anchor. Consequently, the task force formed a team of experts to undertake the study.

I therefore wish to acknowledge the various contributions made to this study without which this plan would not be a reality: GTZ/PSDA, CIP and USAID for providing resources and logistics for carrying out the study; the study advisory team comprising Juan Landeo (CIP), Ian Barker (CIP), Eberhard Krain (GTZ-PSDA), Gladys Maingi (GTZ-PSDA), Julius Nyangaga (ILRI), and Evans Sikinyi (KEPHIS) and the Potato Task Force Team for their invaluable input and wisdom; the District Agricultural Officers of the study districts (Imenti North, Meru Central, Nyeri North, Nyeri South, Nyandarua North, Nyandarua South, Nakuru North, Molo, Bomet, Narok North, Narok South, Keiyo, Marakwet, Mt. Elgon, Kiambu East, Kiambu West, Taita) for successfully organising the various phases of the study at district level; the various Institutions (ADC-Molo, Midlands Ltd, Kenya Seed, KEPHIS, KFA, MoA, KARI, Kenyatta University, Jomo Kenyatta University of Agriculture and Technology, GTIL, and FRESCHO), for the information and insights they provided during the study; the farmers and other stakeholders who participated in the various diagnostic forums and workshops; the interviewee farmers and the enumerators who spent

large amounts of time completing more than 1,337 questionnaires under strenuous field conditions.

I would also like to acknowledge the National Potato Council of Kenya which has taken the responsibility of implementing the revised study in collaboration with MOA, KARI, CIP, GTZ-PSDA and other stakeholders.

Signed: _____

Date: _____

Dr. John K. Mutunga

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EXECUTIVE SUMMARY

1. Background

This document is a result of a study requested by the Permanent Secretary, Ministry of Agriculture, which was conducted by a team of experts from MoA, KARI, CIP, GTZ, KEPHIS, ADC and private consultants amongst others. By virtue of being a seed potato master plan the document encapsulates the status and performance of the whole seed sub-sector, identifies stakeholders and actors and their roles and the challenges that hinder optimal performance, and gives recommendations. It describes the current production, distribution and use of seed, and identifies the barriers and bottlenecks hindering efficient performance. It also gives suggestions on effective alternative models and budget estimates over the next five year period, and provides estimates of potential economic benefit to the country in adopting the recommendations.

This document was prepared with inputs from farmers and actors in research, production, multiplication, distribution and marketing at field, district and national levels. Information and data were collected using literature review, institutional evaluation, diagnostic forums and field surveys. Performance and capacities of institutions such as KARI, MOA, KEPHIS, ADC and CIP were evaluated and existing production, multiplication and distribution marketing systems were examined by stakeholders in diagnostic forums held in 10 major potato producing districts and national forums. Farm data on availability and use of seed potatoes were collected using a structured questionnaire with 1337 farmers randomly selected from the 10 districts. Finally, the final document was peer reviewed by a team of experts.

2. Potato status in Kenya

In Kenya potato ranks as the second most important food crop after maize and is both a staple food and a cash crop for many rural and urban families. As a food crop, potato is an important source of carbohydrate, proteins, and vitamins and plays a major role in food

security. It is also a major source of income and is increasingly assuming importance as a cash crop.

Total area under potato in 2008 was estimated to be 158,386 hectares (ha) with an average yield of about 7 tons/ha and estimated total gross margin of Kenya shillings (Kshs) 8.105 billion. Farmer seed system currently dominates the sub-sector, contributing about 96.3% of the total seed used, while both clean and positively selected seed contribute 2.6%, and certified seed contribute 1.1% only. Use of certified seed and other quality seed has remained low despite efforts over the years from the government and development partners. However, the majority of farmers are aware of the importance of quality seed and are willing to pay some premium for quality. Farmers are travelling an average of 124 km to source for certified seed, spending about 5 cents per kilogram of certified seed on transport charges. Although 90% of farmers stored seeds, only 4% had been trained on seed storage and diffused light stores, while only 40% of farmers renewed seed regularly.

In the formal seed system, which involves production and distribution of certified seed, Kenya Agricultural Research Institute (KARI) in collaboration with International Potato Centre (CIP) develops, maintains potato varieties and supplies foundation seed. Kenya Plant Health Inspectorate Services (KEPHIS) offers seed inspection services while Agricultural Development Corporation (ADC), and a myriad of farmers and private companies, carry out multiplication of basic seed to produce certified seeds. The Government provides policy and regulatory framework while extension services are specifically provided by Ministry of Agriculture (MoA) together with other partners like KARI and NGOs.

3. Shortcomings in the Sub-sector

According to FAO data[1], Potato yields per ha have been declining at an annual rate of 11% mainly due to adverse weather conditions, poor soil fertility, use of low yielding varieties and poor quality seeds. Use of low yielding varieties and poor quality seed is highly attributed to an existing inefficient seed system, regulatory and policy framework. Although the formal system of seed potato production started in 1958, many elements of the system have systematically declined and only about 1.1% of seeds used by farmers are certified while about 2.6% consist of other good quality seed. Currently, the farmer seed system is characterised by poor seed quality with 96% sourced from farm saved seed or neighbouring farms, due to unavailability of good quality seed and lack of guidelines and knowledge.

Currently the sub-sector lacks an elaborate distribution system and farmers have to travel long distances to source certified seed from either ADC or the other few existing multipliers. The existing seed production and distribution system is characterised by a number of constraints and inefficiencies which include: inadequate funding and personnel at both institutional and farm level; inadequate distribution of roles between public and private sector; limited land at research and multiplication levels making it difficult to allow for the mandatory requirement of three year fallow/ crop rotation - as a result, inadequate quantities of breeder and basic seed are produced. The prerequisite National Performance Trials (NPTs) and Distinctiveness, Uniformity and Stability (DUS) tests for a variety release are poorly funded and are also perceived to be costly and time consuming. Moreover, the high cost of inputs such as fertilizer, inadequate technical know-how among farmers and extension service providers, high transportation costs during distribution and the perishable nature and bulkiness of seed tubers, in addition to lack of on-farm storage facilities and poor access roads, have continued to slow down the efficiency of the seed

[1] Source: http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567; Dated July 2009

potato sub-sector. Low accessibility and knowledge gaps by farmers and lack of recognition by law have continued to stifle use of other quality seeds. On the other hand, the seed certification process is perceived to be costly and bureaucratic, and, coupled with lack of knowledge and information about the importance of certification by both extension service providers and farmers, has compounded the above mentioned problems. The lack of a stakeholders' and actors' forum or institutional structure for advocacy, lobbying and pursuance of relevant sub-sector issues, has slowed down formulation, revision and implementation of relevant sub-sector policies and regulations.

4. Targeted and Projected Status

With investment, the total area under potato is expected to grow at an annual growth rate of 3.7% and reach 189,581 ha by the year 2013, while the yields are expected to improve to about 13 tons/ha. In the next five years, use of certified seed is expected to increase to 10%, use of clean seed to 25% and use of positively selected seed to 30%, reducing use of farmer seed to 35%. Without intervention, and maintaining the same level of use of quality seed, the 189,581 ha in the fifth year would yield a total gross margin of 8.105 billion. An increasing area under quality seed without intervention would increase the total annual gross margin to 12.959 billion. However, interventions aimed at improving both quality of seeds and management practices are expected to increase the gross margin to 21.046 billion.

5. Budget Implication

The total budget for implementation of the planned activities over the five years is estimated to be Kshs 318.84 million. The five year investment in each of the sub-systems varies, with the highest investment of Kshs 270.845 million intended for the formal sub-system (including policy and regulatory framework), Ksh 31.745 million for the semi-formal sub-system and Kshs 14.650 million for the farmer seed system. The total budget

requirement for all the sub-systems and themes in the short term is Kshs 154.710 million, in the medium term 114.635 million and in the long term 49.495 million.

6. Recommendations and Conclusion

To overcome the current constraints and arrive at the targeted status there is a need for the Government, development partners and private sector to work in a complimentary manner to ensure that all facets of the sub-sector (research, production, multiplication, certification, distribution and use) are efficient. The following are targeted priority areas:

i. investment in modern technology of seed production, multiplication, and storage;
ii. encourage greater involvement of the private sector in the seed potato sub-sector;
iii. involving universities and other players in research, production and multiplication of seeds;
iv. establish variety adaptive research at regional levels while maintaining the national coordination to ensure selection and release of varieties suited to respective ecological zones;
v. establish seed multiplication centres at district levels to reduce the distance travelled by farmers when sourcing seeds and, hence, increase access to quality seed;
vi. tapping the existing distribution network within Kenya seed companies and others;
vii. embracing the concept of clean seeds (under a devolved mandate from KEPHIS) and legally recognising it as tradable seed, hence exploiting the potential of clean seed to reduce diseases and increase yields;
viii. create awareness and train farmers on the importance of using quality seeds (certified, clean and positively selected seed), good management practices, post harvest handling and policy and legal requirements and this should be facilitated by government in partnership with development agents;
ix. increasing government's budgetary support to the public institutions in the sub-sector;

x. formation of a National Seed Potato Committee based in the National Potato Council to coordinate the sub-sector and carry out any necessary advocacy and lobbying;

xi. review current policy and legal framework to address new challenges in the sub-sector based upon an economic analysis of the costs and returns of different policy options;

xii. create ICT based information centres from where farmers can access relevant information on seed potato in terms of varieties available, seed type, location and prices.

If these turn-around measures are undertaken, productivity is expected to improve by over 83%, from an average yield of about 7 tons/ha to about 13 tons/ha in five years. This improvement is expected to emanate from improved availability, distribution, awareness and use of high quality seed. Although the benefits of a Government investment of an the estimated Kshs 318.84 million in the seed sub-sector is expected to be cumulative, starting from first year, in the fifth year alone the total benefit is expected to range from 2.7 billion to 13 billion, depending on the innovations and interventions that will take root in the value chain of the seed system.

Signed: _____

Date:_____

Mr. Wachira Kaguongo,

Study coordinator

National Potato Council of Kenya/ International Potato Centre (CIP)

ACRONYMS

ADC	Agricultural Development Corporation
ATC	Agricultural Training Centres
CDS	Challenge Development System
CIP	International Potato Centre
DAO	District Agricultural Officer
DLS	Diffused Light Store
DUS	Distinctiveness Uniformity and Stability
GTIL	Genetics Technologies International Limited
GTZ	Germany Technical Corporation
ILRI	International Livestock Research Institute
KARI	Kenya Agricultural Research Institute
KENAPOFA	Kenya National Potato Farmers Association
KENFAP	Kenya National Federation for Agricultural Producers
KEPHIS	Kenya Plant Health Inspectorate Services
KShs	Kenya Shillings
KFA	Kenya Farmers Associations
MoA	Ministry of Agriculture
NGO	Non Governmental Organisation
NPT	National Performance Trials

PS	Permanent Secretary
PSDA	Promotion of Private Sector Development in Agriculture
PQS	Plant Quarantine Station
SWOT	Strengths, Weaknesses, Opportunities and Threats
TC	Tissue Culture
TOT	Trainer of Trainers
TPS	True Potato Seed
USD	United States Dollars

DEFINITIONS

Improved potato varieties

Improved varieties are defined here as those that have been released or distributed by National Agricultural Research Systems (NARS) since 1970. Many of these varieties were developed from materials provided by CIP. They are usually considered to be superior in attributes such as yields, resistance to diseases, dormancy period, maturity period, taste or uniformity for processing purposes as compared to the 'local' or existing varieties which they have tended to replace (KARI, 2000; KARI, 2005).

Note: "improved" here refers to superior genetic composition of the variety compared to these local varieties and not to the healthiness of the seed itself which is considered under seed quality.

Improved varieties also include those varieties originating from trials conducted by NARS and selected and adopted by farmers because of their superior qualities but which have not been with the farmers for more than **35 years**.

Local potato varieties

Varieties with the farmers whose origin is unknown or varieties released by NARS but which have been out with the farmers for more than **35 years** without being screened and cleaned up against diseases.

Clean seed

Seed at farm level that originated from certified seed or basic seeds whose production has followed laid down guidelines after farmer training by MoA, KARI, GTZ, TOT, but that has not been inspected by KEPHIS. This seed category is not acknowledged by law and

currently cannot be sold through formal market channels. It is also known as informally traded seed and it is categorised as non-certified quality material that is tradable.

Positively selected seed

Seeds produced from ordinary seed through a process of positive selection by farmers trained on seed selection and management by MoA, KARI, GTZ, TOT or CIP. The process involves farmers identifying the healthy looking plants in the field and marking them using pegs. During harvest, seed potato is obtained from the marked plants only. This is as opposed to negative selection, where the unhealthy plants are identified and removed.

Positively selected seed is classified as non-traded seed and is not recognised by law.

Farmer/ Ordinary seed

Seeds sourced at farm level or market place whose production or selection is not done following any quality control procedure guided by either KARI, MoA, KEPHIS or any other potato experts. It is common with farmers where they use small ware tubers as planting material but it is classified as non- tradable seed although farmers sell to each other.

Breeders' seeds

This is seed directly controlled by the originating or sponsoring plant breeder of the breeding programme or institution and/ or seed whose production is personally supervised by a qualified plant breeder and which provides the source for the initial and recurring increase of pre-basic and basic seed. Breeders' seed is maintained genetically pure so as to guarantee that the subsequent generation (i.e. pre-basic and basic seed class) conforms to the prescribed standards of genetic purity.

Pre-basic and basic seed

This is the progeny of breeders' seed or it can be produced from pre-basic seed, which can be clearly traced to breeders' seed. Thus pre-basic and basic seed can be produced from pre-basic. Pre-basic seed is multiplied twice in the field to produce basic seed. In production the minimum seed certification standards are the same as for both pre-basic and basic seed and it is supervised and approved by the certification agency (KEPHIS). It is handled so as to maintain specific genetic identity and genetic purity and it is required to conform to the certification standards specified for potato. Although mainly produced by the public sector, the private sector is potentially important in production of Pre-basic and basic seeds.

Certified seed

This is the progeny of basic seed and its production is handled so as to maintain specific genetic identity and purity according to the standards prescribed for certified potato. Certified seed may be the progeny of certified seed provided this reproduction does not exceed three generations beyond basic seed stage. It is obtained from multiplying basic seeds under stringent supervision of KEPHIS. It is the only tradable seed potato under the Kenyan law. Although mainly produced by the public sector, the private sector has high potential of production and distribution.

Distribution

Distribution entails collection, moving or transporting of seeds from the multipliers and availing it to users who include farmers, farmer groups, and institutions, and any market transactions involved in the process. Ideally, the function of distribution should be performed by an independent body and should help seed reach multiple users in various parts of the country whilst viable and in time for planting. Distributors should have storage capacity that allows seed to be released when farmers require it and entails marketing the seed so that farmers know the varieties available, prices and sources.

1. BACKGROUND

In Kenya, potato ranks as the second most important food crop after maize (Guyton et al., 1994; Seed potato study, 2009). Potato is both a staple food and a cash crop in many rural and urban families in Kenya and plays an important role in national food and nutrition security, poverty alleviation, and income generation, and provides employment in production to consumption continuum (Kabira et al., 2007). There is increasing trade to supply the growing cities and towns with cheap staple food and satisfy the growing fast food industry. About 60-65% of the fresh potato supplied by urban traders in Kenya is processed in fast food outlets such as restaurants and street stalls (ECAPAPS, et al., 2005; Kirumba et al., 2004).

Potato production in Kenya occurs mainly in the highlands of central, eastern and rift valley regions, in Mau range and the slopes of Mt. Kenya. Moreover, other regions such as Mt. Elgon in the Western province and Taita Taveta in the southern border region with Tanzania have also started growing potatoes on a commercial basis **(**Figure 1**).**

Potatoes were introduced in British colonial times in Kenya and other parts of East Africa in the 1880s. After 1920s, the crop became popular with indigenous Kenyan farmers who started potato cultivation, especially in the former white highlands where the yields obtained were 22.5t/ha and eventually entering export market in 1923. However, during the 1930s, Kenyan potato production suffered both from economic problems associated with the global depression and from pests and diseases (Waithaka, 1976).

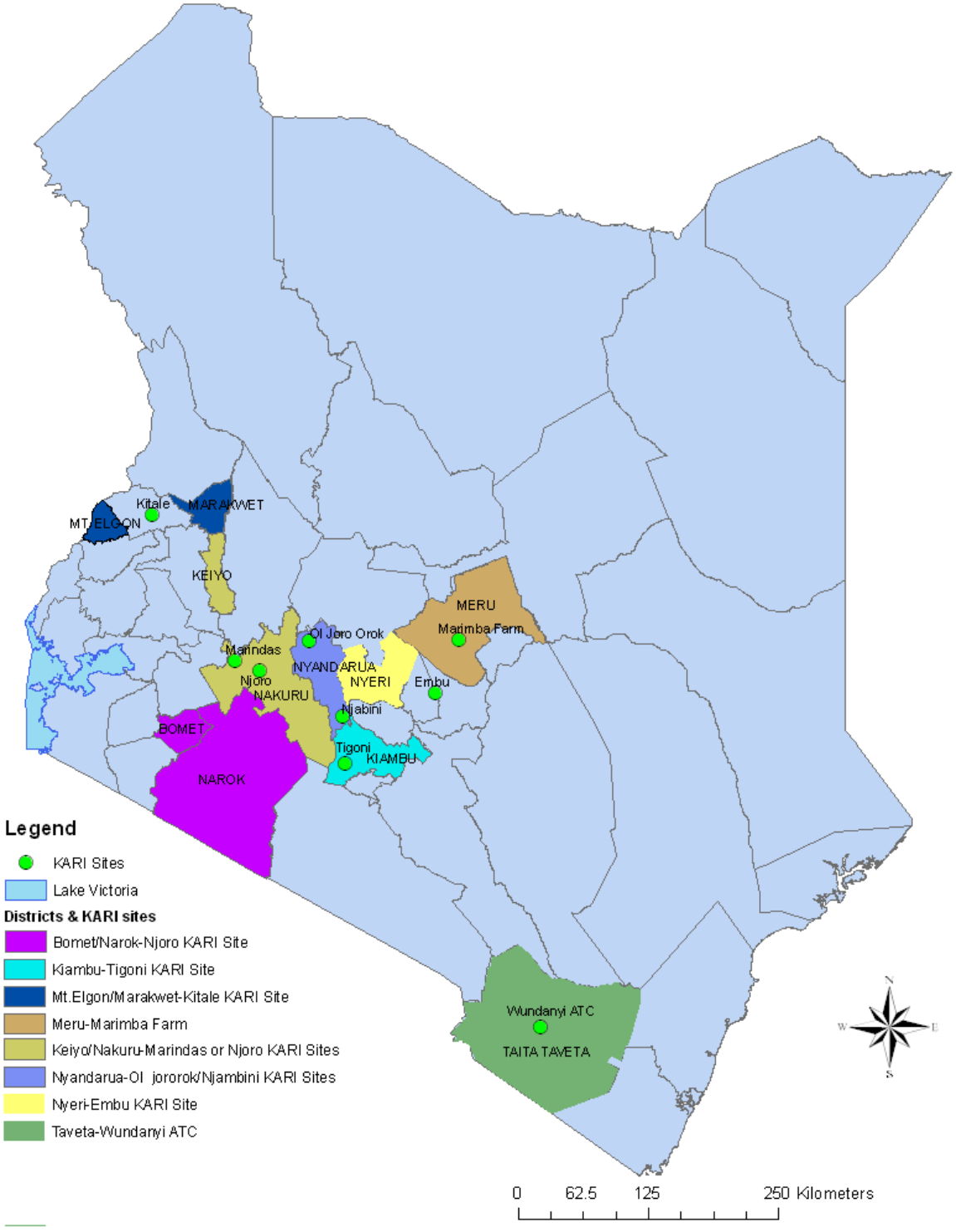


FIGURE 1: MAP OF KENYA SHOWING MAIN POTATO PRODUCING DISTRICTS AND PROPOSED NPT SITES

The formal system (modeled after the European type) of potato seed production in Kenya started progressively in 1958 and by 1980s the system had achieved technical and organisational efficiency at its peak - the ADC, for instance, produced 42,000 bags of certified seed in 1986. New potato varieties and seed potato production were introduced at the National Agricultural Laboratories, Kabete, in 1903 and at the Plant Breeding Station, Njoro, in 1927. In 1967 the Kenyan Government, with technical assistance from West Germany and the UK, started a project on potato development with a mandate of establishing programs in variety screening, plant breeding, seed multiplication, and agronomy (Dũrr and Lorenzel, 1980). During this time, a basic seed production station was established at Tigoni, which is now KARI-Tigoni, and by 1979 it became a full potato research station.

Between the late 1970s and 1990s CIP was maintaining and supplying clean foundation seed to KARI-Tigoni, while KARI-Tigoni increased the production of basic seed and released varieties like the widely adapted white and red skin potato varieties and also provided for seed inspection. Seed multiplication was then carried out by ADC and several large scale farmers. Between the 1970s and 1980s the Faculty of Agriculture, University of Nairobi, and the International Potato Centre cooperated with the national potato program in conducting and promoting research and extension activities on potato (Nkanya, 1984; Kabira and Njoroge, 1982). However, in the 1990s many elements of the potato development system collapsed, due mainly to political interference leading to the grabbing of potato research and ADC seed potato production land, the decline of the hitherto effective potato distribution system provided by KFA and co-operative among others. Ware potato production started to decline - for instance, KARI- Tigoni, was not able to release new varieties between 1982 and 1997. This led to the entrenchment of the farmer based seed system which has continued to thrive with minimal Government or donor involvement and support.

Institutional changes and special projects were initiated in the late 1990s to early 2000 in attempts to revive a structured seed potato system in Kenya. The basic elements were: CIP was to continue maintaining and supplying clean foundation seed to KARI-Tigoni. KARI-Tigoni, under a special project (Foundation Seed Unit -FSU), was to increase production of basic seed and release new varieties. KEPHIS would provide voluntary seed inspection. Seed multiplication and distribution could then be carried out by NGOs interested in farmer based seed production. During the same period CIP set up special projects to finance pre-basic seed production and to stimulate farmer-based seed multiplication (Crissman et al., 1999). Since then, only remnants of this structured system have remained and the operational elements have been inefficient, allowing the farmer seed system to thrive with little guidance or support from government or development agents.

2. OBJECTIVES AND JUSTIFICATION

Potato yields have been declining in the recent past at the rate of 11% per year (Figure 2). This trend has been blamed mainly on adverse weather conditions, poor soil fertility, use of low yielding varieties and poor quality seeds (Kaguongo et al., 2008; Okoboi, 2001). Despite the fact that quality potato seeds are viewed as holding the key to improved yields in potato production, very few farmers use them. According to Kaguongo et al. (2008) 94% of seed potatoes used by farmers in Kenya in 2005 were sourced from farmers who were not trained on how to produce clean or positively selected seeds (farm saved seed and neighbour harvests). Clean and positively selected seeds constitute about 2.6% while certified seeds alone hardly exceed 1%. Although limited quantities of quality seeds are available from trained farmers' associations, seed growers trained through the efforts of GTZ-PSDA, KARI-Tigoni, CIP, MOA and other national research stations, there exist institutional, infrastructural, regulatory, policy and knowledge barriers that have hampered effective utilisation of clean and certified potato seed, thus reducing the benefit. Similar barriers have also hindered full participation of private sector and other stakeholders in development of the potato sector.

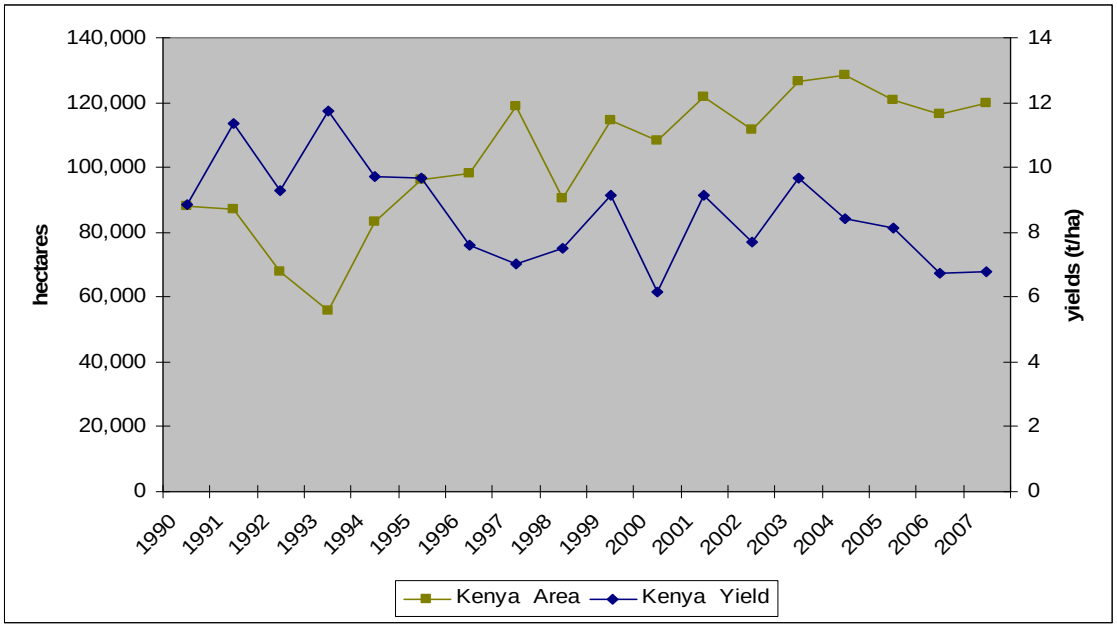


FIGURE 2: POTATO PRODUCTION TREND (1990-2007)-FROM FAO DATA

Although numerous germplasm of superior quality exist in other countries and in CIP's gene bank, only a few improved varieties have been tested and adopted in Kenya (Demo, 2008). Furthermore, only a few of the superior varieties have been pre-released due to the inability of KARI-Tigoni to produce enough quantities to meet the mandatory seed stock. The limited capacity of KARI, which is the public institution mandated to produce basic seed of old cleaned (disease free) and new varieties for further multiplication, has also led to only a handful of new varieties and minimal quantities of certified seeds entering the distribution system each season (KARI, 2000; KARI, 2005; personal conversation).

In addition, the post-election mayhem in early 2008 led to the loss of most of the certified and clean seeds in institutions, group and individual farms in Rift Valley, which is an important seed producing region, thereby elevating the seed crisis.

These concerns prompted the Permanent Secretary of the Ministry of Agriculture to commission this study. The study was also recommended by the National Potato Task Force.

In order to prepare the master plan, the current status of the seed potato sub-sector has been evaluated by analysing the distribution systems, identifying barriers and bottlenecks hindering efficient performance and recommending effective alternative models.

Specifically, the following issues were examined and recommendations given:

i) the barriers/bottlenecks hindering development of effective and efficient potato seed sub-sector in Kenya;

ii) how restrictive, facilitative or development oriented is the existing legal and policy framework in view of recommending necessary changes;

iii) the roles played by the public and private sectors in the seed potato sub-sector;

iv) awareness status on the need for clean and certified seeds among the farmers and other stakeholders;

v) the demand and supply of clean and certified seed potato and the willingness to pay by farmers;

vi) identify models or systems that would see efficiency in the roles played by various stakeholders in terms of seed production, quality assurance, distribution, marketing and utilisation;

vii) indicate budgetary and cost implications of implementing the identified seed potato system.

The master plan explains the tasks involved in this transformation, giving details of the current constraints, how to address these constraints and spelling out the steps each player and stakeholder should take to effect the turn around, and the role the government should

play to oversee sustained development of the sub-sector to ensure the country transforms from a seed potato deficit to a seed potato sufficient nation.

3. PLAN OUTLINE

This plan comprises the executive summary, background information, objective and justification of the study, methodology and the findings of the study. The study findings are presented in themes or system functions and give the current situation of seed potato sub-sector and the desired or targeted status. Existing constraints and opportunities are documented and recommendations of activities and investments needed to transform the sub-sector are given.

4. METHODOLOGY

The seed potato study was conducted by a team of professionals from various realms of the seed potato industry (research, public and private sector agencies). Data collection used a triangulation approach (Webb et al., 1966) where the strategy of multiple data sources and multiple data collection methods is followed in order to capture information from a variety of vantage points. The study used heuristic and analytical methods sequentially arranged to feed into each other and largely followed principles of the Outcome Mapping. The methods used included collection and collation of existing information, field surveys and dialogue with stakeholders and experts. Data collection steps include Institutional evaluation, Rapid appraisal, Diagnostic forums, Seed demand survey and a National stakeholders' workshop.

4.1. Study Areas

The study was conducted in the 10 main potato growing (old) districts in Kenya, namely Kiambu, Nyeri, Meru, Nyandarua, Nakuru, Bomet, Narok, Mount Elgon, Taita- Taveta, and Keiyo -

Marakwet[2]. Figure 1 above shows the map of Kenya with main potato growing districts[3] visited (Table 1).

4.1.1 Data Collection

Data was collected in three stages. The first stage comprised institutional evaluation, the second stage comprised rapid appraisal and diagnostic forums with stakeholders and the third phase comprised the seed potato supply and demand survey (household surveys).

Institutional evaluation

The first stage involved evaluating key institutions to find out their strengths and weaknesses, opportunities and threats (SWOT) in relation to their optimal performance. Information relating to the institutions' mandates in the potato seed sub-sector, as well as their short and long term needs in terms of financial, legal, personnel and other capacity requirements, was assessed. The existing regulatory and policy framework at the Ministry of Agriculture level was evaluated and its strengths and weaknesses assessed.

Diagnostic forums

The second stage involved conducting diagnostic forums in 10 major potato producing districts and getting an overview of seed potato production, multiplication and distribution in the districts, and identifying bottlenecks and opportunities in the sub-sector. Working with stakeholders, the forums also identified the major seed sources, seed potato and ware production and their seasonalities, and roles played by the private sector.

[2] Districts visited are in the following counties: Kiambu, Nyeri, Meru, Nyandarua, Nakuru, Bomet, Narok, Bungoma, Taita-Taveta and Elgeyo-Markwet

[3] Larger or older districts which existed before creation of new districts between 2007-2009

Seed potato supply and demand survey

The third stage involved collecting household data from farmers to help estimate quantitatively the demand and supply of certified and clean seeds and take audit of constraints facing farmers in accessing good quality seeds. A sample size of 1337 randomly selected farmers from 10 major potato producing districts was targeted. A questionnaire with both closed and open questions was used to interview randomly selected farmers. The information collected included awareness of the need to use clean seed, accessibility and availability of clean and certified seeds, source and prices of different seed types used. Sampling was done at several levels: all potato producing divisions in the 10 districts were selected, half of the locations in the divisions were randomly selected and half of sub-locations in the locations were randomly selected. One village was randomly selected from each sub-location and five farmers were selected from each village to account for 0. 7% of the households in each district (Table 1).

TABLE 1: SAMPLING DETAILS PER DISTRICT

Old District	Divisions		Locations		Sub-locations		Villages		Households
	Potato producing	Selected	Potato producing (from selected divisions)	Selected	Total producing	Selected	Total	Selected	Selected hhds
1. Meru (Imenti north & Central)	5	5	25	22	67	29	118	29	145
2. Keiyo-Markwet (Keiyo & Marakwet)	5	5	18	10	37	16	-	16	80
3. Mt. Elgon	4	4	12	6	25	11	-	11	56
4. Nakuru (Nakuru & Molo)	11	11	45	45	90	40	-	40	202
5. Narok (North & South)	5	4	19	9	34	18	-	18	88
6. Bomet	2	1	8	8	23	10	95	10	48
7. Nyandarua (North & South)	6	6	26	26	79	35	-	35	175
8. Nyeri (Nyeri South & North	7	7	25	13	135	52	270	52	260
9. Taita	4	4	12	6	27	12	108	12	62
10.Kiambu (East & West)	8	8	34	18	52	44	131	44	221
Total	57	55	224	163	569	267	509	267	1337

Data entry and analysis

Information and data from institutional evaluation and diagnostic surveys were collated and synthesised and their results are presented in summary or SWOT tables in appendix 5 of this

report. Data from field survey was entered and cleaned using CSPro and analysed using SPSS, Stata and Excel for descriptive analysis, cost-benefit analysis and demand estimation.

Estimation of demand for quality seeds

To estimate demand for quality seeds, farmers' Willingness to Pay' (WTP) was used. Concept of contingent valuation method (CVM) was used to gauge how farmers perceive the quality seed and how much farmers were willing to pay for each type of seed. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for 'new' commodity or service such as a specific environmental service[4]. It is called 'contingent' valuation, because people are asked to state their willingness to pay, *contingent* on a specific hypothetical scenario or description of the environmental services. According to Rappoport et al. (2002) some of the weaknesses of WTP include the usefulness of the methodology to the products and services that are generally available and understood. Although the majority of farmers may have perception of the quality of certified seed the seeds are not readily available.

During data collection farmers were asked to indicate the maximum amount they were willing to pay for each type of seed. Although farmers were not first asked whether they were willing to buy various types of seeds, we made a 'strong' assumption that once a farmer offered any price for a given type of seed that then implied they were willing to buy and they fully understood the quality of that type of seed. In this case a truncated demand was applied, since the demand for those who would pay zero for a quality seed could not be observed. A truncated regression (Double hurdle model) was used to analyze the elicited WTP.

[4] http://www.ecosystemvaluation.org/contingent_valuation.htm#over:dated August, 2009

5. CURRENT SEED POTATO SUB-SECTOR SITUATION

The current seed potato situation is described based on the results of the above three main methodological steps that involved institutional evaluation, diagnostic analysis and seed supply and demand surveys. Quantitative results from the ten major potato growing districts are extrapolated to national level using sampling logic and the MoA's reported output data for the 10 districts and national output for three years running from 2004 to 2006. Targeted situation is simulated using estimated seed demand in an optimal situation arrived through projection from survey results and input from experienced experts.

5.1. Farmer characteristics

The households interviewed had a mean family size of 5.7 and the majority of households were male headed (78.1%). Overall, farmers in the 10 districts visited owned an average of 1.7 ha and cultivated an average of 1.3 ha with differences witnessed across districts with the highest farm and cultivated areas in Narok and the lowest in Kiambu (Table 2) Farmers had mean experience of 14 years in potato production, with the most experienced farmers being in Meru (19 years) and the least experienced located in Nakuru, Bomet and Taita (8 years).

In the districts visited, potato was the most important income crop (ranked first by 46% of farmers) followed by maize (ranked first [t] by 12%) whilst together with maize it was the most important food crop (both ranked first by 47 % of farmers). However, diagnostic surveys placed potato as the second most important crop after maize in the districts visited, considering both potato growing and non-growing areas.

A little less than half (48%) of potato households in the survey districts experienced at least one month of food shortage in a year, with the level varying across districts. Nearly all (95%) of Mt

Elgon farmers experience periods of food shortage during the year while relatively fewer (< 40%) of farmers in Meru, Narok, Bomet and Kiambu experience food shortage in a year.

Most (63%) of the potato producers sell more potatoes than they consume with differences apparent in the different districts such that the vast majority (>90%) in Keiyo Marakwet, Narok and Bomet sell more than they consume while only 22% in Kiambu sell more than they consume.

TABLE 2: FARMER CHARACTERISTICS AND POTATO PRODUCTION PRACTICES

	Meru	Keiyo_ Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Overall
Gender of household head											
Male	83.8	96.4	91.3	79.8	96.6	96.6	81.8	56.6	67.9	79.0	78.1
Female	16.2	3.6	8.7	20.2	3.4	4.0	18.2	43.4	32.1	21.0	21.9
Average family size (std)	4.9 (2.3)	7.1 (2.8)	9.0 (3.9)	5.9 (2.4)	7.0 (3.4)	6.4 (2.8)	5.7 (2.5)	5.1 (2.6)	5.0 (2.0)	4.8 (1.9)	5.7 (2.7)
Average farm size (ha)	1.2	2.7	2	2	5.2	1.8	1.7	1	1.2	0.8	1.7
Average cultivated farm size (ha)	1.4	3	1.8	1.3	2.8	1.2	1	1.2	1	0.5	1.3
Area under potato (Oct-Feb)	0.3	0.5	0.2	0.3	1.2	0.3	0.3	0.2	0.1	0.1	0.3
Farmers lacking food at least one month in a year (%)	37	71	95	58	38	33	50	42	58	36	48
% ranking potato as most important income crop (rank)*	68 (1)	69 (1)	57 (1)	59 (1)	91 (1)	58 (1)	57 (1)	24 (2)	48 (1)	6 (4)	46 (1)
% ranking potato as most important food crop (rank)*	73 (1)	36 (2)	27 (2)	32 (2)	83 (1)	48 (2)	43 (2)	47 (2)	21 (2)	45 (1)	47 (2)
Experience of growing potatoes (years)	19	10	9	8	10	8	17	17	8	15	14
% that sell more than they consume	63.4	95.0	75.0	80.7	96.6	93.8	74.3	43.1	62.9	22.2	62.3
Sample size	**145**	**80**	**56**	**202**	**88**	**48**	**175**	**259**	**62**	**220**	**1330**

*Rank evaluated against other crops

Source: Master plan field survey results (2009)

5.2. Seasonality

Across the country, potatoes are produced throughout the year although seasons differ across regions; hence, there is potato production in at least one district every month (Table 3). The

seasonal differences should be taken into account in seed production and distribution ensuring that seed is available in all the districts and divisions at the respective time of planting.

TABLE 3: MONTHS OF PLANTING AND HARVESTING

Month	Time of planting	Time of harvesting
January		Central Kenya/West of Rift/ Central Rift/Nakuru/Nyandarua
February		Central Rift/Nakuru/Nyandarua
March	Central Kenya/West of Rift/South Rift/Central Rift/Nakuru/Nyandarua	Central Rift/Nakuru/Nyandarua
April	Central Kenya/West of Rift/Central Rift/ Nakuru/Nyandarua	
May		Central Kenya/West of Rift/South Rift/Central Rift/Nakuru/Nyandarua
June		Central Kenya/West of Rift/South Rift/Central Rift/Nakuru/Nyandarua
July	South Rift	
August	South Rift/ Central Rift/Nakuru/Nyandarua	
September	Central Kenya/West of Rift/ Central Rift/Nakuru/Nyandrarua	
October	Central Rift/Nakuru/Nyandarua	South Rift
November	Central Rift/Nakuru/Nyandarua	South Rift
December	Central Rift/Nakuru/Nyandarua	Central Kenya/Central Rift/Nakuru/Nyandrarua

Source: Master plan district diagnostic forums (2008)

5.3. Production practices

5.3.1. Varieties grown

The most commonly grown varieties in the country in the year 2008 were Tigoni (cultivated by 25.7%), Nyayo (cultivated by 24.8% of potato farmers) and Thima thuti (22.7% of farmers) (Table 21). Similarly, the highest proportion of land was under Tigoni (20.7%) followed by Thima Thuti (20.2%) and Dutch Robjyn (10.5%) (Table 22). Although a high proportion of farmers cultivated Nyayo it occupied only 9.5% of total land, indicating that many farmers were growing it on smaller farm acreages than either Tigoni or Thima thuti (Table 22). Widely grown varieties do not

always have the highest acreage as, overall, Dutch Robjyn acreage was higher than that of Nyayo even though only 9.6% of all farmers grow Dutch Robjyn compared to 24.8% growing Nyayo.

Thima thuti reigned in Narok (grown by 72.7% of farmers and occupying 61.4% of potato area) and in Nyeri (64.9% of potato farmers but only 34.8% of potato area) with some respectable presence in Kiambu (29.9% of farmers and occupying 19.2% of potato area).

Tigoni holds sway in Nakuru (grown by 61.9% of potato farmers and occupying 43.2% of potato area), Taita (48.4% farmers and 37.1% of potato area), Keiyo Marakwet (76.3% farmers and 73.6% of potato area) and has some presence in Nyandarua (grown by 29.7% of farmers and having 21.4% of potato area).

Nyayo was the most widely grown variety in Kiambu (47.5% of farmers but only 26.1% of potato area) and it was familiar with farmers in Nyandarua (47.1% of farmers and 18.7% of potato area), Nakuru (37.1% of farmers but only 16.3% of potato area) and in Nyeri (27.5% of farmers but only 9.2% of potato area).

Dutch Robjyn was grown in Narok (23.9% of farmers and 14.8% of potato area), Taita (32.3% of farmers and 24.6% of potato area) and Nakuru (19.3% of farmers and 17.9% of potato area) but was of singular importance in Bomet (81.3% of farmers and 86.8% of potato area). Districts with unique but widespread varieties are Mt Elgon with Arka (91.1% of farmers and 66.5% potato area) although there was some Arka in Meru (6.9% of farmers and 3.3% of potato area) and in Keiyo Marakwet (8.8 % of farmers and 6.1% of potato area). Only in Meru was Purple Tigoni important (grown by 38.6% of farmers and 23.3% of potato area).

Other fairly important varieties in specific districts were Asante in Meru (31.7% of farmers and 33.5% of potato area), Mt Elgon (12.5% of farmers and 12.4% of area), Nakuru (14.4% of farmers and 6.9% potato area) and Taita (19.4% of farmers and 15.9% of potato area). Shangi was significant in Nyandarua (25.7% of farmers and 14.7% of potato area), Kiambu (16.7% farmers planting and 9.4% of the potato area) and Narok (5.7% of farmers and 5.6% of potato area). Meru

Mugaruro in Nyandarua (13.7% of farmers planting and 13% potato area), Kiambu (10.4% of farmers and 13.8% of potato area) and Nyeri (12.3% of farmers planting and 5.5% of potato area).

5.3.2. Use of different types of seeds

Potato yields have generally been declining over the years due to limited use of high quality seeds and widespread use of degenerated seeds which have high viral and bacterial loads (district appraisals). This trend has been blamed mainly on limited production of high quality seeds, lack of access to available quality seeds and a poorly, malfunctioning distribution system (district appraisals). Clean and positively selected seeds constitute about 3.0% of total seed used and are grown in 2.6% of the total area under potato, while certified seeds contribute about 1.1% of total seed used and occupy 1.2% of the area under potato (Table 4). Although limited quantities of quality seeds are available from a few trained farmers associations, seed growers trained through efforts of GTZ-PSDA, CIP, KARI Tigoni and MoA and national research stations, there exist institutional, infrastructural, regulatory, policy and knowledge barriers (Table 20) that have hampered effective production and utilisation of clean and certified potato seed thus reducing potential benefits. Only 9.4% of farmers had been trained on positive seed selection with differences across districts such that only 2.3% had been trained in Kiambu and 22.8% had been trained in Meru (Table 20).

The best combination of seed systems in the country is yet to be defined and there is no proof to show that focusing primarily on the formal seed system is better and more cost effective than the farmer seed system. Earlier studies have pointed out that most states in developing countries have had limited success in building a dominant formal seed system and they have shown a need to recognise and strengthen farmer seed systems since farmers systems are always predominant (Thiele, 1998; Tripp, 1995; Jaffee and Srivastava, 1992). Studies have also shown weaknesses of both formal and informal seed systems and increasingly there is emphasis on building on the

complimentarity of the two systems through recognising, linking and strengthening them. The formal seed system has been known to lock farmers into high input systems and eliminate local diversity by supplying seeds of inappropriate varieties (Boef de, Berg and Haverkort, 1995) while the farmer seed system has been accused of leading to low yields through use of low quality seeds (Douglas, 1980). According to Thiele (1998) formal seed production schemes have had limited outreach, finding it difficult to supply seed to small-scale farmers who only require seed intermittently in small quantities and live in areas with poor road access.

TABLE 4: AREA UNDER DIFFERENT TYPE OF SEEDS; PERCENTAGE USE BY WEIGHT AND OF FARMERS USING IN 2008

	Meru	Keiyo Marakwet	Mt.Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	All district s	National**
Percentage area under different type of seeds												
Certified	0.7	1.6	0.0	1.7	2.3	0.0	1.6	0.0	4.3	1.4	1.4	1.2
Clean	6.0	0.3	0.0	1.1	1.1	14.2	0.4	0.0	5.6	1.4	1.9	1.5
Positive	7.4	0.0	0.0	0.0	0.6	0.0	1.2	4.9	7.3	0.0	1.8	1.5
Unselected	85.9	98.1	100.0	97.2	96.0	85.8	96.9	95.0	82.7	97.2	94.9	95.8
Percentage by weight of seed type used												
Certified	0.7	0.0	0.0	1.7	2.3	0.0	1.6	0.0	0.0	1.4	1.3	1.1
Clean	6.0	0.3	0.0	1.1	1.1	14.2	0.4	0.0	5.9	0.0	1.8	1.4
Positive	7.4	0.0	0.0	0.0	0.6	0.0	1.2	4.9	7.7	0.0	1.5	1.2
Unselected	85.9	99.7	100.0	97.2	96.0	85.8	96.9	95.0	86.4	98.6	95.4	96.2
Percentage of farmers growing												
Certified	0.7	3.8	0.0	2.0	1.1	0.0	1.1	0.0	1.6	0.9	1.0	0.9
Clean	3.4	1.3	0.0	1.0	1.1	8.3	1.1	0.4	0.0	0.9	1.3	1.0
Positively Selected	11.7	0.0	0.0	0.0	1.1	0.0	1.1	5.4	4.8	0.0	2.8	2.2
Quality	15.2	5.0	0.0	3.0	3.4	8.3	3.4	5.8	6.5	1.8	5.1	4.1
Farmer	90.3	97.5	100.0	97.5	96.6	91.7	97.7	95.8	96.8	98.6	94.9	96.9

*Zero means use of the type of seed was not noticeable in the district

** National figures obtained through extrapolation

Source: Master plan field survey results (2009)

5.4. Access to Quality Seed and Storage

Survey results indicated that according to farmers the most important attributes that comprised good quality seed were high yields (32%), many healthy eyes (23%), medium to small sized tubers (15%) and seed from a healthy mother plant (12%). Shortage and high prices were the main challenges of accessing good quality seeds, as reported by 40% and 37% of farmers, respectively. Other challenges included lack of knowledge on quality seed (14%) and the distance to the quality seed (12%) with differences that transverse districts. Unavailability of quality seed was a problem to the highest number of farmers in Keiyo Marakwet (55%) and Meru (52%) and to the lowest number in Kiambu (24%), which is close to KARI-Tigoni - the main source of certified seed and other interventions on quality seeds. High seed cost was mainly a problem to more farmers in Mt Elgon (52%) and a lesser problem in Kiambu and Narok where it was cited by only 23% of farmers (Table 5).

TABLE 5: RENEWAL, ACCESS AND STORAGE OF SEEDS

	Meru	Keiyo Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Overall
Farmers renewing seed (%)	32	42.5	52	40	20.5	69	36	39	50	46	40
Seed renewal rate (after how many seasons)	1.7	2	3.5	2.7	3.6	3	3.5	2	2.3	1.9	2.5
Distance to sources of different seed types (kms)											
Certified seed	207.7	205.0	-	87.3	200.0	212.5	114.6	-	7.0	12.1	124.2
Clean seed	28.9	4.3	-	26.0	2.1	175.0	73.4	-	27.2	-	37.3
Positively selected seed	13.0	-	-	-	1.3	-	1.0	16.2	50.7	-	18.3
Farmer seed	7.4	15.9	6.5	7.4	3.4	4.4	2.7	6.2	33.1	8.5	7.9
All seed types	13.7	36.1	6.5	13.5	5.4	32.3	11.4	7.5	35.6	8.6	13.2
Seed storage											
Farmers storing seeds (%)	72	84	89	91	99	100	98	95	89	84	90
Average storage period (days)	44	43	56	48	40	76	67	47	42	72	54
Farmers trained on DLS (%)	11	4	9	2	2	2	3	5	2	2	4
Problems in using quality seeds (% of farmers)											
Seed unavailable	52	55	48	33	37.5	37.5	31	44	74	24	40
Quality seed are expensive	43	45	52	39	23	37.5	49	29	58	23	37

	Meru	Keiyo Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Overall
Lack of knowledge	10	22.5	23	2.5	22	25	14	8	31	18	14
Distance to source of quality seed	5	15	32	14	20.5	25	14	7	21	2	12
Poor roads	1	35	25	1	8	4	0	0.4	0	0	

Source: Master plan field survey results (2009)

On average, the higher the quality of seed the further the farmers had to travel to obtain it. Although distance travelled varied across districts, farmers on average had to travel 142 km to source for certified seed compared to 37 km for clean seed and 18 for positively selected seed. Farmers sourcing for farmer seed travelled the shortest distance (Table 5). This means reducing distance travelled when sourcing seed through improved distribution would be critical in improving access to quality seed.

5.4.1. Willingness to pay and demand for quality seed

On average farmers were willing to pay more for certified, clean and positively selected seeds than for the farmer seed, which indicated that farmers attribute more value to quality seeds and were willing to pay some premium for quality (Table 6). Certified seed emerged as the most valued seed in all districts save in Nyandarua, where farmers valued clean seed slightly higher than certified seed.

TABLE 6: PRICES FARMERS WERE WILLING TO PAY FOR VARIOUS TYPES OF SEEDS

	Meru	Keiyo-Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Total
Mean price (Kshs/kg)											
Certified seed	32.1	29.7	28.8	17.4	13.1	24.2	18.4	17.8	26.1	20.5	18.8
Clean seed	31.0	19.3	20.0	13.1	12.0	19.9	19.1	13.9	33.3	16.3	16.3
Positively selected	25.4	18.8	10.3	12.9	11.2	16.3	16.4	11.9	27.0	12.0	15.7
Farmer seed	22.0	19.2	17.9	9.6	11.1	12.6	12.5	10.4	28.9	17.8	14.9
Proportion of quality seed to farmer seed											
Certified seed	1.6	1.6	1.9	2.0	1.5	2.0	1.8	2.0	0.9	1.8	1.9
Clean seed	1.5	1.0	1.0	1.5	1.4	1.6	1.9	1.8	1.1	1.7	1.7
Positive selected	1.2	1.0	0.7	1.4	1.4	1.3	1.5	1.4	0.9	1.3	1.4
Farmer seed	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: Master plan field survey results (2009)

Proportionately, farmers nationally were willing to pay for certified seeds 1.9 times the price of the famer seeds (Figure 3).

Similarly, farmers were willing to pay for clean seed 1.7 times the price of farmer seed. This indicates that farmers recognized the importance of good quality seed in potato production and were willing to pay a premium for quality seed.

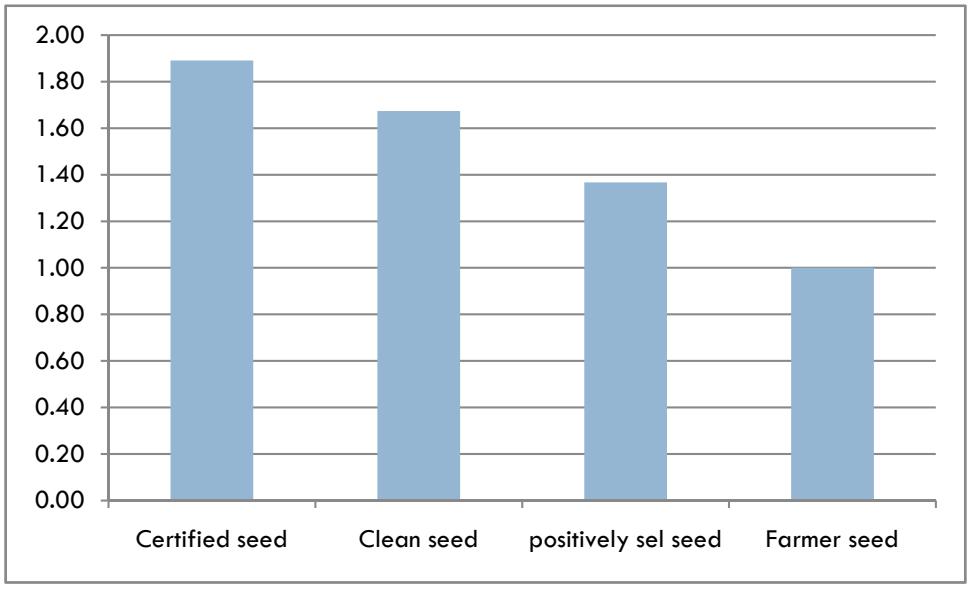


FIGURE 3: PROPORTIONATE PRICE FARMERS WERE WILLING TO PAY FOR QUALITY SEED

To assess the suitability of the elicited WTP in estimating demand a truncated regression model was used. In the regression WTP was used as the dependent variable while a set of explanatory variables were explored to evaluate their capacity to explain the expressed willingness to pay and a few variables were used as controls. Dummy variables representing different communities (districts) were used to control for agro-ecological differences in each community and community fixed effects.

Table 27 shows the results of regression analysis which had a good fit with Wald test, the value of sigma being very significant. The results indicated that having used certified seed previously did not have significant effect on the WTP for the seed. Although this may be surprising, one interpretation could be related to the quality of the "certified" seed experienced before by respondent farmers. Not having a proper high quality seed may have resulted in no increase of potato yields. Another interpretation is that even those who had no experience with certified seed could have the same impression about the certified seed (good or not good) as the people who experienced this seed. The variable that influenced the willingness to pay for certified seed highly is having received training, which would imply that trained farmers were more aware of the importance of a good seed management and were willing to pay more for certified seed.

Although distance of the respondent to the source of seeds seemed to be marginally insignificant it was clear that the further the distance to the seed source, the higher the WTP for certified seed, which could be interpreted as an effect of transport cost.

Surprisingly, being a male significantly reduced the WTP for certified seed, which means that women were willing to pay more for certified seed. The other significant variable is age and the positive sign means the older the respondent the greater the WTP for the certified seed. Having used fertilizer or manure did not seem to affect the WTP.

Using the concept of willingness to pay and the approach used by Rappoport et al. (2002) and Goolsbee (2001) in estimating market demand for broadband services and demand for DVDs the demand for certified seed was estimated based on the proportion of farmers willing to pay minimum of Kshs 25 per Kg. Estimates of WTP are important in providing direct guidance for decisions associated with product pricing, marketing and positioning, and also in guiding public debate. The result indicated that at least 7.4% of farmers were willing to buy certified seed equivalent to 31,677 tons, grown in an estimated 10% of total potato area (Figure 6). Although this was the estimated demand for certified seed in year 2008, the Master plan recognises the challenges of upgrading the level of use from 1% to 10% and used a level of 10% as the targeted level in the five year planning period. The use of a conservative level is borne from the realisation that countries that have invested heavily for a long time in the formal seed sector have had challenges in reaching the level of 10% (Table 26).

5.4.2. Farmer suggestions on how to improve use of quality seed

Key solutions suggested by farmers to improve their use of quality seed included provision of low priced seed (25%), provision of high quality seed (24%), provision of more seed stations (23.5%) and training of farmers on high quality seed (23%) (Table 7).

TABLE 7: FARMER SUGGESTION ON HOW TO IMPROVE THEIR USE OF QUALITY SEED

	Meru	Keiyo_ Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Overall
Provide quality seed at low prices	17	22.5	25	29	9	27	41	23	24	26	25
Avail quality seed	28	34	34	16	19	25	13	28	56.5	20	24
Provide more quality seed centres	17	25	30	28	26	40	30	28	18	9	23.5
Provide more training on quality seed	28	52.5	50	2	26	33	21	21	43.5	16	23

Source: Master plan field survey results (2009)

5.5. Potato related diseases

Bacterial wilt was the most prevalent disease according to 77% of potato farmers, followed by Late blight (67%) and viral diseases (12%) although there were differences across districts. Leaf roll was the most reported viral disease. Viral diseases were widely reported in Mt. Elgon (71.5%) while late blight was reported by the least number of farmers in Kiambu (23%) and by the highest number of farmers in Narok (91%) and Keiyo Marakwet (89.5%) (Table 28). Farmers mainly control late blight by chemical spraying (55%), bacterial wilt by uprooting (41%), crop rotation (36%) and chemical spraying (21%).

5.5.1. Late Blight

Varieties believed to be tolerant to late blight varied across districts, with the highest number of farmers believing Tigoni to be tolerant, especially in Keiyo Marakwet (38%) and Nakuru (27%). Other varieties believed to be tolerant by many farmers are Arka (27%) in Mt Elgon and Dutch Robjyn (20%) in Bomet.

A few farmers (34%) believed they knew how late blight is spread. The most cited method for spreading late blight was infected seed (13.5%), cold and misty weather (10%) and infected soil

(10%) with infected seed most commonly mentioned in Taita (37%), Keiyo Marakwet (31%), Nakuru(27%) and Mt Elgon (20%). Weather is named in Nakuru(21%), Keiyo Marakwet (16%), Nyandarua(14%) and Nyeri(21%) while infected soil is quoted in Taita(32%), Keiyo Marakwet (26%), Nakuru(17%), Mt Elgon (14%) and Bomet(12.5%). Another method referred to is flooding in Keiyo Marakwet(17.5%) and Nakuru(14%).

Late blight control was mainly through chemical spraying (55%) with its use being most prevalent in Narok (89%), Keiyo Marakwet (84%), Nakuru (75%) and Bomet (71%) (Table 29)

5.5.2. Bacterial wilt

Varieties labelled as resistant to Bacterial wilt were Tigoni in Keiyo Marakwet (30.5%) and Nakuru (17%), Arka in Mt Elgon (36%), Dutch Robjyn in Bomet (12%) and Asante in Mt Elgon(11%). More than half (56%) of farmers believed they knew how bacterial wilt is spread. Quite a number of farmers believed bacterial wilt was spread mainly through infected soil (41%) and infected seed (37.5%) with variations in the percentage of farmers citing each method from district to district. Infected seed was most cited in Nyeri (62%) and least in Narok (10%) whilst infected soil was most cited most in Nyandarua(51%) and least in Keiyo Marakwet(22.5%).

In the control of bacterial wilt, uprooting (41%), crop rotation (36%) and chemical spraying (21%) were the main control methods. Spraying was the predominant control method in Mt Elgon (63%), Narok (49%) and Keiyo Marakwet (44%) while crop rotation was the lead control method in Taita (58%), Nyeri (50%), Bomet (46%) and Meru (44%). Uprooting of the crop was the chief method in Nyandarua (62%), Kiambu (47%) and in Nakuru (45%) (Table 30).

The high incidences of bacterial wilt in farmers' fields in the country poses a big challenge in multiplication of certified seeds and calls for creating farmer awareness on measures to control accumulation of the disease. The phytosanitary regulations in the seed certification process provide for zero tolerance for bacterial wilt, while for viral diseases, such as leaf roll, there is some level of field tolerance (<5% of growing potato plants in the field). As a means to control these diseases farm level testing of bacterial wilt and viral diseases using ELISA or field testing kits should be encouraged, especially for seed multipliers. There is a need to create awareness of the importance of using ELISA or field testing kits and the Government should facilitate importation of adequate amounts of the kits, possibly through tax concessions, to make them easily and widely available (possibly to cost less than 1USD per kit).

6. CURRENT AND TARGETED SUB-SECTOR SITUATION

From the district appraisals, the sub-sector is currently characterised by: (1) Lack of national seed plans, (2) Shortage of expertise, (3) Non-sustainable production and distribution system, (4) Low level of private sector involvement, (5) Outdated technologies (use of pots for seed multiplication, field germplasm maintenance [no in-vitro capacity for storage], use of leaf and stem cuttings to clean varieties [thermotherapy facility not in optimal use] etc. , (6) Low farmer awareness, (5) Lack of appropriate regulatory and policy framework, and (7) Malfunctioning of Institutions. This leads to a situation of: (1) Demand for certified and clean seeds exceeding supply, (2) Limited access to certified and clean seeds, (3) High cost of sourcing certified and clean seeds, (4) Uncoordinated production and supply of certified and clean seeds, (5) Wide use of low quality and uncertified seeds, (6) Slow roll out of new and improved varieties, (7) Limited adoption of improved potato varieties.

To change the situation there needs to be investments in the sub-sector, a review of the relevant regulatory and policy framework and an encouragement of more private sector involvement. These interventions will lead to the targeted seed situation where use of certified seed will increase from 1.1% to 10%, use of clean seed will increase from 1.4% to 25% while use of positively selected seed will increase from1.2% to 30% (Table 8). This will improve productivity by 83%, increasing yields from 7.1 tons per ha to 13.05 tons per ha.

6.1. Priority actions

To achieve the targeted situation, the priority actions from the district appraisals and the demand study that should be undertaken include:

1. investment in modern technology of seed production, multiplication, and storage;
2. tapping the existing distribution network within Kenya seed companies and others;
3. establish variety adaptive research at regional levels while maintaining the national coordination to ensure selection and release of varieties suited to respective ecological zones;
4. establish seed multiplication centres at district levels to reduce distance travelled by farmers when sourcing seeds and hence increase access to quality seed;
5. embracing the concept of clean seeds and government legally recognising them as tradable seed, hence exploiting the potential of clean seed to reduce diseases and increase yields;
6. encourage greater involvement of private sector partners who have comparative advantage and capacity for various tasks in the sub-sector value chain that the public sector is not able to perform optimally;
7. creating awareness and training farmers on the importance of using good quality seeds - certified, clean and positively selected seeds, recommended potato management practices, policy and legal guidelines and post harvest handling - through government facilitation and partnering with development agents to disseminate information and improve access to quality seed;

8. involving interested universities and other players in research, production and multiplication of seeds so as to exploit their capacity (multiplication laboratories, expansive land in various parts of the country, research capacity to solve specific problems, etc.);
9. increasing Government's budgetary support to the sub-sector and public institutions in the sub-sector;
10. formation of a Seed Potato Council in form of a National Potato Council to coordinate the sub-sector and carry out any necessary lobbying;
11. reviewing current policy and legal framework to address new challenges in the sub-sector;
12. creating ICT based information centres from where farmers can access relevant information on seed potato in terms of varieties available, seed type, location and prices.

TABLE 8: CURRENT PRODUCTION LEVEL AND TARGETED CHANGES

Potato type	Details	Current status	Targeted status	Comments
Ware potato	Area (ha)	158,386	189,581	20% increase due to increased availability of good quality seed and profitability after improved yields
	Production (tons)	1,123,964	2,467,825	120% due to increased use of good quality seeds and good management practices
	Yields (tons/ha)	7.10	13.02	Improved by 83%
Seed potato	Certified seed (tons)	2,706	37,916	Use increases from 1.1 to 10% due to improved research, production of basic seed, distribution, awareness, private sector involvement, regulatory framework etc.
	Clean seed (tons)	3,494	94,791	Use increases from 1.4 to 25% due to improved training, distribution, regulatory framework, awareness, etc.
	Positively selected (tons)	2,873	113,749	Use increases from 1.2 to 30% due to improved training, distribution, regulatory framework, awareness, etc.
	Farmer seed (tons)	232,830	132,707	Use decreases from 96 to 35% due to increased use of high quality seeds

6.2. Budgetary requirement

The total budget for implementation of the planned activities over the five years is estimated to be Kshs 302.565 million. The budget is spread in three phases that run from 2009-2014. The implementation period is divided into short term (year 1-2), medium term (year 3-4) and long term (year 5). Based on urgency, priority and the time it requires for implementation, activities are either planned for short, medium or long term.

The five year investment in each of the sub-systems varies with the highest investment of Kshs 270.845 million intended for the formal sub-system (and regulatory framework), Ksh 31.745 million for semi-formal sub-system and Kshs 14.650 million for the farmer seed system (Table **9**). The total budget requirement for all the sub-systems and themes in the short term is Kshs 154.710 million, in the medium term Ksh 114.635 million and in the long term Ksh 49.495 million (details in tables 14, 16, 18).

TABLE 9: FIVE YEAR INVESTMENT REQUIREMENT IN SEED POTATO SUB-SECTOR (2009-2014)

System/ function	Short term (years 1& 2) '000	Medium term (years 3&4) '000	Long term (year 5) '000	Overall '000
Formal	129,815	99,715	41,315	270,845
Semi-Formal	13,445	12,120	6,180	31,745
Farmer seed system	10,650	2,000	2,000	14,650
Regulatory & policy framework	800	800	0	1,600
Grand Total	154,710	114,635	49,495	318,840

6.3. Cost benefit analysis of different seed types in current and targeted situation

In the next five years, the area under potato is expected to increase from 158,386 ha to 189,581ha using the annual growth rate of 3.66% estimated from 10 year data from FAO and master plan

survey data (2009) (Table 19). If the recommended interventions are implemented it is expected that there will be increase in use of all types of quality seed and this will lead to improved yields. It is estimated that use of certified seeds will increase from 1.1% to 10%, which is equivalent to increasing acreage under certified seed from 2,706 ha to 37,916 ha; that of clean seed will increase from 1.4% to 25%, which is equivalent to increasing the acreage from 3,494 ha to 94,791 ha; that of positively selected seed will increase from 1.2% to 30%, which is equivalent to increasing the acreage from 2,873 ha to 113,749 ha. This will lead to the area under farmer seed reducing from 96% to 35%, which is equivalent to reducing the acreage from 232,830 ha to 132,707 ha (Table 2).

Although yields from high quality seeds were generally higher than that from farmer seeds they were much lower than the levels estimated by KARI-Tigoni and even the mean yields of positively selected seeds were lower than that of farmer seed (Table 10).

Although yields from certified seeds were the highest (12.7 tons/ha) they were much lower than the expected yields of 25.0 tons/ha estimated by KARI-Tigoni. Similarly, the yields from clean seeds grown by farmers (11.3 tons/ha) were lower than the yield level estimated by KARI-Tigoni. However, this deviation could mainly be due to the fact that although quality of seed is important in determining yields, other factors such as management practices, weather conditions, disease prevalence, and control methods, play equally important roles. Moreover, there is no procedure to guarantee the quality of much of the seeds used by farmers, hence some of the seeds received by farmers as clean and positively selected seeds may fail to pass a quality test if laboratory and/or field evaluated. Yields from positively selected seeds were notably lower than yields from all other types of seeds which possibly could be explained by the fact that interventions were targeted in areas with high disease prevalence.

The low yields from high quality seeds point to the need to accompanying adoption of high quality seed with improved management practice.

At current farmer management practices the gross margins from use of certified seeds (Kshs 101,760/ ha) and clean seeds (Ksh 90,328/ha) are higher than that of farmer seeds (Kshs 42,000/ ha) by more than 110%. Improving management practices under the current level of use of different types of seeds is expected to more than double the gross margin of certified and positively selected seeds while it almost doubles that of clean seeds.

Although at current farmer management practices the gross margin from use of certified seeds per hectare is only about 13% higher than that of clean seed, improving management practices has the potential of increasing the difference to 66% (to Kshs 268,578 and 161,715, respectively).

Under the current situation the total gross margin from the estimated 158,386 ha under different seed types totals to 6.9 billion. Growth of total area under potato in 5 years to 189.581 ha without interventions and maintaining area under different types of quality seeds at the same level would see an increase of the total gross margin to 8.3 billion per year. Increasing area under certified seeds, clean and positively selected seeds to 10%, 25% and 30%, respectively as projected would increase the total annual gross margin to 10.9 billion. However, interventions aimed at improving both quality of seeds and management practices are expected to increase the gross margin to 21.2 billion. Although the benefits of investing the estimated Kshs 302,265 million in the seed sub-sector are expected to be cumulative starting from first year, in the fifth year alone the total benefit is expected to range from 2.7 billion to 13 billion, depending on the innovations and interventions that will take root in the value chain of the seed system. This means the performance of the seed sub-sector will highly depend on the effectiveness of intervention methods used, extent and effectiveness of private sector participation, number of multipliers introduced, level of promotion and awareness creation and the establishment of a distribution and marketing system.

TABLE 10: YIELDS AND GROSS MARGINS OF DIFFERENT TYPES OF SEEDS

	Certified seed	Clean seed	Positively selected seed	Farmer seed	Total
Per hectare details					
Farmer yield (current)	12,741	11,285	9,567	6,894	7,138
Expected yield with improvement in mgt	25,000	17,500	11,500	7,700	8,354
Seed rate (kg/ha)	1,125	1,367	1,463	1,515	1,506
Seed price (Kshs/kg)	32.5	28.0	18.5	14.7	15.6
Ware Price (Kshs/kg)	14.5	14.5	14.5	14.5	14.5
Total revenue (Kshs/ha)	184,743	163,635	138,722	99,963	103,504
Input costs (Kshs/ha)*					
Seeds	36,521	38,212	27,080	22,292	23,528
Other costs	24,739	24,739	17,039	17,039	17,335
Total input costs	61,259	62,950	44,119	39,332	40,863
Labour costs					
Hired labour costs only	8775	8775	9900	9900	9,857
Hired & family costs labour	16425	16425	20025	20025	19,887
Total costs (with hired labour cost only)	70,034	71,725	54,019	49,232	50,720
Total costs (with hired and family labour costs)	77,684	79,375	64,144	59,357	60,750
Gross Margins (Kshs/ha)					
Gross Margin (with hired labour costs only)	114,709	91,910	84,703	50,731	52,784
Gross Margin (with hired and family labour costs)	107,059	84,260	74,578	40,606	42,754
Gross Margin (with improved practices)	273,163	162,468	92,984	43,390	51,275
Current national scenario					
Current area	2,218	2,913	3,634	149,621	158,386
Gross margin '000,000	237	245	271	6,075	6,829
G M after 5 years with not interventions (3.66% area growth)	284	294	324	7,272	8,105
Targeted national scenario					
Percentage of area under the seed type	10	25	30	35	100
Area under the seed type	18,958	47,395	56,874	66,353	189,581
Gross margin (Using current practices)	2,030	3,994	4,242	2,694	12,959
Gross margin2 (Using improved practices)	5,179	7,700	5,288	2,879	21,046

*Used input costs from adoption study conducted in 2005 (Kaguongo et al., 2008) after adjusting for inflation

7. TARGETED CHANGES IN THE SEED THEMES

7.1 Seed Potato Sub-Systems

The current seed potato sub-sector comprises three main sub-systems: formal, semi-formal and farmer seed sub-systems. These sub-systems consist of several channels and have various actors playing distinct roles in the five main functions or themes of the systems - research, production, certification, multiplication and distribution. Figure 4 illustrates the current situation of the three sub-systems and the existing actors and their functions while Figure 5 depicts the targeted outcomes when the seed sub-systems are improved.

FIGURE 4: CURRENT SEED POTATO SUB-SECTOR FRAMEWORK

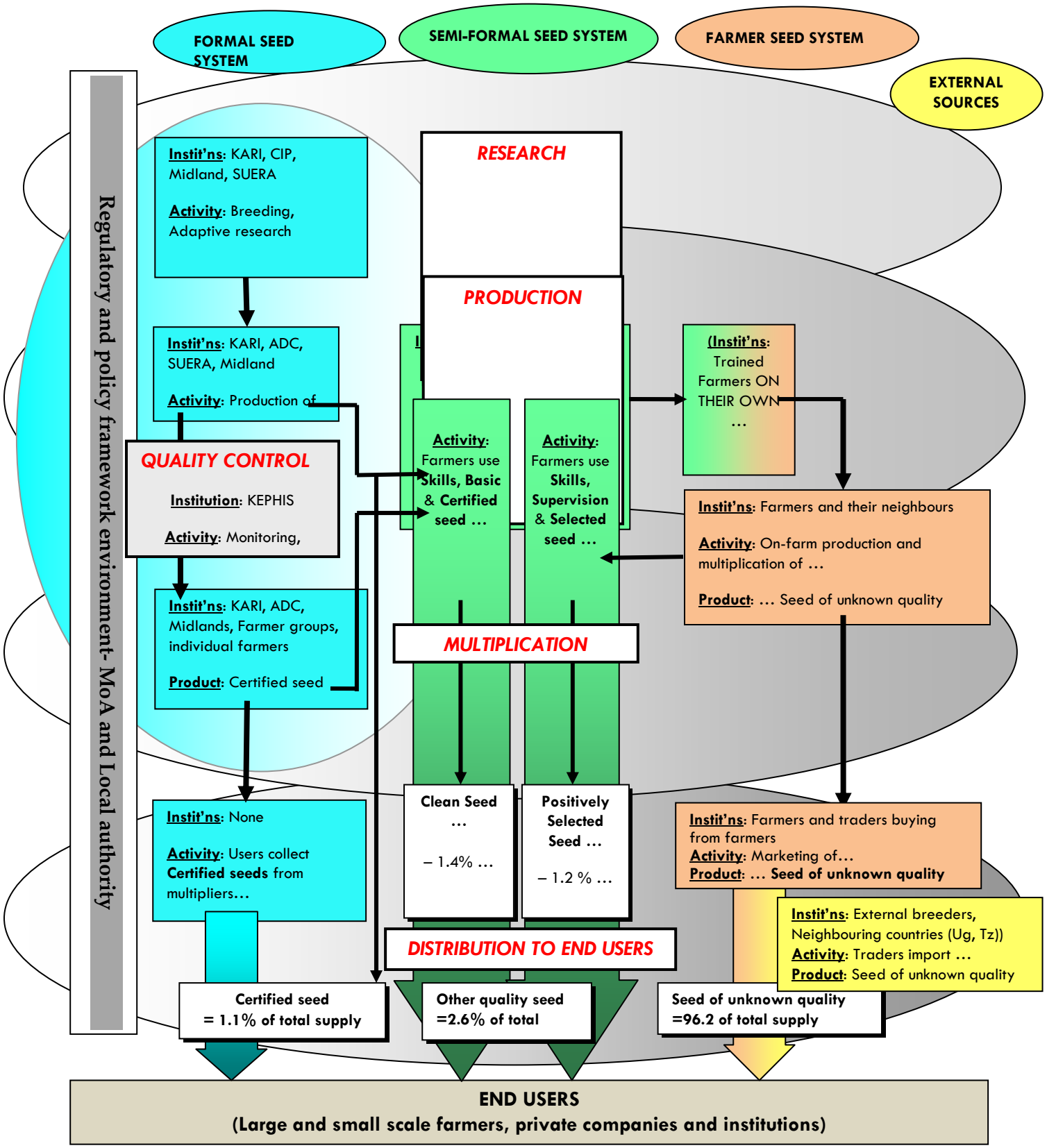
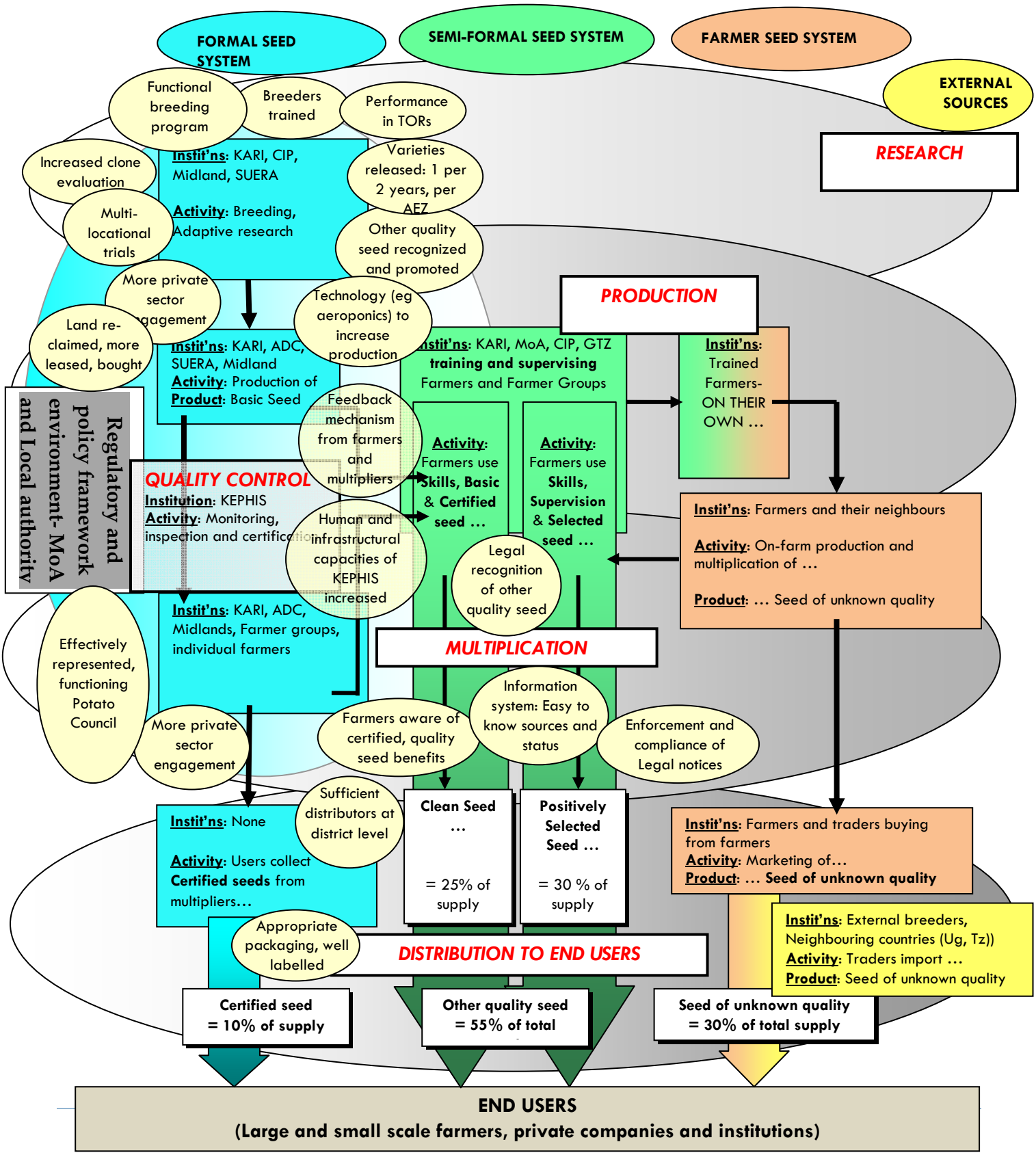


FIGURE 5: TARGETED OUTCOMES OF MASTER PLAN



7.2 Formal Seed System

This system is characterised by official rules through laws and guidelines from government departments. It has evolved over the years from various projects and programs funded by government and other development partners. Over time the programs have created institutional structures whose effectiveness and efficiency has declined over time due to lack of funding, policy and other institutional support. SWOT analysis was conducted on the actors and institutions working in the five themes of the sub-system (Appendix 5).

7.2.1 Research

Potato research themes include breeding, seed technology, agronomy, crop protection, post harvest and adaptive research. Breeding involves accessing breeding materials, evaluating them and releasing them to the farming community. Currently, seed potato research is dominated by CIP and KARI-Tigoni - they are the main bodies involved in potato research in the country and remain the major sources of breeding materials. CIP mainly provides new improved varieties (currently from population B that has minor gene resistance to critical diseases), helps clean existing old varieties and provides technologies and technical support to KARI. KARI-Tigoni carries out testing and evaluation of the breeding material, recommends varieties for release and cleans and maintains varieties.

7.2.2 Adaptive research

The Breeding program evaluates germplasm on-station and those that are promising are further evaluated off-station in adaptive trials. These are multi-locational, on-farm and National Performance Trials (NPT) that test varieties across agro-ecological zones to allow for variety release. NPT's and multi-locational trials by KARI and other partners have been revitalised to ensure region specific varieties but funding for these trials is erratic, inadequate

and varies from season to season. The centre has eight promising clones that it has in the last season put under National Performance (NPT) and Distinctiveness, Uniformity and Stability (DUS) tests for possible release, but it has erratic and unreliable funds for these activities. These NPTs are currently supported by CIP.

KARI-Tigoni's limited capacity makes it incapable of releasing to the farming community those varieties that have undergone testing and it is unable to evaluate larger quantities of germplasm. In 2002 four varieties were pre-released but have not been officially released to-date since the centre is unable to produce the mandatory 10 tons per variety required for a variety to be released. Moreover CIP (Lima) currently has over 350 germplasm accessions with superior qualities that have not been tested and evaluated in Kenya due to KARI's limited technical and financial capacity.

Private institutions involved in adaptive research are Midland and Suera companies who have imported breeder seed and evaluated them in the country. Midland imported four varieties from Holland which were tested by KEPHIS for three years for phytosanitary requirements and were released to Midlands in September 2008 to bulk enough seed for NPTs and DUS.

In the short term there is need to complete the current CIP supported NPTs so that varieties are released. It is envisioned that NPTs will be institutionalised, prioritised and allocated adequate funding from Government so that the variety release process is uninterrupted and has an output of at least one variety every 2 years. In the medium term there is need to synchronise market and production needs with research objectives and output so that the varieties are released and the research is carried out is in line with what the farmers and markets are demanding. There is thus need to develop an information system that can capture supply and demand information to support this synchronisation.

In the long term there should be a push for policy changes that allows the use of centre-collected revenue as a revolving fund that can support the research activities and it may even become

necessary to de-link KARI-Tigoni from the Ministry and the larger KARI if increased autonomy could be structured to enhance timely and effective decision-making for increased efficiency.

7.2.3 Breeding

Breeding involves carrying out variety development and also accessing breeding materials and evaluating them on station and later carrying out adaptive trials. The centre's variety release rate is too low with the last two variety releases having a 10 year interval (1988-1998) - this has been partially attributed to erratic, low funds, as well as high staff turnover. In the last 16 years there have been five breeders working for an average of three years, which is a wholly inadequate time to breed/evaluate and release a variety. This high turnover has led to an ebb and flow of activities as each new breeder familiarises him-/herself with the activities before starting to implement activities, and in some cases first has to seek funding before starting any substantial work. The turnover has also resulted in germplasm accessions getting lost or destroyed in the interim handover period after one person has left and the other is either not in place or is not yet fully in control of the program. There are currently two breeders in the program who are responsible for the activities, with one having been recently hired, but there are no technicians in the program as those who left were not been replaced. This means that the breeders must personally supervise all their field operations at all their sites and also collect all their data in addition to their breeding activities.

Another constraint is that Tigoni does not develop its own varieties and instead relies on CIP for development and selection of lines. This is despite Tigoni having the facilities required for breeding and there being a need to improve varieties that farmers have as well as those coming in from other sources.

In the short term the program needs to focus on adaptive research and cleaning for varieties that have the preferred qualities for the targeted market. There is also a need to urgently hire

technicians to support the breeding program. In the medium term there is need to develop an information system to capture farmer and market requirements so that the varieties released match up with what the farmers and markets are demanding.

In the medium and long term there is a need to continuously equip the breeders with skills so that they can gradually improve on weak attributes of those varieties that are popular with farmers and the market. In the long term it is envisioned that breeding of new varieties would go hand in hand with variety adoption so that the requirements of the Kenyan farmer and market for varieties is adequately tackled.

7.2.4 Other research

Other research activities at KARI-Tigoni involve seed, agronomy, crop protection and post harvest research that inform the production and processing process and it is also characterised by irregular and erratic flow of funds. There is also poor information flow between researchers, MoA extension officers and farmers, despite the existence of research-extension liaison offices. The research-extension liaison officer is mainly expected to provide a link between the MoA and research but their task is limited to the initiatives of the MoA office at which they are based and the research institutes that are interested in having activities with them, so that researchers often go directly to the farmers with their technologies without involving them. They often do not get the latest research findings as there is no protocol requiring their engagement in the process by research institutes. There is thus a dire need to strengthen and clearly define the linkage and the operational tasks to be performed between and by research and extension, to ensure that farmers get the latest technologies and training in potato production.

Other organisations that have been involved in potato research include JKUAT, Kenya Seed Company and other universities (e.g., Nairobi). JKUAT has been involved in germplasm

conservation in collaboration with CIP as well as in seed, agronomic, crop protection and post harvest research using students as part of their academic requirements, as has the University of Nairobi, but both have experienced problems of low funding levels. These research efforts from the universities tend to be uncoordinated, since students work on areas for which funding is available or of interest to them or their professors. Kenya Seed Company had carried out research on true potato seed in the early 1990s, in conjunction with KARI-Tigoni, with the anticipation of releasing TPS progenies for commercial use by Kenyan farmers, but this was curtailed by failure of the seed material to meet the Distinctiveness, Uniformity and Stability (DUS) requirements, lack of finance and personnel.

In the short term there is need for government commitment in the form of funding and harnessing partnership with development agents and NGOs to boost research in priority areas of potato production, post harvest handling and marketing.

In the medium term KARI-Tigoni should seek to incorporate private sector research partners and in the long term there should be lucrative Intellectual Property Rights (IPR) policies in place that attract the private sector. IPR policies would govern the treatment of intellectual property in the production of deliverables by the private and public sector partners and would specify how the various parties would benefit from these rights. In the medium and long term a potato council should be formed with private and public sector representation from the district level to articulate and lobby for potato issues. The potato council would also put recommendations forwards for potato research initiatives.

7.2.5 Basic seed production

The second role of KARI-Tigoni is to produce basic seeds for onward multiplication and distribution. However since KARI-Tigoni's inception, the centre's production of basic and breeder

seed has oscillated up and down over the years and the volumes produced have not exceeded 1% of the national seed requirement. For the last eight years KARI-Tigoni has only managed to produce a maximum of 77.5 tons of basic seed per year (Table 24) which would be expected to produce a maximum of 7750 tons of certified seeds after multiplication for at least two seasons. This amount of certified seeds is much lower than national requirements. The fact that more than 70% of basic seed produced at KARI-Tigoni ends up being farmer seed for ware production rather than for multiplication makes this channel inefficient and costly and further reduces certified seed available to farmers. Basic seed is used to produce ware potatoes mainly due to two factors: i) most(>50%) basic seed is sold to farmers in Kiambu district (Karinga et al., 2006) which is in close proximity to Nairobi and they have a ready market with retailers (grocery shops/institutions) that pay a price premium compared to the wholesale market where potatoes from other parts of the country trade, ii) the cyclical nature of potato production means that during periods of potato scarcity the price of ware potatoes soar, making the ware market a sure and alluring option compared to seed whose market would be months away and uncertain, as seed may be source-able from other parts of the country. Increasing the cost of basic seed so as to discourage this use would likely price them out of the reach of non-Kiambu farmers and would kill seed sales, as production is a risk venture (seed and ware price is never assured as it depends on what is happening in other production regions, the weather and the disease pressure).

In the short run an ad-hoc committee (that includes KARI-Tigoni, KENAPOFA, ADC, KARI, Ministry and KEPHIS) is necessary to help distribute the current basic seed being produced using clear, transparent and sustainable allocation criteria. In the medium term the allocation committee functions should be streamlined and handed over to the Potato Council. The committee and council should then develop a long-term allocation system and process.

Another fundamental institutional problem of KARI-Tigoni is the annual cycle of budgeting for seed production, where production is based on an allocated budget instead of the national seed

requirements. Other important limitations include land and personnel. Currently, Tigoni has only 50 acres from an initial 240 acres and it recently got back an additional 17.5 acres. The centre achieves only three acres of seed potato per season from Tigoni and an additional 1-3 acres from its sub-centres, and this land is too little to meet demand. Tigoni and its sub-centres have a combined total of 420 acres of unused land which translates to 70 acres per season for a three year rotational program. However, the centres lack irrigation facilities to ensure scheduled production and multiplication of seeds without interruption by increasingly unreliable and inadequate rain. The centre currently has a staff capacity of 10 researchers (with at least BSc qualifications) and has a deficit of seven researchers, including a seed technologist. It also has 12 technicians with a deficit of 4 (Parliamentary question No.316 of 2008).

In the short-run, the centre should concentrate on adaptive research and production of basic seed and avoid selling basic seed directly to end users; also, it should adopt out grower models with farmers and farmer groups in addition to using its other sub-centres that currently have a total of 70 acres of unused land per season, with a three year rotation. Moreover, ATC's which are under MoA have some land that could be strategically used to produce potato seed at district levels e.g. Mt. Elgon, Keiyo/Marakwet, Nyandarua, Kiambu, Taita Taveta and Nyeri, which can provide viable land for certified seed production and multiplication. To enable KARI-Tigoni to perform optimally in the medium term the centre needs restructuring and some budgetary support (capital and operations) that will enable expansion of personnel, infrastructural and technological capacity which will help improve the centre's performance in executing its mandated roles (Table 12).

In the long term, the institution needs capital investment that will help expand and increase working laboratories, acquire modern equipment and technologies, research land and increase outreach centres to ensure better adaptability tests (higher degree of specificity), adequate production of basic seeds and wider distribution and reduction of transaction costs.

In the short term the supply chain should be strengthened and actors (especially the out-grower farmers) monitored and incentives put in place to encourage compliance to supply chain terms and to ensure that only minimal quantities of basic seed are diverted for ware production. Technical support should be enhanced in a semi-formal system to help support farmers and farmer groups in increasing production of both clean and positive seeds as a stopgap measure as other remedial measures are taken to help increase basic seed production in the medium and long run.

To help fill the gaps in the sub-sector CIP and GTZ are helping disseminate modern technologies that will improve testing, multiplication and distribution of quality seeds. Currently, with backstopping and funding from CIP, GTZ and USAID, KARI-Tigoni is in the process of adopting modern basic seed production techniques. The centre has just started using it recently constructed aeroponics facility to enable it produce large quantities of mini-tubers in a shorter time. CIP, GTZ and USAID are also facilitating the participation of the private sector to help fill existing gaps in the sub-sector.

7.2.6 Seed potato multiplication

Multiplication entails bulking of certified seed potato. After production of basic seed it is important to further multiply the seed to increase the quantities and reduce the cost of seed production. Although there are a few seed multipliers (who include ADC, few farmers, farmer groups and institutions) the bulk of the basic seed produced by KARI-Tigoni (over 70%) ends up being used for ware potato production as ADC has a maximum requirement of 26 tons. Out of 59 tons produced in 2008 by Tigoni, ADC received only 1.3 tons. In order to ensure certified seed is available in the amounts required, Government, KARI, CIP and the private sector will need to invest more in modern technologies (aeroponics) to hasten the multiplication process in order to produce enough basic seeds of new and superior varieties and of old varieties that are in high demand.

The Agricultural Development Corporation (ADC) is a Government parastatal with the mandate for multiplication and bulking of seed potato, with KARI-Tigoni as its specific seed source for breeder seed. ADC uses the out-grower model to facilitate multiplication. However, due to financial constraints they only have two out-growers with a production capacity of 5 ha. Annual production has oscillated at around 425 bags/ha (50kg bags) with 1989 having the best performance with a production of 750 bags/ ha. The production estimates for 2008/09 were 25,000 bags of 50kgs and it aims to increase its production to 42,000 bags in the next 5 years. ADC owned three farms in the Molo area, i.e Sirikwa, Tall trees and Nyota, with a total acreage of about 12,000 acres. However, after land was allocated to individuals in the 1990s only 150 acres remained in Sirikwa. Recently the Government purchased about 700 acres and funded the rehabilitation of the potato cold store and built a tissue culture laboratory to enable the corporation to fulfill her potato mandate, but the land is still not adequate as ADC requires 3,000 acres for effective seed potato production. Due to rotational requirements only about 100 acres can be used at a time. Currently ADC has no organised distribution system and farmers have to travel to Molo for their seed. In order to get fully operational in the market, ADC may need to use or appoint stockists for distribution of seed potato and also liaise with DAO's in potato production areas and avail lists of varieties, quantities and prices every season. Additionally, ADC will have to increase her out-growers and have them spread over the potato producing regions. Furthermore ADC has a cold storage capacity of 2,000 metric tons.

Midland limited company is an agro-processing company concentrating on the temperate climate horticultural and industrial crops. The system of seed multiplication adopted by the company is that of out-grower contracts similar to ADC**.** They produced 16,000 bags (50kgs) of certified seed in 2008. The company's challenge is predominantly with its out-growers, who are geographically dispersed, leading to high overheads for the company. The out-growers also produce at less than

optimal yield levels due to their meagre potato production knowledge, but the company's business outlook is positive.

Kenya Seed Company; a quasi government parastatal, in collaboration with other partners, could be involved in seed multiplication using the same out-grower model as the one it uses for seed maize. Kenyatta University also has a farm in Embu that they could use for certified seed production as a teaching field and as part of their income generating activities.

To oversee and monitor activities of all these possible actors an efficient seed monitoring system should be established through collaboration of the seed multipliers, certification agencies, and the law enforcers. This monitoring system should be entrenched in the seed production and marketing system to regularly monitor adherence to guidelines and standards by players in the industry.

In the short term, it is recommended that no basic seed should be sold directly to farmers for ware production but the seed should be supplied to the multipliers (ADC, KARI and private seed merchants) with multiplication decentralised to reduce transportation costs and to involve other players besides ADC, KARI and the ATCs. In order to determine the suitable seed multiplication areas a remapping is recommended as climate change has resulted in hitherto disease-free areas becoming disease prone. In the medium term, the capacity of the existing public seed multipliers (KARI and ADC) should be enhanced in terms of irrigation facilities and modern equipment to ensure that production of certified seed is not dependent on availability of rain. The quantities and scheduling of basic seed production of different varieties should be improved and matched with multiplication which should also be synchronised with variety and seasonal demand of potato producing districts. The multipliers should also have access to affordable credit (e.g. from Equity bank, AFC etc.) to enable them expand their seed multiplication businesses.

7.2.7 Seed Potato Certification

Certification is the quality assurance provided by an independent and recognized authority. In Kenya, seed certification is mandatory for any seed packed for sale. Additionally, potato is classified as a scheduled II crop, hence it is under mandatory certification. Kenya Plant Health Inspectorate Service (KEPHIS) is a Government institution with the seed certification mandate. The body is mandated to supervise and carry out Distinctiveness, Uniformity and Stability (DUS) tests and National Performance Trials (NPTs) before officially releasing and allowing commercialisation of any varieties. The greatest challenge faced by KEPHIS with potato seeds is mainly in enforcing the law. This is due to the vacuum created by inadequate quantities of seed potato in the country, prompting unorthodox ways and players to seek to fill the void by importing tubers (either by exploiting loopholes in the existing legislation or illegally) from other countries, contrary to the spirit of the Seeds and Plant Varieties Act. Another challenge is the increased interest in True Potato Seed (TPS[5]) which has been a challenge due to the regulations, as the law requires them to go through the established variety release system which is not suitable for TPS since TPS progenies are not uniform and thus cannot meet DUS tests. KEPHIS currently does not have sufficient capacity or personnel at the plant quarantine facility to cope with the workload that is coming in from various industries and players because the current 12 seed inspectors and its Plant Quarantine Station (PQS) serve all the crops in the country. The PQS also lacks the capacity for testing of some potato viral diseases e.g. Potato spindle viroid.

There have been plans to expand both the staff capacity and laboratories of the institute in its outreach centres (Nakuru, Kitale, PQS-Muguga, Embu, Mombasa and in Nairobi) so as to address the country's growing needs. This planned capacity enhancement is long overdue and with the envisaged expansion of seed potato sub-sector, where wide use of out-grower model is expected,

[5] TPS is botanical seed derived from berries of potato plants. Each seed is biologically different from the other but potato varieties selected/bred for commercial TPS use give progenies that are relatively uniform but each progeny is still genetically different from each of the others (and thus not uniform) unlike tubers of the same variety which are genetically identical and thus uniform

KEPHIS will need to speedily increase its staff capacity countrywide as well as accredit trained institutions or individuals to help in timely monitoring and efficient inspection. This calls for speeding up of the current on- going but slow review of the Seed and Plant Varieties Act (cap 326).

In the short run, the Seed and Plant Varieties Act (cap 326) should be reviewed in order to allow certification by third parties on behalf of KEPHIS as this would greatly support the seed potato industry. In the medium term, institutions and individuals capable of implementing KEPHIS mandate should be identified and given accreditation after acquiring necessary skills and expertise.

7.2.8 Certified Seed Distribution

For the formal seed system this function was previously carried out by KFA, Kenya Seed Company and farmer cooperatives. Due to scarcity of seed and collapse of the distribution system, users currently collect certified seed directly from multipliers and sometimes from KARI centres. KFA went under in 1992, despite its good distribution network, and currently most of its activities are on hold due to financial problems. KFA is currently indebted and requires about Ksh 2 billion to pay creditors, especially banks and staff salary arrears.

Kenya Seed Company has 180 agents spread out in the entire country. These include institutions such as KFA, cooperative societies and numerous chemical companies. The company also has about 4000 stockists spread in different parts of the country. The company, in collaboration with other partners, not only has the capacity for seed multiplication using the same out-grower model as the one used with seed maize but can also effectively use its well established network for seed potato distribution - a move that would ensure that seed potato is availed at closer sources for the farmers throughout potato growing areas in the country. This will remove the burden of the

farmers having to travel to ADC-Molo and KARI-Tigoni to buy seed, taking into account the perishability and bulkiness of potato seed which increases transport cost significantly. Currently, transport cost averages 5 cents per kg per km which makes seed potato too expensive for most farmers.

Appointment of seed stockists and other input suppliers by institutional seed multipliers (e.g. ADC) as potato seed distributors will be key in availing seed closer to farmers and thus reduce seed sourcing cost. The distribution system will need to be backed by an efficient communication and marketing system that also links all the players (KARI, CIP, GTZ-PSDA, multipliers, MoA, KENAPOFA and farmers).

In the next five years, it will be important to invest in cold storage facilities at the district level in order to handle excess seed potato produced from one season to another to help maintain quality and stabilise prices. These stores should be owned partly or fully by those farmers using the facility in the area, controlled by these farmers and of direct benefit to the same farmers. This will ensure that ownership rights are as much as possible in the hands of farmers. An annual national potato trade fair, where seed stockists, multipliers and other players will participate, would be very useful in promoting the use of high quality seed through creating awareness and marketing. The road network is also key to seed distribution as well as production and marketing of farm produce, and, in this regard, Government and other development partners will need to set funds aside to ensure that there is a good road network linking the potato producing districts to main markets.

In the short term efforts should be made to establish major seed potato outlets (stockists, cooperatives etc.) in the growing localities to encourage them to stock seed of varieties that farmers

want in differently sized packages (5, 10, 20, 50 and 100 kgs). These outlets should increase in number and scope in the medium and long term.

7.2.9 Use of certified seed

This is the level of use of certified seeds by individual farmers, farmers groups and institutions. Only about 1% seed used in the country is certified seed. The majority of farmers know about quality seed but they have problems accessing these seeds. In addition they also lack technical know-how on how to produce good quality seed. The majority of farmers know the importance of using good quality seeds but lack access, leading to about 94% of them using poor quality seeds from their own or neighbouring farms. For the vast majority of farmers, certified and good quality seeds reach them when sourcing for new varieties as most do not renew seed as part of their production process. For example, only 40% of farmers reported renewing seed after two to four seasons (Table 5). Although farmers are willing to pay some premium for quality seed most of them believe that available good quality seeds are overpriced. Sources of the limited certified seeds available are far from the users and the few small scale farmers who are determined to use them have to team up and source seeds as groups to reduce transport cost. Currently the farmers are travelling an average distance of 124 km to source for certified seed and paying transport cost of about 5 cents per kg per km which makes them too expensive. A large proportion of small scale farmers cannot afford the 50 kg bag of seed potato and would prefer seed to be packed in smaller packages of 5, 10 or 20 kgs.

There is need to increase awareness and availability of certified seeds to improve use by small scale farmers.

Table 11 below shows details of challenges and opportunities in current status of the formal subsystem and the targeted status. This is followed by Table 12 which shows the recommended

activities, actors and budgetary investment required in the short, medium and long term to move the subsystem from current status to targeted status.

TABLE 11: CURRENT AND TARGETED STATUS IN THE FORMAL SEED POTATO SUB-SECTOR

Current			Targeted
Status	Challenges	Opportunities	Status
RESEARCH			
1. Adaptive research => at KARI-Infrequent variety release (4 pre-released in 2002, 3 released in 1998 and 3 released in 1988)	1. Land shortage leading to bulking problem	1. There are emerging technologies that do not require much land-Aeroponics 2. The government has initiated a land re-claim process 3. There are several other KARI centres in different locations (Embu, Kitale, Oljororok, Njoro and the Matuga sub-centre at Shimba hills) as well as Tigoni sub centres(Njabini, Marimba, Marindas) that could be used for adaptive research 4. There is land available to buy or lease in various parts of the country	1. Release the 4 pre-released varieties (K. Karibu for crisps, K. Sifa for chips, K. Faulu for frozen chips, K. Mavuno for chips and mashing) 2. Release 1 variety every 2 years for each agro-ecological zone 3. All released varieties are available to multipliers that demand for them
	2. Intermittent and inadequate funding- (a) in 2007/08 KARI-Tigoni had budget short fall in recurrent expenditure of 7,273,840 from a budget of 9,857,440 (b) Current multi-locational trials have 15 clones in 4 sites that are run erratically based on funds availed and NPTs have	1. Current government good will in the sub-sector that could translate to seed potato policy to support sustainable funding (Core funding & not fully donor dependent) 2. Private sector has shown interest in adoptive research and this could compliment programs at KARI-Tigoni 3. There are emerging technologies (such as Aeroponics) that can be used to rapidly multiply varieties to get sufficient seed quantities for NPTs	1. Number of clones being evaluated increased from less than 90 to more than 1,000) 2. Should have an improvement program for farmer varieties (none in place now) 3. Multi-locational trials in all the important potato growing agro ecological zones every season 4. At least 10 promising clones in NPTs every season in all the important agro ecological zones 5. Policy message

Current			Targeted
Status	Challenges	Opportunities	Status
	just started with 8 entries (of which 2 are checks) in 6 sites 3. Insufficient seed quantities to allow for the planned 10 varieties in the NPTs 4. Lack of varieties well adopted to some regions		developed from master plan study and used to make urgent appeal for government commitment and funding 6. Private sector partners participating in research
=> Private sector- -Only 2 private companies involved (Midland, Suera)	1. Quality control in private sector is difficult to enforce	1. An internationally recognised regulatory authority exist (KEPHIS) 2. Adoptive research by a regulated private sector could improve frequency of variety release 3. There is a need for a Public-Private-Public Partnership (PPP) initiative and policy that could be brought to drive productive partnerships	1. Use the PPP policies to enhance or increase involvement of regulated private sector 2. Release 1 variety every 2 years in every ecological zone
Breeding at KARI- no variety crossing has taken place in the last 10 years (focus has been on adaptive research)	1. High staff turnover (5 different agronomists/breeders over the last 16 years working for an average of 3 years before leaving) whose remuneration is based on research outputs (mainly publications)	1. There is only 1 breeder who can be trained to breed and release the minimum breeding targets as part of his terms of service (the other is almost retiring) 2. Improve terms of service of breeders	1. Functional breeding program 2. Breeders trained on modern technologies who are highly motivated 3. Breeding deliverables incorporated in breeder's TORs and performance deliverables
	1. Breeding/ adaptive program is donor dependent 2. Inadequate	1. Current government good will in the sub-sector that could translate to seed potato policy supporting stable and sustainable funding (non-	1. Sufficient and stable funding for core research activities 2. Adequate personnel and infrastructure

Current			Targeted
Status	Challenges	Opportunities	Status
	personnel and infrastructure	donor dependent) 2. Seed potato master-plan study in the process of being completed	3. Policy message developed from master plan study and used to make urgent appeal for government commitment and funding
	1. KARI-Tigoni is a quarantine station that cannot be used for selection against bacterial wilt and virus diseases	1. KARI-NARL has in the past been used for disease breeding/selection but it has insufficient capacity (human and infrastructural) currently to do this	1. Selection/breeding against all the major diseases not just late blight
Other Research -KARI, Universities and other research bodies like ICIPE carry out research that informs production, disease monitoring and storage	1. Uncoordinated research initiatives 2. Insufficient funds for research 3. Poor linkages between researchers and MoA/farmers	1. Technical capacity is available in KARI, CIP and Universities 2. Existing and new stakeholders can be engaged to prioritise and coordinate research 3. Existing development partners are willing to support research 4. There is renewed Government interest to support potato sub-sector research and development (and this seed master plan is a case in hand) 5. Linking forums exists	1. Sufficient funds for research 2. Policy message developed from master plan study and used to make urgent appeal for government commitment and funding 3. Potato council with representation at district and national level (private and public sector) to inform the industry 4. Coordinated research activities 5. Effective linkages between researchers and MoA/farmers
PRODUCTION			
Status	**Challenges**	**Opportunities**	**Status**
1. Basic seeds-Limited basic seed in terms of quantities, varieties, distance to	1. Insufficient quantities from KARI-Tigoni (59.15 tons in 2008)-most of which goes directly to	1. Technologies capable of reducing production generation gaps are now available–Aeroponics (that produces 50 mini-tubers from 1 in vitro plantlet) in every season and requires 2 field	1. Use aeroponics to increase supply that will meet demand for basic seeds by multipliers-to increase area under certified seed to 10% 2. Rapid multiplication

Current			Targeted
Status	Challenges	Opportunities	Status
the source and location specific varieties	farmers (ADC max requirement is 26 tons) 2. Use of obsolete technologies 3. Use of pots where 1 in vitro plantlet produces about 5 mini-tubers 4. Slow process from in vitro plantlets to basic seed involving 5-6 field multiplication	multiplications 2. Other good quality seed such as clean and positively selected seeds can be promoted and used for emergency redress 3. .Under-utilised capacity in private sector	with few field multiplications that allows for a faster "flush out" system 3. Use, recognise and promotion of other quality seed besides certified seeds
	5. Basic seed sold to users instead of multipliers 6. Irregular allocation of available seed in a non-transparent fashion	1. Existing and willing multipliers to be recruited 2. There is extra land in various government institutes that can be used strategically to increase production 3. There are already some stakeholder forums and additional ones can be established to allocate seed transparently	1. Basic seed sold only to strategic seed multipliers in the potato producing districts 2. Multipliers receive quantities' of basic seeds that they require
	7. Not all varieties required by multipliers are available	1. More effective technologies, varieties and expertise (CIP, KARI, GTZ, etc) are available 2. Knowledge on planning and scheduling of quantities and varieties available at KARI 3. Existing information dissemination channels can be used to enhance communication between KARI and the multipliers	1. Sufficient quantities of basic seed (900 tons annually) of the required varieties 2. Feedback mechanism from farmers and multipliers to allow matching of seed supply to demand-qty & varieties
	8. Mistrust between private and public sector partners to deliver quality seeds	1. There are stakeholder forums and additional ones can be established to build trust	1. Effective working relationship between sector players

Current			Targeted
Status	Challenges	Opportunities	Status
1. Only certified seeds of a few varieties is available (Asante, Tigoni, D.Robjyn, K. Sifa, K. Karibu)	1. Lack of certified seed of the varieties preferred by the farmers and the market	1. Technologies that can speed up cleaning, multiplying and release of varieties exist	1. All varieties preferred by farmers are available as certified seed within the next 5 years
1. Production based on allocated budget instead of national requirement	1. Insufficient quantities of a few varieties multiplied	1. Budgeting expertise is available 2. National master plan is available	1. Implementation of national master plan with budgetary allocation from Government and support from development partners
MULTIPLICATION			
1. Bulking of basic seed to produce certified seeds is done by few farmers, farmer groups, ADC, and Midlands (currently only 5 ha are used by out growers at ADC)	1. Centralised multiplication (Tigoni, ADC Molo, Oljororok, Njabini, Meru, Embu) 2. Minimal quantities of basic seeds reach multipliers-(only 1.3 tons out of 59 tons of basic seed-in 2008) 3. High distribution/ sourcing costs	1. KARI-Centres, ATC, Universities, willing farmer and farmer groups can be used to increase multiplication 2. There are willing universities with land that can be used for seed multiplication	1. Most of the seed multiplication to be undertaken by private seed companies. 2. Decentralised Basic seed multiplication centres to reduce distribution costs e.g. Marimba in Meru, Wambugu ATC, KARI Ol jororok, Njabini 3. Decentralise seed multiplication by contracting more out growers to cover at least 200 ha per major growing district for the short-run.

Current			Targeted
Status	Challenges	Opportunities	Status
			4. Functioning seed potato distribution system
	4. Minimal private sector involvement (only Suera and Midlands)	1. More private sector partners willing to participate	1. Involvement of more private sector partners of at least 2 companies in a district
	5. Few farmer groups involved in seed multiplication (not more than 2 groups per district)	1. Existing Common Interest Groups(CIG) in the producing districts that can be involved in seed multiplication	1. At least 5 farmer groups involved in seed multiplication in the potato producing districts
	6. Seeds arrive late when season has already started	1. Availability of water conservation and storage technologies that can be used in timing the crop 2. Knowledge on planning and scheduling of quantities and varieties with the various partners (KARI, ADC)	1. Seed of the required varieties available at planting season
	7. Climate change so that previously disease free areas have diseases	1. Technologies to re-map the country are available	1. Map of suitable multiplication sites
	8. Erratic weather condition	1. Water management technologies available	1. Year round production
	9. High incidences of pests & diseases	1. Availability of IPM technologies 2. Germplasm that is disease resistant is available	1. Farmers able to manage pests and diseases
1. Out of the initial 12,000 acres of land at ADC, only 150 acres remained due to land grabbing,	1. Shortage of disease free land 2. Land grabbing	1. Land available for lease 2. Existence of a government institution (KACC) with mandate to recover grabbed land	1. Sufficient land available for ADC (3000acres) for seed multiplication
	3. Inadequate infrastructure	1. Farming public willing to invest in the company	1. Modern infrastructure available and in use

Current			Targeted
Status	Challenges	Opportunities	Status
	(irrigation, modern technology)	through the buying of shares	2. Company competing effectively with the private sector and able to sustain itself
1. One private company- Midlands is using out grower model produced 800 tons of certified seed in 2008	1. High cost of inputs (fertilizers) including basic seed 2. Farmers/ extension staff uncertain about the quality of seeds (complains)	1. Credit available from financial institutions and government parastatals 2. Government has ability to provide input subsidies as demonstrated in March/April 2009 when fertilizer was subsidised at NCPB outlets 3. There are farmer associations that can buy inputs in bulk 4. There is an internationally accredited body (KEPHIS) that can strengthen its supervisory role	1. Access to affordable credit facilities 2. Midlands and other seed companies operating at optimal capacity 3. Assured quality control
CERTIFICATION			
1. Limited number of KEPHIS personnel (12 seed inspectors countrywide for all seed crops) **2.** Limited number of KEPHIS offices in the country- Nakuru, Nairobi, Kitale, Embu	1. High cost of registration as seed multiplier/ merchant (ksh75,000 to register as seed multiplier), Perceived high cost of certification (Kshs 4000 per small-scale farmer)	1. The existing out grower model can be up scaled –more farmers multiply under existing seed merchants 2. Existing information dissemination channels (field days, trade fairs etc) can be used to inform farmers on the actual costs and benefits of seed certification	1. Wide spread use of certification process 2. Farmers and extension understand benefits of using certified seeds 3. Increase human and infrastructural capacities for KEPHIS
	2. Inspection services not available when required – ADC, KARI, Farmers	1. Competent persons and institutions available for providing outsourced inspection services at district levels under directions of KEPHIS 2. Seed and plant varieties act (Cap 326) is being reviewed to allow qualified institutes/ individuals to carry out routine	1. Timely inspection services on demand

Current			Targeted
Status	Challenges	Opportunities	Status
		inspection services on behalf of KEPHIS	
	3. Lack of awareness about KEPHIS by both extension staff and farmers	1. Existing information dissemination channels can be used to create awareness	1. Players/Users are aware of the benefits, requirements and business opportunities in multiplication and production of certified seeds
DISTRIBUTION ANDMARKETING			
1. No form of organised distribution system exists in the country	1. High cost of transportation (currently ranging from 10-50 cents/Kg/Km)	1. There is an under-utilised distribution system (KFA, Farmer co-operatives) already established distribution system that can be used 2. Existing distribution companies (KFA, Kenya seed etc), stockists, cooperatives could be used for distribution 3. Users can come together and obtain transport services at a competitive rate	1. Effective distribution and marketing system/services
2. Farmers collect seed directly from the multipliers (KARI, ADC, etc)	1. Poor road infrastructure (most roads in Nakuru, Mt Elgon, Keiyo, Marakwet, Narok and access roads in Meru, Nyandarua)	1. Availability of institutes and individuals who can lobby respective institution e.g. local authorities, public works to provide and improve road infrastructure	1. Acceptable infrastructure (all weather roads into major producing locations)
	2. Few individual distributors	2. Institutes/curriculum on entrepreneurship training available	2. Sufficient distributors at district level
3. No appropriate storage facilities at district and farm level	1. High post-harvest losses due to lack of appropriate storage facilities	1. Storage and post harvest handling technologies are available 2. ADC has storage capacity that can be leased out to farmers in the area	1. Storage facilities available and used at district and farm level 2. Farmers are able to store seed harvested for a maximum of one year
4. Poor	Poor information	1. Existing information	1. Effective and efficient

Current			Targeted
Status	Challenges	Opportunities	Status
information flow on available seed type, variety, location/ outlets and quantities	flow from multipliers to the users (information on the seed type available, where and when)	dissemination channels can be used to enhance communication between multipliers and users 2. Efficient and effective ICT based information systems are now available	information sharing system (ICT based) 2. Have national ware and seed potato forums with regular trade fair
5. Inappropriate packaging	1. In 2008 some seed was distributed in nylon/gunny bags instead of the recommended sisal bags 2. Lack of expiry dates on certified seeds and poor labelling of the seeds 3. Poor /compromised grading by mixing grades and varieties in the same bag 4. Packaging in 50kgs is not convenient for all the various farmers' demand	1. There is an internationally accredited body (KEPHIS) that can strengthen its supervisory role 2. There is a legal and policy framework on packaging standards 3. There is an internationally accredited body that can improve on the quality of its label and include expiry dates 4. There is an internationally accredited body that can help multipliers pack seed in assorted packages	1. Appropriately packaged and labelled seed potatoes 2. Seed packed in assorted sizes 3. Correct grades and varieties packed
6. Inefficiency of the distribution system	1. Seed from Kari-Tigoni to the orphan crops program in the MoA was delayed and when it reached the farmers it was rotten 2. Varieties that farmers want are	1. There is an internationally accredited body that can improve on the quality of its label and include expiry dates 2. There is an under-utilised distribution system (KFA, Farmer co-operatives) already established distribution system that can be used 3. Institutes (private and public), farmers and farmer groups	1. Sufficient number of distributors at the district level 2. Effective distribution system distributing seed that has not expired 3. Sufficient quantities of the varieties that farmers want being distributed

Current			Targeted
Status	Challenges	Opportunities	Status
	not available for distribution 3. Insufficient quantities of seed distributed and sold	interested in multiplying seed available as is the technology to rapidly multiply varieties 4. Trained institutes and personnel that can be trained by KEPHIS to carry out certification on behalf of KEPHIS 5. Plant and Varieties Act (cap 326) is being reviewed to allow 3rd parties to certify on behalf of KEPHIS	
USE			
1. About 1 % use of certified seed	1. High cost of seeds 2. High sourcing costs	1. Credit can be obtained from both private and public institutions	1. Increased use of certified seed by at least 10% in the next five years
	3. Shortage of certified seed	1. There are players willing to be involved in certified seed production e.g. the private sector players have expressed interests	1. Involve more private sector in the multiplication of seed to ensure more seed is availed to the farmers
	4. Lack of storage facilities at farm level	1. Storage and post harvest handling technologies are available 2. Development partners who are willing to fund farmer groups	1. Farmers are able to store seed harvested for an extended time period
	5. Low awareness on the benefits of using certified seeds	1. Use the existing information dissemination channels to create awareness	1. Farmers are aware of benefits of using certified seeds
	6. Disease accumulation in farms leading to declining yields mainly due to the use of own/neighbour seed	1. Modern technologies for disease and pest management (IPM) available	1. Effective disease and pest management at farm level
	7. Erratic rainfall	1. Water management technologies are available	1. Effective water management at the

Current			Targeted
Status	Challenges	Opportunities	Status
			farm level
	8. Limited land due to small land sizes and contamination by bacterial wilt diseases on most land	1. Modern technologies for disease and pest management (IPM) available	1. Effective disease management at the farm level
	9. Mistrust between farmers, MoA, KEPHIS and KARI	1. There are existing stakeholder forums and new ones can be established to build trust	1. Various partners working together effectively
1. Certified seed is only available in 50 kg packets	1. Some smallholder farmers require smaller quantities while others cannot afford the 50kg packet 2. Legal requirement limit packaging to 50kg packet	Policy review is in progress KEPHIS has the technical capacity to advice multipliers on packaging	1. Assorted packages available ranging from 10 to 100 kgs

To achieve the targeted status in the formal seed sub-system the following activities and investments are necessary in the short, medium and long term.

TABLE 12: RECOMMENDED ACTIVITIES INDICATING ACTORS, TARGETS AND BUDGETS NEEDED TO ACHIEVE THE TARGETED STATUS IN FORMAL SUB-SYSTEM (DETAILS APPENDIX 1)

Activities	Actors	Particulars/targets	Short-term (yrs 1& 2) '000	Medium term (yrs 3 & 4) '000	Long term (year 5) '000
Formal System					
Research					
1. Recruitment of 4 seed technicians and one breeder by KARI to support breeding program	KARI	1. Operational Allowance for 10 weeks a year by 3 days per week by Kshs.6,500/day	1,560	1,560	780
2. Task force committee to review the terms of service for breeders	KARI	2. Review committee exists (should be done in the short run-1 week)	210	-	-
3. Conducting training sessions for the breeders and technicians on modern technology & potato specific skills	KARI, CIP, USAID	3. Funds for short-term training for 10 people @ Kshs 6,500 for 5 days	375	_	_
4. Capacity development for breeders and seed technicians	KARI, CIP, GTZ, USAID	1. Staff development fund	2,000	-	-
5. Review budgetary allocation to KARI-Tigoni	MoA, KARI	A routine KARI activity	NBI*	-	-
6. Planning and preparation for the meeting for the release of varieties	KARI, MOA, KEPHIS	1. Variety release committee to be convened (minimal costs for tea and snacks and correspondence)	10	-	-
7. Bulk the varieties to 40 MT	KARI	1. Cost of bulking varieties to 40 MT on 2 Ha @ Kshs 380,000 per ha	760	-	-
8. Perform multi-locational trials and mount NPT for the varieties in 8 potato trial zones 1= Taveta-(Wundanyi ATC), 2= Mt Elgon &Marakwet (Kitale), 3= Bomet and Narok (KARI-Njoro), 4= Meru – (Marimba farm) 5= Nyeri (KARI-Embu),6=Nyandarua (Njabini & KARI Ol	KARI, KEPHIS, CIP	2. Transport 3. Land for NPTs 4. Labour	1,600	1,600	800

Activities	Actors	Particulars/targets	Short-term (yrs 1& 2) '000	Medium term (yrs 3 & 4) '000	Long term (year 5) '000
Jororok), 7=Keiyo and Nakuru (Marindas or KARI-Njoro sites), 8=Kiambu (KARI-Tigoni)					
9. Develop proposals for improving farmer selected varieties		Proposal documents	250		
10. Collection of the varieties with farmers, cleaning the varieties, bulking and release of varieties	KARI, KEPHIS, CIP, GTZ, KENAPOFA	At least 2 farmer varieties cleaned per district per year 1. Transport 2. Lab materials 3. Labour 4. Release 100MT	1,250	1,250	625
11. Identify clones for evaluation	KARI, CIP	1. To produce 100MT of basic seed per year will require 5 ha at a cost of Kshs 1,250,000 per year 2. Use KARI land or identify land for leasing 3. Labour	2,500	2,500	1,250
12. Zoning/remapping of AEZ for seed potato production. Disease free area	KARI, CIP, GTZ	4. GIS and Potato Experts (Estimates are based on the expenses incurred in the revision of Farm Management Hard Book)	-	2,500	
13. Identifying and mainstreaming additional private sector players in the adaptive research and drafting of MoUs with various players	GTZ, MoA CIP	5. Logistics and operational costs to identify various value chain activities (multiplication and distribution) to be undertaken by private sector	250	-	-
Production					
14. Increasing area under basic seed by 36 ha every year through involvement of private sector and use of aeroponics	KARI, Private sector	1. Leasing of land 2. Farm machinery and variables 3. Construction of screen houses by KARI &	59,200	29,600	14,800

Activities	Actors	Particulars/targets	Short-term (yrs 1& 2) '000	Medium term (yrs 3 & 4) '000	Long term (year 5) '000
		private sector 4. Purchase of in vitros and labour 5. KARI invests 20% , Private sector 80%			
Certification					
15. Creating awareness on certification process (sixty forums for creating awareness)	KEPHIS, MOA, Private sector	1. Transport, allowances	720	720	360
16. Hiring 6 additional KEPHIS field staff	MoA	2. Operational allowances for 6 new staff for 10 weeksx3days a week x Kshs 6,500/day	2, 340 3,000	2,340 -	1, 170 -
17. Buying of vehicles to improve staff mobility		3. Vehicles (one)	NBI*	-	-
18. Identifying and vetting some private sectors for accreditation to support in inspection process (KEPHIS)		4. Capacity assessment for the identified private sector players (A routine activity that attracts no new budget)			
Multiplication					
19. All KARI-Tigoni Sub-centres multiplying basic seed @ Kshs 152,000 per ha for 7 ha (from 2 ha)	KARI	1. Variable costs	1,064	587	0
20. Contracting out grower by KARI for 7 ha and increasing annually by 7 ha	KARI	1. Variable inputs	2,128	1,064	0
21. MoA, GTZ and KARI to recruit at least 2 farmer groups per district per year at a cost of Kshs 30,000	MoA GTZ	1. Logistics, transport @Ksh30,000 per group	1,200	1,200	600
22. Contracting out growers by ADC for 7 ha and increase annually by 7 ha (from 5 ha)	ADC	1. Variable costs	2,128	1,064	0
23. Identification of private partners for seed multiplication at district	Private sector	1. Logistical and operational costs at Kshs 10,000 per district	400	400	200

Activities	Actors	Particulars/targets	Short-term (yrs 1& 2) '000	Medium term (yrs 3 & 4) '000	Long term (year 5) '000
level for 15 ha and to increase annually by 15 ha		for at least 2 companies per district 2. Variable costs for multiplication	4,560	2,280	0
24. ADC potato activities to be privatised in long- term	MoA, ADC	1. Logistics and prospectus	-	-	2,500
25. Linking multipliers to financial institutions	MoA, GTZ, Potato Council	1. Logistics, mobilisation and training on fund utilisation (all @ Kshs 250,000 per annum)	500	500	250
26. Midland accesses funds from financial institutions to expand operations of seed multiplication	Midland	-	-	-	-
27. KEPHIS training of accredited public/private sector inspectors	KEPHIS, MoA, Private sector	1. Training funds for 1 inspector per district @ Kshs 25,000	250	250	250
28. Supervision of inspectors	KEPHIS,	1. Transport @ Kshs 15,000 per inspector once a year	150	150	150
Marketing					
29. Government to transfer seed distribution to private sector marketing e.g. Cooperatives, KFA and Traders	MoCDM, MOA, GTZ, USAID,	1. Development of business plans and awareness creation	2,000	2,000	-
30. Construction of cold storage facilities per district		1. At least one cold storage per district with capacity of 200 tons (Based on recent rehabilitation costs of ADC which was 6 m)	-	10,000	-
31. Outsourcing/consultants to establish a mobile based information system well linked to all players in the seed and ware market (sms) within the district and across districts	KARI, USAID, CIP, GTZ, Potato council	1. Consultancy (1.5m) and purchasing of computers 2. Staff development/hiring of IT personnel and purchase of computers	2,000	650	
32. MoA to ensure that in the	KARI,	1. "National Potato	1,600	-	-

Activities	Actors	Particulars/targets	Short-term (yrs 1& 2) '000	Medium term (yrs 3 & 4) '000	Long term (year 5) '000
yearly held trade fairs, seed potato types and availability are popularised and that multipliers participate	MoA, USAID, CIP, GTZ, Potato council	Council" to organise potato trade fairs yearly in 8 regions @ Kshs 200,000 (Only in the short-term-there after Council to device ways of raising funds)			
End use					
33. Training farmers on recommended potato production practices in the producing districts including post harvest handling and storage	KARI, USAID, CIP, GTZ, MoA	1. Train 25,000 farmers per year @ Kshs 1000 per farmer in all districts	10,000	10,000	5,000
34. Reviewing of relevant legislation to accommodate new seed potato packages		1. MoA and the Potato Task Force to facilitate the review/incorporation of assorted packages of seed potato in the policy in short run(Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 10 days	650	-	-
CROSS-CUTING RESEARCH ISSUES					
35. Government of Kenya to increase annual budgetary allocation to KARI -Tigoni	GOK	1. Currently at Ksh 2,583,600 reviewed upwards to 10,000,000 annually	20,000	20,000	10,000
36. Construction of disease testing laboratories at KARI-NARL	GOK	1. Construction and equipping	6,000	6,000	3,000
37. MoA to incorporate the "Potato Council" in both the legal and policy framework	MoA Stakeholders	1. Potato council to operate at annual budget on Kshs. 750,000	1,500	1,500	750
Sub-total			129,815	99,715	41,315

*NBI= NO BUDGET IMPLICATION

7.3 Semi-Formal Seed System

7.3.1 Clean Seed

7.3.1.1 Clean Seed production

This comprises seed multiplied at farm level which originates from certified seed or basic seed, whose production followed laid-down guidelines after farmer training by MoA, KARI, GTZ, TOT, but that has not been inspected by KEPHIS. Most production guidelines used in production of certified seed are also used in clean seed production and only sample testing and supervision by KEPHIS is lacking. Negative selection is used to remove the diseased and weak plants. Currently, the process of producing clean seed is technically backstopped by extension service providers from MoA, KARI and NGOs and has been a collaborative effort funded by GTZ and CIP. The seed multipliers receive training on how to produce clean seed from basic or certified seeds. Despite the potential of clean seed to improve yields by over 100% in one season (as reported by GTZ and KARI, 2007) use of clean seed stands at 1.9% and it is not accepted by law and currently cannot be sold through formal market channels. Rather than emphasising regular renewal of seeds by use of certified seeds, which is costly and inadequate in the market, clean seeds would be very useful as an immediate short term stop gap measure of solving seed shortages, reducing disease loads and spread and improving yields.

7.3.1.2 Clean Seed Multiplication

Multiplication in this system is carried out by companies like Midlands and farmer groups. To accelerate the use of clean seed more farmers and farmer groups should get involved in multiplication. In the short term more farmers and farmers groups should be recruited and trained as multipliers. It is recommended that MoA registers all clean seed multipliers in all the different regions and avail this information with varieties grown, quantities and prices by these multipliers to the various users. Legal recognition of this seed and setting up of standards for this seeds should be done in the short to medium term as an emergency measure, so that the seed can be formally traded and there can be some form of quality guarantee for the user.

7.3.1.3 Clean Seed Distribution

Distribution in this system does not exist, as users collect clean seed from the multipliers. In order to improve distribution it is recommended that for distribution efficiency, market points for potato seed and ware trade should be established, as well as strategic farmer information desks or mobile text features established to provide agricultural messages that will support timely usage of clean seed. Development partners such as GTZ-PSDA, MoA, the private sector and KARI need to create more awareness and facilitate information flow of benefits of using clean seeds, locations of clean seed producers, varieties available and their quantities. This could be done through use of mobile phone text accessible features that farmers or interested parties could log into or access freely or after paying a small fee.

7.3.1.4 Clean Seed Use

Current use of clean seed stands at a measly 1.4% and farmers experience high post harvest losses on the farm due to lack of appropriate storage. In order to increase use of clean seed to about 25% in the next five years, there is need to increase involvement and recognition of farmers trained as trainers of trainers (ToTs) to support extension services, as well as establish training and demonstrations of post harvest technologies at farm level. Promotion of diffused light stores (DLS) at farm level would help farmers store clean seeds between seasons. Commercialisation of clean seed should be enhanced through creation of standards and facilitation of use of truthfully labeled bags for marketing to build trust and increase its use.

7.3.2 Positively selected seeds

These are seeds produced from ordinary or farmer seed through a process of positive selection by farmers trained on seed selection and management by MOA, KARI, GTZ, TOT or CIP. Although the process of production lacks stringent procedure and inspection by KEPHIS it offers an opportunity to the majority of farmers to significantly improve their yields by up to 30% per season and also significantly controls some of the potato diseases in the farms (Gildemacher et al.,

2007). This system, if well managed, has the potential as a stop gap measure to significantly increase the yields of a majority of farmers.

The seed multipliers receive training on how to select the best plants when growing to finally become mother plants from which seeds are selected. Despite these efforts, the use of positively selected seed stands at 1.5% in the country. In order to increase the use of positively selected seed to at least 30% there is a need for training on positive seed selection techniques in most districts as there is only a limited number of groups who have been trained and still fewer of them who are utilizing the techniques.

In the short run there is need to support the on-going efforts by CIP, KARI, MOA, GTZ and USAID in creating awareness and training farmers about positive selection. Although positively selected seed is not tradable it would help boost potato yields significantly in the short run since it involves minimum cost investment by the farmer. In the medium and long term it will also help reduce cost of high quality seed by lengthening the period a farmer can get high quality seeds from his own harvest even without going back to the shop to buy certified seed or clean seed every season.

Table 13 below shows details of challenges and opportunities in the current status of the clean and positively selected seed in the semi-formal seed subsystem and the targeted status. This is followed by Table 14 which shows the recommended activities, actors and budgetary investment required in the short, medium and long term to move the current status of clean and positively selected seed use to targeted status.

TABLE 13: STATUS OF THE CURRENT AND DESIRED STATUS OF CLEAN AND POSITIVE SEED IN THE SEMI-FORMAL SEED SUB-SYSTEM

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
Clean seed				
1. Multiplica -tion	1. Emerging types of other good quality seed:- clean seed constitutes about 1.9%	1. Seed type not recognised by the policy and legal framework	1. Potato policy is in the process of being finalized 2. Advocacy by institutes, farmers and farmer groups led by the MoA to MPs can be done	1. Policy and legal recognition of clean seed
		2. There is no quality guarantee	3. Potato policy is in the process of being finalised 4. FAO standards for informally sold quality seed is available and can be adopted for use in Kenya	2. Standards for clean seeds
		3. Seed multipliers are not well known	5. Institutions (MoA, KARI) working closely with farmers are able to register seed multipliers 6. ICT based information system available	3. A register of seed multipliers 4. Farmers can easily access information on where, from who and which varieties are available
		4. Insufficient quantities of clean seed	7. Farmers and farmer groups willing to embrace clean seed due to its comparative yield advantage of about 50% 8. Existing farmer groups, TOT's and individual farmers trained (about 300 trained) 9. Existing knowledge within MoA, KARI, CIP and GTZ	5. Sufficient quantities of clean seed available (90,000 tons in year five)- 25% of all seed used 6. Well trained farmers and farmer groups in every district-

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
				7. 18% farmers producing and using clean seeds
Marketing	1. Farmers collect seed from the multipliers (farmers and farmer groups)	1. Insufficient multipliers in the production localities 2. Lack of information on varieties and the quantities produced	1. Farmers and farmer groups are willing to undertake clean seed production 2. There are seed traders in the localities who can be involved in marketing 3. Existing information dissemination channels can be used to enhance knowledge 4. ICT based information system available	1. Sufficient numbers of multipliers in each production locality 2. Adequate quantities of seed with local seed traders 3. Users are informed on the varieties available, where and at what price
	2. Minimal on-farm storage	3. Insufficient quantities of seed 4. Lack of appropriate on-farm storage facilities	5. Storage and post harvest handling technologies are available-DLS	4. Farmers able to appropriately store harvested seed for up to 6 months
	3. No specific labelling or packaging for quality seed	5. No way to distinguish between good and poor quality seed	6. Existing institutions (KEPHIS, MoA, CIP, KARI, GTZ) are able to provide quality guidelines	5. Truthfully labelled and easily distinguishable quality seed
	4. Un designated local authority markets for separate ware and seed potato sales	6. There are no designated markets for ware and seed potato 7. Inadequate enforcement of the legal notices-44	7. There is willingness by the local authorities to create designated areas in the markets for seed and ware potato 8. By-laws to enforce the legal notices are in place	6. Clearly designated areas in the markets for ware and seed potato 7. Enforcement of and compliance

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
		and 131		with the legal notices
End use	1. High post harvest losses- minimal appropriate storage at farm level	1. Lack of storage facilities at farm level 2. High disease incidences 3. Poor sprouting	1. Storage and post harvest handling technologies are available .	1. Farmers able to store seed for maximum of six months 2. Seeds remain viable after long storage
	2. No specific labelling or packaging for quality seed	4. No way to distinguish between good and poor quality seed 5. No quality standards for clean seed	2. Existing institutions (KEPHIS, MoA, CIP, KARI, GTZ) able to provide quality guidelines	3. Truthfully labelled and easily distinguishable quality seed
Positively Selected Seed				
Production and Use	1. Positively selected seed constitutes about 4.3% 2. Few farmers and farmer groups practising it	1. Not easy to tell the quality of the seed as seed improvement is an ongoing process	1. Farmers /farmer groups able to improve the quality of their own seed 2. 10,000 farmers and 100 extension staff have been trained (GTZ, CIP, KARI) 3. There are institutions with the capacity to train on positive seed selection	1. At least half of the farmers trained adopt and practise the method every year 2. 30% of potato farmers using positive selection 3. 108,000 farmers trained in 5 years
		2. Seed type not recognised by the policy and legal framework	4. Potato policy is in the process of being finalized	4. Policy and legal recognition of positively selected seed

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
	3. High post harvest losses- minimal appropriate storage at farm level	3. Lack of storage facilities at farm level 4. High disease incidences 5. Poor sprouting	5. Storage and post harvest handling technologies are available.	5. Farmers able to store seed for maximum of 3 months 6. Seeds remain viable after storage

Table 14 shows the recommended activities, actors and budgetary investment required in the short, medium and long term to move the current status of clean and positively selected seed use to targeted status.

TABLE 14: RECOMMENDED ACTIVITIES INDICATING ACTORS, TARGETS AND BUDGETS NEEDED TO ACHIEVE THE TARGETED STATUS IN SEMI-FORMAL SUB-SYSTEM

Activities	Actors	Particulars/targets	Short-term (1-2yrs) '000	Medium term (3-4 yrs) '000	Long term (year 5) '000
Semi-formal system					
Clean seed					
1. Reviewing of policy to include clean seed and positively selected seeds in the short term and also reviewing of relevant legislation to accommodate the seed types and set their standards	MoA, KEPHIS, AG's draftsmen	1. MoA and the Potato Task Force to gather stakeholders to update policy and review the legislation to recognise this type of seed (Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 5 days	325	-	-
2. DOAs to develop an inventory and maintain registers for the seed multipliers in their districts	MoA, KENAPOFA	1. All potato growing Districts	200	200	200

Activities	Actors	Particulars/targets	Short-term (1-2yrs) '000	Medium term (3-4 yrs) '000	Long term (year 5) '000
3. DAOs together with other stakeholders in the district level cooperate in establishing an information system that links the multipliers, distributors and farmers	MoA, Ministry of planning, private sector, KENAPOFA	1. Computers and personnel (No cost implications has been taken care of in the number 31 under table 7)	-	-	-
4. MOA, and other partners (GTZ, CIP) to train farmers on clean and positive seed production	MoA, GTZ, CIP, USAID	1. 90,000 farmers trained in 5 years in 10 potato producing districts (18,000 farmers per year at Kshs 1000 per farmer, Each farmer to produce 1 ton per year)	3,600	3,600	1,800
Distribution of clean seed					
5. Identifying farmers who are strategically located within the producing localities to minimise seed sourcing costs by both individual farmers and farmer groups	MoA	1. At least 25 farmers per district @ksh50,000 per district (logistics and mobility)	500	-	-
6. MoA to train seed traders on quality handling and register them with KEPHIS	MoA, KEPHIS	1. At least 4 traders per district @ Kshs 1000	40	40	40
7. DAOs to install data bases accessible by farmers at divisional level	MoA	1. As under multiplication (No.31 table 7	-	-	-
8. Training farmers on DLS storage technology	KARI, CIP, GTZ, MoA, USAID	1. At least half of the 90,000 farmers trained on seed production and hence 4,500 per district and 900 per year	1,800	1,800	-900

Activities	Actors	Particulars/targets	Short-term (1-2yrs) '000	Medium term (3-4 yrs) '000	Long term (year 5) '000
		@ Kshs 1000			
9. KEPHIS and her authorised agents to design procedures for labelling and packaging	KEPHIS, MoA, KARI	1. All producers of clean and positively selected seed to have labels (Logistics and Mobilisation)	500	-	-
10. MoA, KARI, and other development partners to train 108,000 farmers on positive selection 11. MoA, KARI and other development partners to train 108,000 farmers on storage technologies	MoA, KARI, GTZ, USAID, CIP	1. 10,800 farmers per district in five years translating to 2,160 farmers per year @ ksh 1,000 per farmer for 5 years per district. 2. Train 2,160 farmers per year @ Kshs 500 (non residential)	4,320 2,160	4,320 2,160	2,160 1,080
Sub-total			**13,445**	**12,120**	**6,180**

7.4 Farmer Seed System

This system is comprised of seeds obtained from own and neighbour farms and is mainly of low quality. In this system no guidelines are followed and no systematic seed selection is done. The majority of farmers will use left-over tubers (after sale or own consumption) and unconsciously select small tubers with negative characteristics leading to even lower potato production in the following cultivation. Farmers will generally select small sized tubers for seeds and consume or sell the rest. About 92.8% of the seed available in the country stems from such sources and are of low quality after years of degeneration. This type of seed suffers from pest and disease (especially bacterial wilt and viral diseases) accumulation leading to low yields and it contributes greatly to the spreading of diseases. It is believed to be the major culprit in the endemic spread of bacterial wilt and leaf roll viruses in most potato producing territories. The seed is sourced at farm level and is available in the ware potato markets.

Table 15 and Table 16 below show challenges and opportunities in current status and the recommended activities, actors and budgetary investment required over time to reduce use of farmers seed to the targeted level.

TABLE 15: STATUS OF THE CURRENT AND TARGETED PRODUCTION AND USE OF FARMER SEEDS IN FARMER SEED SYSTEM

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
1. Multiplica -tion	1. Few deliberate multipliers	1. Poor quality seed	1. Institutions, farmers/farmer groups are willing and able to increase the supply of high quality seed	1. Reduce number of farmers using ordinary seeds to 35% in five years
1. End use	1. About 92.8% using unselected seed	1. Inadequate supply of certified and clean seeds 2. Few farmers using positively selected seeds	1. Institutions, farmers/farmer groups are willing and able to increase the supply of high quality seed	1. Reduce number of farmers using ordinary seeds to 35% in five years.
		3. Low use of recommended practices	2. Institutions (MoA, GTZ, CIP and KARI) are willing to train on good agricultural practices	2. Over 10% of farmers adopting recommend-ed agricultural practices annually
		4. Proliferation of seed borne diseases especially bacterial wilt and leaf roll viruses	3. Institutions (MoA, GTZ, CIP and KARI) are willing to train on IPM	3. Use of high quality seed increases to 65% over the next 5 years

Theme/ Functions	Current			Targeted
	Status	Challenges	Opportunities	Status
		5. Poor yields	4. Institutions, farmers/farmer groups are willing and able to increase the supply of high quality seed	4. Increase production by 180% over the planned period
	1. Farmers have several farmer selected varieties that are not in the formal system	1. The varieties preferred by farmers are not in the certification programme	1. Institutions (KARI, CIP, KEPHIS) with the knowledge and capacity to clean farmer varieties and release them back to the farmers	1. Varieties preferred by farmers are selected, cleaned and availed to farmers within the next 5 years
		2. Farmers grow mixed varieties	2. Institutions (MoA, GTZ, CIP and KARI) are willing to train on seed selection and on good agricultural practices 3. Legal framework exists	2. Most farmers (90%) growing varieties in pure lines (non-mixed) within 5 years 3. Implementa-tion of the legal notices (44)

TABLE 16: RECOMMENDED ACTIVITIES INDICATING ACTORS, TARGETS AND BUDGETS NEEDED TO REDUCE USE OF FARMER SEEDS TO TARGETED LEVEL

Farmers Seed System			Short-term (yrs 1& 2) 000	Medium term (yrs 3 & 4 y) '000'	Long term (year 5) '000
Multiplication and use of Unselected seed			Short-term (yrs 1& 2) '000	Medium term (yrs 3 &-4 y) '000	Long term (year 5) '000
1. KARI, CIP, GTZ and MoA identify the preferred varieties and clean them in the short run	KARI, CIP, GTZ, USAID and MoA	1. At least 2 varieties per district obtained through quick survey/data analysis (Ksh8m) and to clean and multiply using aeroponics @2,000,000 every term	10,000	2,000	2,000
2. MoA to review legal Notice no. 44 of 2005 to expand category of inspector	MoA	1. Allowances for the review committee in the short run only (Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 10 days)	650	-	-
Sub-Total			**10,650**	**2,000**	**2,000**

7.5 Regulatory and policy framework

This entails the aspect of creating an enabling policy and legal framework for the sub-sector's growth. There are a few existing legal and policy frameworks that need to be harmonised and enforced. The Ministry of Agriculture has the mandate for potato development and has a draft Potato policy in place. Seed is regulated by the Seeds and Plant Varieties Act (cap 326) and legal notice no. 44 of 2005. The legal notice has requirements for seeds and ware potatoes in terms of quality standards and packaging as well as standards for potato processing but it has not been effectively enforced, although there have been isolated but effective strides made in Molo and

Meru Central where the MoA, in collaboration with farmers, local leaders and the local Government authorities, have had some inroads in controlling the bag size in the last year or so. They have not been completely successful but they have demonstrated that a collaborative effort between the various stakeholders is necessary to effect any meaningful change. The ware potato bag recently launched by KENFAP to help in implementing the legal notice is also too expensive, at Ksh 270 per bag, which may make it difficult for farmers and traders to adopt it.

In the short term the local Authorities should enforce the legal notice no. 113 of September 2008 that compels traders to use standardized 110 kg bags at their cess collection points to help farmers benefit from potato production and be able to afford high quality seeds. It should be noted that this bag requirement, though problematic to implement, is still a breach of international labour law to which Kenya is a signatory that requires bags carried by human beings not to exceed 50kgs.

The packaging requirement of seed into 50kg bags is one of the legal requirements that are not suitable since it discriminates against accessing seeds in smaller or larger packages. The requirement that the bag be made from sisal or jute also makes it expensive, at Ksh 95 per bag, and this cost is usually passed on to the farmers.

The Seeds and Plant Varieties Act (Cap 326) recognises only certified and standard seed but standard seed is declared so only during crisis by the Minister of Agriculture. This creates a bottleneck in the sub-sector since the existing institutions and certification, multiplication and distribution systems lack capacity to meet demand and reach the majority of farmers. Furthermore, the certified seeds are too expensive for some farmers. Currently, the sale of clean seeds is in breach of the existing laws and therefore, in the proposed model, there is a need to recognise the existence of the various types of seed planting materials and establish standards for these seeds.

There is also a need to come up with a distinct way that allows farmers to visually differentiate the different types of seeds or planting materials.

Unmatched transfers of extension staff from the Ministry of Agriculture and experts from KARI centres lead to moving of personnel with potato expertise from where they are needed most, creating a vacuum in potato growing areas and potato research- mandated KARI centres.

In the short run, a coalition of stakeholders (MoA officials, local councils, KENAPOFA, farmers and others) should spearhead the enforcement of the existing statutes to ensure adherence to the law from production to marketing. In the medium and long term this role should be taken over by National Potato Council, which should oversee the smooth running of the sub-sector.

In the short term, the MoA will also be the legal driver of the recognition effort for informally traded quality seed. This effort will entail informing the law-makers (MPs) about the various categories of seed and their advantages (being done partially by this study). To beef up this effort, the current draft Potato Policy and cabinet memo should include major changes needed toward recognition and promotion of certified seeds and informally traded planting materials. In order to fully recognise informally traded seed there is a need to look at the FAO standards for informally produced and traded planting materials, and explore ways of adapting them to local Kenyan conditions.

In the short to medium term a Potato Council that was recommended by the National Potato Task force should be formed with main stakeholders from public and private sector; this council would articulate and coordinate all potato concerns and issues.

It is also recommended that in the medium term the necessary policy adjustment should be done to allow ADC to open itself to co-use or leasing out of its potato facilities, especially the cold store, borrowing models used by other public-private partnerships. In the medium to long term, ADC would then be able to open itself to co-ownership by the private sector (by selling shares to the public). In the long term, the legal notices are expected to be adapted as a new law in force. Immediate support and advocacy should be undertaken to hasten the on-going redrafting of the Seeds and Plant Varieties Act permitting third party certification on behalf of KEPHIS.

Table 17 below shows challenges and opportunities in current status in the existing policy and regulatory framework while Table **18** shows the recommended activities, actors and budgetary investment required to move the sub-sector to targeted status.

TABLE 17: STATUS OF THE CURRENT AND TARGETED POLICY AND REGULATORY FRAMEWORK IN POTATO SUB SECTOR

Current			Targeted
Status	Challenges	Opportunities	Status
1. In place is the Crop and Plant Varieties Act (Cap 326) and legal notice no. 44 of 2005 which regulates seed and ware production, marketing, packaging and processing 2. Legal notice 131 of 2008 regulates marketing of agricultural produce-bag weights for market entry	1. Low enforcement of these laws 2. Does not recognise any other type of seed except the certified seed	1. Local authority, police and the provincial administration are strategically placed to assist in enforcement of this laws 2. The potato policy is in the process of being finalised and can include a clause to recognize the existence of the various types of seed and establish a way to visually differentiate them	1. A potato sub-sector where laws are enforced and adhered to Legal recognition of other quality seed 2. Clean seed legally traded
	3. Packaging requirement of seed into 50kg bags discriminates	3. The policy is in the process of finalisation and can consider incorporating assorted packages (5, 10, 20 50 and	3. Seed available in assorted packages

	against accesses of seeds in other quantities	100Kgs)	
	4. Low capacity of KEPHIS	4. Plant and varieties act (cap 326) being reviewed to allow for 3rd party certification 5. Advocacy by institutes and other forums to hasten the review of Cap 326	4. Timely certification at district level 5. Formation of Potato Council

TABLE 18: RECOMMENDED ACTIVITIES WITH ACTORS, TARGETS AND BUDGETS NEEDED TO ACHIEVE THE TARGETED POLICY AND REGULATORY FRAMEWORK

Activities	Actors	Particulars/targets	Short-term (1-2yrs) '000	Medium term (3-4 yrs) '000	Long term (Year 5) '000
1. MoA liaises with Provincial Administration and Local Government to establish sub-locational committees to monitor compliance with and enforcement of the law	MoA, Provincial administration, local councils	Use existing district agricultural forums	-	-	-
2. Training of the committees on the policy and legal requirements on Irish potato in general	KARI, CIP, GTZ and MoA	20 stakeholders to be trained in each of the 10 districts per year except in the LT at a cost of Kshs 1000 per person for 2 days	800	800	-
Sub-Total			**800**	**800**	**0**
[6]Grand Total			**154,710**	**114,635**	**49,495**

[6] The total for the Formal Seed system, Semi formal, Informal and Policy and regulatory framework

7.6 Private sector participation

If the seed potato sub-sector is to bounce back to its rightful position in providing food for the country, the private sector must become a major player. The private sector can play a major role in seed potato multiplication, distribution and marketing due to its renewed interest in potato and its strategic position in the industry. Traditionally the private sector has had a role in adding value to ware potato into chips, crisps etc. Currently, private companies such as GTIL and Midlands are involved in seed multiplication and distribution and others, like Kisima, Freshco Ltd and Western Seed Company, have shown interest in multiplying mini-tubers from aeroponics laboratories into basic seed and certified seeds for farmers.

If these players are well integrated in the potato seed system and given an appropriate policy backing, then they hold a potential to boosting production of the much needed certified seed. Some private companies like Freshco also have the potential to use out- growers to multiply the mini-tubers and produce certified seeds.

Combining these private multipliers with the use of private agro-vet dealers spread out all over the country and linking them will ensure that the quantities of high quality seeds produced will be adequately distributed. However, financial limitations may derail some of the companies interested in seed potato from being effective or, in extreme cases, from even getting involved. It is proposed that a "venture capital fund" be established by the Government to finance upcoming private sector undertakings to get fully established. After companies have used this capital and are fully established in five years the same capital would be repaid and invested in other similar efforts.

To establish cold storage facilities for seed potato at district level the collaboration of the private sector with government and other development agencies such as GTZ, USAID etc. is necessary to

provide resources for the construction of facilities at potato producing districts. Possibilities of using locally available and inexpensive construction materials to make these cold stores should also be explored. Structuring of ownership rights (who owns, who controls and who benefits) for these stores needs to be legally established and aligned so as to ensure optimal and widespread use of these stores so that they are used efficiently without being the preserve of a few elite or powerful individuals.

There is need for enhanced public-private partnerships at all levels where even agro-vet dealers collaborate with extension personnel and other service providers in holding field days and demonstrations to showcase the available technological innovations. KENAPOFA, as a farmer association, is yet to gain visibility amongst farmers. It is important for the organisation to carry out member recruitment and familiarisation campaigns and also be strengthened enough to be able to carry out advocacy activities together with the National Potato Council, and effectively champion the interests of farmers, such as improved road networks, affordable inputs, implementation of the potato legal notice etc.

ADC can, in the short run, lease out some of its storage capacity to the upcoming private companies as they establish themselves and build their own facilities.

7.7 Road infrastructure

A good road network is crucial for an effective distribution system. More so for potatoes which are very bulky. In the potato producing districts most of the access roads are dry weather roads that are impassable during wet season, resulting in high transportation costs of both seed and ware potato and a lowering of produce prices by the traders as soon as the rains begin. This is also followed by an increase of input prices and a decrease in ware potato prices.

It is therefore recommended that 795 km of strategic roads in the potato producing districts be improved from dry weather to all weather roads. The critical roads that require immediate attention by relevant government department are detailed in Appendix 3. It is estimated that Ksh3.5 billion (cost of muruming 5 metre wide rural access roads per km basis; murum & transport =1.8 million, compacting & levelling= 1.8 million, culavating =4.1million) would be required to upgrade the roads to all weather status.

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APPENDIX 1: TERMS OF REFERENCE FOR THE DEVELOPMENT OF SEED POTATO SUB-SECTOR MASTER PLAN

1. Evaluate the current situation of the potato seed industry in Kenya:
   a. a) in general
   b. b) supported by KARI – Tigoni station
2. Determine the constraints and opportunities of the seed production system in Kenya:
   a. a) technical
   b. b) policy and regulatory framework
3. Assess specifically the current situation of KARI –Tigoni station as main supplier of basic seed production in the Country:
   a. a) infrastructure
   b. b) technical support
   c. c) operational
   d. d) policy and regulatory framework
4. Determine the interaction of KARI – Tigoni with the private sector overall and the health regulation entities (KEPHIS) in the seed potato production systems
5. Determine the seed potato demand in the country and by regional production zones
6. Propose models and schemes for sustainable seed potato production systems involving public and interested private sectors in the country; their obligations, roles and use of new and more efficient technologies
7. Assist in the development of a strategy and a business plan for the potato seed industry including the roles of public and private sector and their cooperation:
   a. costs of infrastructure development,
   b. projected production of pre-basic seed (screen house produced minitubers)
   c. projected production of basic seed (field grown)
   d. projected production of certified or quality declared seed
   e. market value for seed produced
   f. estimated ware production volume and market value
   g. implementation strategies for seed production of existing and new varieties

APPENDIX 2: WARE AND SEED POTATO PRODUCTION TRENDS

TABLE 19: POTATO PRODUCTION AREA AND YIELDS (1990-2007)[7]

Year	Production	Area	Yield
1990	779,190	87,846	8.87
1991	987,828	87,110	11.34
1992	632,572	68,018	9.3
1993	654,123	55,670	11.75
1994	806,000	83,007	9.71
1995	928,744	96,143	9.66
1996	744,000	98,024	7.59
1997	835,208	118,638	7.04
1998	679,738	90,391	7.52
1999	1,047,572	114,614	9.14
2000	670,303	108,463	6.18
2001	1,112,849	121,490	9.16
2002	861,566	111,747	7.71
2003	1,223,531	126,529	9.67
2004	1,084,412	128,485	8.44
2005	980,163	120,859	8.11
2006	783,783	116,348	6.74
2007	800,000	120,000	6.77
2008*	1,124,169	158,386	7.10

*Estimated from master plan survey data (2009)

[7] Source: http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567; Dated July 2009

TABLE 20: CONSTRAINTS TO USE OF QUALITY SEED

	Meru	Keiyo Marakwet	Mt.Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Total
Certified Seeds											
% that know about certified seeds	9.7	25.0	10.7	40.1	22.7	27.1	12.6	34.6	8.1	6.8	21.4
% that know but don't use certified due to cost	4.1	6.2	0	24.8	4.5	4.2	6.9	5.8	0	1.4	7.3
% that know but don't use certified as it's not available	4.8	18.8	7.1	32.2	11.4	18.8	5.1	26.2	6.5	0	14.3
% that know but don't use certified as they lack sufficient information on it	2.8	1.2	1.8	14.9	8	6.2	8.6	16.5	0	4.1	8.5
Clean Seeds											
% that know about clean seeds	13.1	23.8	3.6	19.3	5.7	10.4	6.9	9.6	4.8	2.3	21.6
% that know clean seed but don't use due to cost	6.2	3.8	0	13.8	2.3	2.1	4.0	3.8	0	0.5	4.6
% that know but don't use clean seed as it's not available	7.6	16.2	1.8	14.9	1.1	4.2	2.9	8.1	1.6	0	6.4
Positively Selected Seed											
% that know about positively selected seeds	26.9	17.5	7.1	4.5	8.0	8.3	5.1	30.4	16.1	2.7	13.5
% trained in positive selection	22.8	11.2	5.4	4.5	4.5	4.2	7.4	14.2	9.7	2.3	9.4

Source: Master plan field survey data (2009)

TABLE 21: COMMONLY GROWN VARIETIES IN THE VARIOUS DISTRICTS (% OF FARMERS GROWING)

Variety	Meru	Keiyo-Marakwet	Mt Elgon	Nakuru	Narok	Bomet	ua	Nyeri	Taita	Kiambu	Total
Tigoni	15.9	76.3	1.8	61.9	3.4	.0	29.7	7.7	48.4	13.1	25.7
Nyayo	.0	6.3	3.6	37.1	2.3	.0	41.1	26.5	3.2	47.5	24.8
Thima thuti	.0	.0	.0	1.0	72.7	.0	2.3	64.6	.0	29.9	22.7
Dutch Robjin	.0	.0	.0	19.3	23.9	81.3	.0	.0	32.3	.0	8.9
Asante	31.7	1.3	12.5	14.4	.0	.0	.0	1.9	19.4	1.4	7.7
Shangi	.0	.0	.0	.0	5.7	.0	25.7	.0	.0	16.7	6.5
Meru Mugaruro	.0	.0	1.8	2.5	.0	.0	13.7	12.3	.0	10.4	6.4
Arka	6.9	8.8	91.1	.0	.0	.0	.0	.0	.0	.9	5.2
Meru	.0	.0	1.8	2.5	.0	.0	1.7	15.8	.0	5.9	4.7
Purple Tigoni	38.6	.0	.0	.0	.0	.0	1.7	.8	1.6	.0	4.6
Tigoni red	4.8	.0	.0	.0	.0	.0	1.7	9.6	12.9	6.3	4.3
Desiree	3.4	.0	7.1	2.5	.0	20.8	2.3	1.2	1.6	1.4	2.6
Mwezi moja	.0	.0	.0	.5	.0	.0	.6	10.4	.0	.0	2.2
Kanyoni	.0	.0	.0	.0	.0	.0	.6	10.8	.0	.0	2.2
Anett	.0	12.5	.0	.0	.0	.0	.0	.0	.0	.0	.7
Sample size	**145**	**80**	**56**	**202**	**88**	**48**	**175**	**260**	**62**	**221**	**1337**

Source: Master plan field survey results (2009)

TABLE 22: PERCENTAGE AREA UNDER DIFFERENT VARIETIES IN 2008

	Meru	Keiyo_ Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Total
Tigoni	12.3	73.6	8.4	43.2	3.5	0.0	21.4	9.2	37.1	9.5	20.7
Thima Thuti	0.0	0.0	0.0	0.3	61.4	0.0	1.9	34.8	0.0	19.2	20.2
Dutch Robyjin	0.0	1.2	2.0	17.9	14.8	86.8	0.1	0.0	24.6	0.0	10.5
Nyayo	0.9	0.8	0.3	16.3	3.5	0.0	18.7	14.1	1.1	26.1	9.5
Asante	33.5	0.7	12.4	6.9	0.7	0.0	2.0	1.8	15.9	1.1	6.5
Shangi	0.0	0.0	0.0	0.0	5.6	0.0	14.7	0.0	0.0	9.4	3.7
Meru mugaruro	0.0	0.0	1.0	0.9	1.2	0.0	13.0	5.5	0.0	13.8	3.6
Arka	3.3	6.1	66.5	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.5
Purple Tigoni	23.3	0.0	1.2	0.0	0.0	0.0	1.7	1.7	0.2	0.0	3.1
Meru	8.0	0.0	1.0	2.3	0.0	0.0	1.4	5.4	0.0	2.7	2.3
Tigoni red	1.9	0.8	0.0	0.0	0.0	0.0	0.9	7.8	3.2	5.0	1.7
Desiree	0.8	0.0	4.6	1.8	0.0	9.8	1.9	0.1	0.1	2.1	1.3
Kanyoni	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.9
Annett	0.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Tana Kimande	0.0	0.0	0.0	0.2	0.0	0.0	4.0	1.5	0.0	1.3	0.8
Ngure	5.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6
Other varieties	10.5	7.1	2.6	10.2	9.2	3.4	18.1	10.6	17.7	8.7	10.2
Sample size	**145**	**80**	**56**	**202**	**88**	**48**	**175**	**260**	**62**	**221**	**1337**

Source: Master plan field survey results (2009)

TABLE 23: TOTAL WARE AND SEED PRODUCTION ESTIMATES FOR MAJOR PRODUCING DISTRICTS IN 2008[8]

	Certified Seeds			Clean Seeds			Positively Selected Seeds			Farmer Seeds		
Old District	Total area (ha)	Yields (t/ha)	Output (tons)	Total area (ha)	Yields (t/ha)	Output (tons)	Total area (ha)	Yields (t/ha)	Output (tons)	Total area (ha)	Yields (t/ha)	Output (tons)
Meru	44	18	776	506	13	6,582	897	13	11,295	10,321	8	81,011
Keiyo-Marakwet	94	5	451	58	10	566	0	0	0	8,785	10	88,791
Mt Elgon	0	0	0	0	0	0	0	0	0	4,470	12	51,319
Nakuru	550	14	7,679	116	11	1,257	0	0	0	16,790	8	133,381
Narok	578	26	15,000	145	17	2,500	463	5	2,400	27,478	11	307,812
Bomet	0	0	0	1,012	10	10,575	0	0	0	3,234	11	34,633
Nyandarua	419	13	5,469	43	8	364	116	16	1,886	13,349	7	95,873
Nyeri	0	0	0	6	13	73	769	7	5,169	14,019	5	66,406
Taita	116	6	686	347	9	2,994	102	5	481	1,349	3	4,346
Kiambu	87	20	1,714	58	14	798	0	0	0	7,777	4	27,750
Total	1,888	13	24,052	2,290	11	25,847	2,346	10	22,443	107,572	7	741,598

Source: Master plan field survey data (2009)

[8] These are the larger districts before the recent sub-divisions into smaller districts

TABLE 24: VOLUMES OF BREEDERS AND BASIC SEEDS PRODUCED FROM KARI-TIGONI IN THE LAST 8 YEARS

Year	Breeders seed (tons)	Basic seed (tons)	Basic seed required to produce certified seed meeting 1% of national requirements	Certified seed required to meet 1% of National requirements*	Comments
2008	20.96	59.15		3,168	Drought in SR
2007	20.25	77.5	492	2,400	
2006	17.31	60.9	555	2,327	
2005	10.82	35	590	2,417	
2004	22.17	21.9	632	2,570	
2003	4.5	8	665	2,531	Crop rejected due to bacterial wilt
2002	11.1	16.2	429	2,235	
2001	9.6	24.6	570	2,430	
2000	-	37.25	538	2,169	

* Estimated from total area under potatoes

Source: Master plan institutional evaluation results (2008)

TABLE 25: QUANTITIES OF CLEAN AND CERTIFIED SEED PRODUCED BY VARIOUS INSTITUTIONS

Year	Certified seeds (tons)		
	Kari (Oljororok, Embu)	ADC	Midlands
2008	8.8	474.35	n/a (data not available)
2007	8.8	226.45	n/a
2006	5.0	62.30	n/a
2005	8.3*	94.95	n/a
2004	0.0	54.25	n/a
2003	0.0	22.25	n/a
2002	0.0	119.75	n/a
2001	0.0	52.80	n/a

*All from Oljororok as Embu started production in 2006. Oljororok started production in 2005.

Source: Master plan institutional evaluation results (2008)

TABLE 26: AVAILABILITY OF CERTIFIED (FORMAL) SEED AS A PERCENTAGE OF NEED

Country	Available
Kenya	1%
Peru	2%
China	20%
Argentina	60%
United Kingdom	66%
Holland	99%

Sources: Barker, 2008; Huarte, 2008;Kang,2008

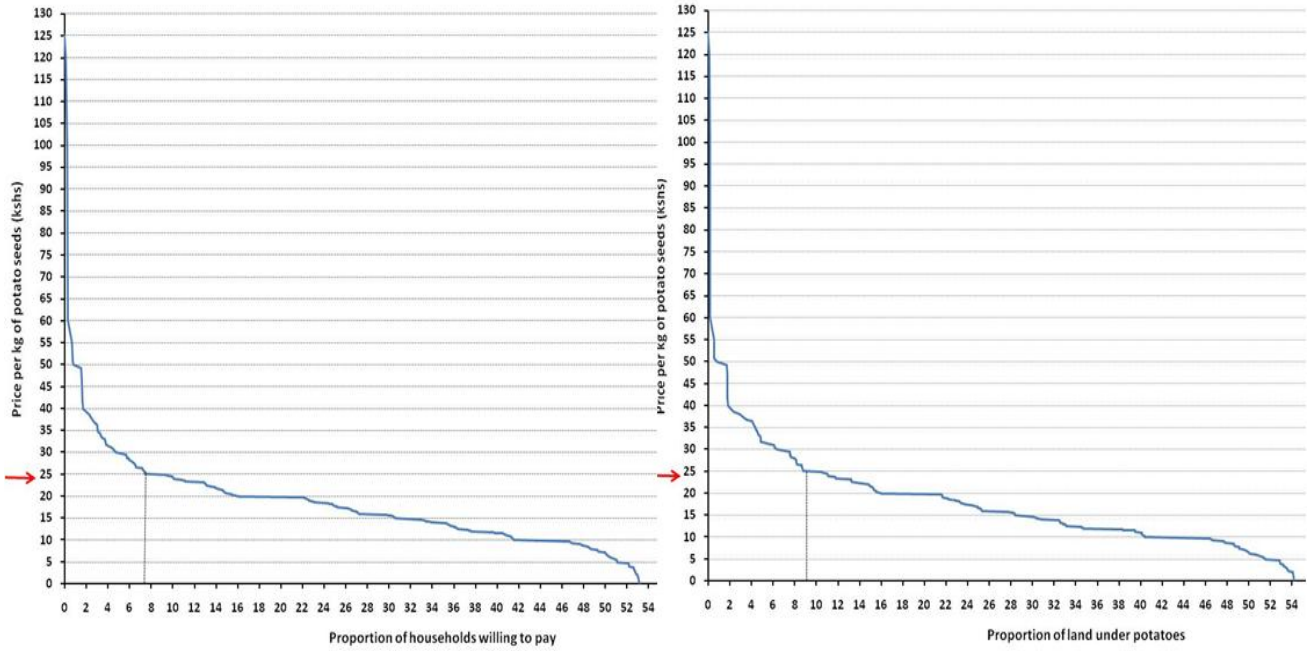

FIGURE 6: DEMAND CURVES FOR CERTIFIED SEED USING WILLINGNESS TO PAY

TABLE 27: TRUNCATED REGRESSION RESULTS

Limit: lower = truncated Number of obs = 623

upper = +inf Wald chi2(19) = 63.37

Log likelihood = -2350.7773 Prob > chi2 = 0.0000

WTP	Coefficient	Std. Err.	z	P>z
Used certified seed	1.074837	5.582324	0.19	0.847
Received potato training	4.575902	1.871912	2.44	0.015
Distance to seed source	0.057678	0 .050615	1.14	0.254
Male	-3.741196	1.973479	-1.90	0.058
Age	0.138228	0.058936	2.35	0.019
Years of education	0.0883639	0.1972691	0.45	0.654
Used fertilizer	1.925966	2.223205	0.87	0.386
Used manure	1.331735	2.423045	0.55	0.583
Farm size	-0.0421824	0.0755285	-0.56	0.577
Potato for income	2.980892	2.054085	1.45	0.147
Family size	-.0803572	0.1248853	-0.64	0.520
Meru	2.762646	8.926488	0.31	0.757
Keiyo	9.60489	10.31155	0.93	0.352
Taita	-10.92825	17.09865	-0.64	0.523
Nakuru	-8.398678	4.02459	-2.09	0.037
Narok	-24.50188	10.7921	-2.27	0.023
Bomet	-8.00497	12.66179	-0.63	0.527
Nyandarua	-10.21141	5.199508	-1.96	0.050
Nyeri	-11.2122	4.323624	-2.59	0.010
Constant	8.555998	5.440655	1.57	0.116
/sigma	15.08416	.7616702	19.80	0.000

TABLE 28: COMMONLY REPORTED DISEASES IN THE MAJOR POTATO PRODUCING DISTRICTS

District	Meru	Keiyo Marakwet	Mt Elgon	Nakuru	Narok	Bomet	Nyandarua	Nyeri	Taita	Kiambu	Overall (combined districts)
Leaf roll	30	12	71	7	9	2	10	2	16	2	12
Bacterial wilt	76	74	76	73	71	87	83	90	73	67	77
Late blight	70	90	60	86	91	84	61	72	79	23	67
Viral diseases	31	12	71	7	11	2	11	2	16	2	12

Source: Master plan field survey data (2009)

TABLE 29: TOLERANCE AND CONTROL OF LATE BLIGHT

District	Varieties considered tolerant (% of farmers considering variety LB tolerant)	Methods of spreading LB (% of farmers citing method)	Control methods used for LB (% farmers citing method)
Meru	Asante (13), Tigoni(11)	-	Spraying (60)
Keiyo Marakwet	Tigoni (38), Nyayo (12), Arka (10)	Infected seed (31), infected soil (26), flooding (17.5), weather (16)	Spraying (84), uprooting (31), crop rotation (26)
Mt Elgon	Arka (27), Asante (11)	Infected seed (20), infected soil (14)	Spraying (54), crop rotation (27), uprooting (18)
Nakuru	Tigoni (27), Asante (10)	Infected seed (27), weather (21), infected soil (17), flooding (14)	Spraying (75), uprooting (19), crop rotation (15)
Narok	Thima thuti(10)	-	Spraying (89), crop rotation (11)
Bomet	Dutch Robjyn(20)	Infected seed (12.5), infected soil (12.5)	Spraying (71), renew seed (15), crop rotation (12.5)
Nyandarua	-	Infected seed (14), weather (14)	Spraying (47), uprooting (12)
Nyeri		Weather (12), Infected seed (11)	Spraying (50)
Taita	Tigoni (13)	Infected seed (37), infected soil (32)	Spraying (66), crop rotation (52), uprooting (31)
Kiambu	-	-	Spraying (14%)
Overall (combined districts)	-	Infected seed (13.5), weather (10), infected soil (10)	Spraying (55), crop rotation (12), uprooting (10)

Source: Master plan field survey data (2009)

TABLE 30: TOLERANCE AND CONTROL OF BACTERIAL WILT

District	Varieties considered tolerant to bacterial wilt (% of farmers considering variety tolerant)	Methods spreading BW(% of farmers citing method)	Methods used to control BW(% of farmers citing method)
Meru	-	Infected seed (48), infected soil (43)	Crop rotation (44)
Keiyo Marakwet	Tigoni(30.5)	Infected seed (30), infected soil (22.5)	Spraying (44), uprooting (37.5), crop rotation (30)
Mt Elgon	Arka(36), Asante (11)	Infected soil (36), infected seed (27)	Spraying (63), crop rotation (32), uprooting (30)
Nakuru	Tigoni(17)	Infected seed (43), infected soil (28)	Uprooting (45), spraying (29), crop rotation (28)
Narok	-	Infected seed (10)	Spraying (49), uprooting (15), crop rotation (12.5)
Bomet	Dutch Robjyn (12)	Infected seed (46), infected soil (46)	Crop rotation (46), spraying (29), uprooting (25)
Nyandarua	-	Infected seed (55), infected soil (51)	Uprooting (62), crop rotation (38), renew seed (21), spraying (14)
Nyeri	-	Infected seed (62), infected soil (42)	Crop rotation (50), uprooting (57)
Taita	-	Infected soil (43.5), infected seed (29)	Crop rotation (58), spraying (51), uprooting (34)
Kiambu	-	Infected soil (41), infected seed (24)	Uprooting (47), crop rotation (26)
Overall (combined districts)	-	Infected soil (41), infected seed (37.5)	Uprooting (41), crop rotation (36), spraying chemicals (21)

Source: Master plan field survey data (2009)

APPENDIX 3: ROADS THAT NEED TO BE IMPROVED TO ALL WEATHER STATUS IN VARIOUS DISTRICTS

Old Districts	New or Old Districts	Road Description	Distance (Km)
Nyeri	Nyeri South	Wamagana-Mukarara	7
		Kagere-Kenyatta High School-Gura River	5
		Ruring'u-Gitero-Muthwa-ini	7
	Nyeri North	Watuku-Kimunyuru	7
		Nyomba Round-Kwa Huku	12
		Endarasha-Ndunyu Wathe	11
Meru Central	Meru-Central	Gathuine-Mujujune	10
		Ntugi-Karanene-Kibirichia Health Centre-Kibirichia Market	7
		Katheri-Gatharanga-Forest	7
	Imenti-North	Kiirua Police Junction-Murunguma-Kiringo-Gitimene Market-Murunguma Primary-Mujwa Nthunguri-gwa Kamau	20
		Kisima-Exlewa Market-Kisima Dispensary-Forest	7
		Katheri Chiefs Camp-Mau mau-Marete	8
Taita	Taita	Wundanyi ATC-SAgaigu-Chawia	20
		Kesses Shopping Centre-Ngulu Mwashimba	12
		Bura Mission-Murugua-Mgange Dawida	16
Keiyo Marakwet	Keiyo	Iteni-Nyaru	70
	Marakwet	Kosingur/Kapkochur-Kapchumavu	6
		Kapyego-Tenderwa-Kabero	8
		Chemulanyi-Kaborowo-Kapsait	14
Mt Elgon	Mt. Elgon	Masaek-Kopsiro-Kipsigon-Rwanda-Kaptirongo-Embakasi-Cheptais-Chepkube	40
Nyandarua	Nyandarua North	Kasuku-Nyairoko	10
		Passenga-Matura	9
		Shamata-Kanari	20
	Nyandarua South	Ack (satima)-Kwa njue-Kwa matu	19
		Soko Mjinga-Kenyatta Road through St. Mary	20
		Nyaturu Road	8
Narok	Narok	Narok-Olkoruto-Olenguruoni	100
		Tipis-Olchorosiyabei	70
		Mulot-Tendwet road	50
Bomet	Bomet	Aisaik-Ndaraweta-Sogoet	15
		Silibwet-Mugango-Kitoben	10
		Silibwet-Kiromwok-Tegat	20
Nakuru	Molo	Bombo-Silibwet-Mauche	57
		County council-Sitoiti-Lagwenda-Seguton	40
		County council-Kuresoi-Chepsir	40
	Nakuru North	Kandutura-Forest road	7
		James Mathare road	4
		Munanda mugwathe road	2

Source: Master plan district diagnostic forum results (2009)

APPENDIX 4: LIST OF STAKEHOLDERS IN THE SEED POTATO SUB-SECTOR

No.	Name of stakeholder	Roles
1.	ADC -Molo	• Multiplication of basic seeds to produce certified seed • Provision of certified seed potato
2.	KARI- Tigoni	• Research • Provision of basic seed potato • Capacity building on positive seed selection • Training of farmers on seed production and marketing
3.	CIP- International Potato Centre	• Capacity building of farmers on both ware and seed potato production • Introduction of new technologies of seed production
4.	Development partners especially GTZ and USAID	• Provision of funds for capacity building on the production of ware and seed potato • Irrigation development • Financing projects • Financing technology transfer
5.	KEPHIS	• Certification
6.	Farmer	• Seed multiplication and sale to other farmers
7.	Bukunye Youth group (Bomet District)	• Multiplier of clean seed
8.	Agro-chemical Companies (Bayer, Syngenta, Osho)	• Farm input supply
9.	Agro-vet dealers and seed stockists	• Farm input supply
10.	Traders and Brokers	• Link farmers to the market
11.	Transporters	• Delivery of seed and other inputs
12.	Extension service providers	• Training of staff and farmers • Technology transfer
13.	Local authorities	• Enforcement of legal framework • Infrastructure development
14.	Police department	• Law enforcement
15.	Judiciary	• Arbitration and administration of justice
16.	Provincial administration	• Law enforcement • Community mobilization
17.	Farmers associations e.g. KENFAP and KENAPOFA	• Lobbying/advocacy
18.	C.D.F. committees in different constituencies	• Financing potato seed projects • Financing Infrastructure development
19.	K.P & LC	• Energy for cold storage
20.	Ministry of Public Works	• Infrastructure development, especially roads
21.	Financial Institution e.g. Equity bank, K-Rep bank, Family Finance Bank	• Availing credit to farmers
22.	Midlands	• A farmer-owned company that produces clean and certified seed. It possibly also carried out on-farm trials of 4 Dutch varieties imported into the country for commercialisation
23.	National Cereals and Produce Board (NCPB)	• Selling inputs mainly fertilizers

24.	University of Nairobi	• Carries out research that informs the whole production continuum
25.	International Centre of Insect Physiology and Ecology (ICIPE)	• Carrying out research on leaf miners in potato

Source: Master plan district diagnostic forum results (2009)

APPENDIX 5: SWOT ANALYSES FOR MAIN INSTITUTIONS IN SEED POTATO SUB-SECTOR

I. Research

1. Kenya Agricultural Research Institute, National Potato Research Centre-Tigoni

The National Potato Research Centre (NPRC) is situated in Tigoni, Kiambu district. It is one of the 33 research centres managed by the Kenya Agricultural Research Institute (KARI). The centre has the national mandate for potato research and development and an adaptive research mandate for flowers. The potato mandate includes coordination of potato research throughout the country and implementation of potato research programmes in breeding; agronomy; crop protection; seed research and production; food processing and post harvest technology; socioeconomics and technology transfer and farmer training. The centre produces basic seed as a service to the industry although the centre is short staffed and under-funded.

SWOT Analysis

Strengths • Cold store capable of holding 40 tons of basic seed 5 tons minitubers • Diffused light store (DLS) and laboratories and green houses for rapid multiplication and food technology • Reasonably qualified staff • Reasonable amounts of land (Marindas 240 acres, Njabini 60 acres, Marimba 120 acres)	**Opportunities** • Large number of people seeking to import seed and also those seeking to export to the region e.g. Burundi • Increased interest in private sector to grow certified seeds
Weaknesses • Poor linkages with other stakeholders for further multiplication of basic seeds leading to insufficient supply of basic seed for the country • Sell pre-basic seed directly to users which is neither cost effective nor efficient • Lack of irrigation on most of the available land	**Threats** • Few growers of certified seed to multiply the basic seeds • Reliance on CIP for germplasm • Lack of partnership linkages with important stakeholders and private sector in the industry • Insufficient operating funds • Staffing and productivity at research and technician levels are inadequate i.e.

	pathologists, seed technologist, qualified farm managers etc.

2. International Potato Centre (CIP)

CIP is an international research institute that is part of the Consultative Group on International Agricultural Research (CGIARs). It is responsible for global potato germplasm and develops and disseminates new and improved clones, varieties and technologies aimed at improving yields, nutrition and market access. Over the years CIP has provided technological backstopping to the seed potato industry in the country. In the past it worked only with the national potato programme to produce potato seed but it is now trying to facilitate involvement of additional private partners in the sub-sector. It aims at providing technical advice and backstopping to ensure private and public sector are able to produce massive amounts of seeds using aeroponics.

Short term Needs	Long term needs
• Closer interaction with the private sector. To know who they are, interact with them and formulate a strategy with them. There is a need for a written government policy statement facilitating this interaction with the private sector i.e. a policy framework for CIP to interact with interested sector players • Trust building between sector players to allow dissemination and uptake of CIP technologies. Currently there is mistrust between public and private institutions such that KARI-Tigoni, JKUAT may not accept in vitro potato plantlets from private companies such as Osearian flowers, GTIL.	• A stable agreement with industry stakeholders whereby the government would provide a general policy on stakeholder framework participation with a board that would control the seed potato industry • That CIP would play an active role in provision of technology and it would be able to change as the industry progresses

SWOT Analysis

Strengths	**Opportunities**

• Reasonable technological capacity required for seed potato development	• Able to provide seed to countries in the region if the capacity in Kenya can be improved through involvement of private companies and capacity building in the public sector.
Weaknesses • National programme partner with inadequate public investment into the programme • Lack of priority given to training further potato breeders in the region.	**Threats** • The prevailing mistrust between private and public sector partners which, if not dealt with, can cripple any initiative between them • Lack of future plant breeding capacity

3. Universities-Jomo Kenyatta University of Agriculture and Technology (JKUAT), Department of Horticulture and Kenyatta University (KU)

JKUAT is mandated to offer training to students on various agricultural areas. Its role in potato seed production is in research and technology development. There has been some work in tissue culture of potatoes and some collaboration with CIP in disease management studies and with KARI-Tigoni with students from the institute working on real problems on farmers' fields.

KU started an agriculture program in 2008 under the department of botany, while it also has a department on education and extension. The vision is for the agriculture department to spearhead the production of potato tissue culture, which it would then be multiplying on the institute's Embu farm and sell certified seed to farmers. The institute has a small propagation laboratory that can be used for seed potatoes and a farm in Embu that can be used for field propagation into certified seeds. The University is now geared toward commercialisation units that also serve as research facilities but the greatest constraint to achieving this envisioned role is financial assistance to establish this unit.

The main problems encountered by the institutes are low funding for research and development and, therefore, seeking technical assistance to build a commercial/research unit for seed potatoes, capacity building of staff in various potato aspects, and linkages with stakeholders in the potato industry - like the International Potato Centre (CIP) - for support. A potato stakeholders' forum to identify research needs and funds to support the work and which would be open to any interested researcher would help remove some of the barriers.

Short-term Needs	Long term Needs
• Availability of scholarships as currently most postgraduates are privately funded and, for their research, have to plug into whatever project is available. There is some limited funding from the institute but these are competitive funds that are open to everyone	• To produce potato seeds using TC. The current capacity is mainly for research purposes but they would like to increase this so as to carry out commercial production
• Funding especially a scenario where each professor has some research funds, as happens in developed countries	• Develop good research facilities that would allow them to carry out first class research as this would help in attracting funding to the institute. The vision is to have a science park with world-class facilities that would be available to everyone
• Better linkages with other stakeholders/institutions so that students can work on issues that are relevant to the industry. Currently there are no structured institutional linkages but what exists now are linkages based on personal initiatives	

SWOT Analysis

Strengths	**Opportunities**
• Human expertise in the required disciplines with facilities in terms of infrastructure (greenhouses, laboratories etc.) • Good linkages with national and	• Unavailability of quality seed potatoes at affordable prices in the country, yet potatoes are widely consumed • Food science department has facilities to carry out value addition and they can

international partners that can be exploited	contribute to diversification of potato products and thus improve further on the demand for seeds
Weaknesses • Lack of a cold store and low financial provision; the facilities need to be modernized and it does not have linkages with institutes like KEPHIS	**Threats** • Government has a poor focus on the potato seed sub-sector • Potato diseases that are now so widespread that farmers in some areas are now reluctant to grow potatoes • Other seed suppliers from the anticipated influx of low priced non-certified seeds by those desiring to make a quick profit by the raised demand for seed potatoes

h. Genetics Technologies International Limited (GTIL)

GTIL is a privately owned tissue culture laboratory that offers micro propagation services to any crop as long as there is a demand for it from farmers and it is profitable for the company. The company is currently working with the International Potato Centre (CIP) to multiply potato germplasm material from Lima, Peru, for the regional program.

SWOT Analysis

Strengths • Technological capability, facilities and capacities as the company has been in this type of business for 15years	**Opportunities** • Many players in the potato industry and these players are raising the demand for clean potato seed
Weaknesses • Inability to multiply the mini-tubers further and so ensure the quality of the seed produced through the process due to the fact that the company is limited to the laboratory and the greenhouses and has to hand over the product to others before the product can get to the farmer	**Threats** • Aeroponics has not been commercialised for a long time so it may present challenges as the company progresses with its use, and this is the reason the company still uses pots for mini-tuber production so as to mitigate against any unforeseen technological

	hitches from aeroponics

Seed potato multiplication and Distribution

i. Agricultural Development Corporation (ADC)

Agricultural Development Corporation (ADC) is a parastatal established through an Act of parliament, Cap 346 of 1965, and later revised through Cap 444 of 1986. ADC is charged with the responsibility of promoting and executing schemes that are aimed at agricultural development and reconstruction in Kenya by initiating, assisting and expansion of agricultural undertakings/enterprises through production and supply of quality seed, livestock, technological transfer and training in sustainable and affordable manner. Its major mandate in seed potato is multiplication and bulking of seeds with KARI-Tigoni as its specific seed source. ADC gets high status material in the form of breeders' material which comes from clones.

Short –term and long term needs

Short term	Long term needs
• Subsidized inputs e.g. fertilizer, herbicides, and other sprays by government • Immediate need for land (it lost 4800 ha to grabbers) and machinery (lost to grabbers and post election violence) so the firm can perform optimally	• Modern machinery, grading system. ADC is currently using the old model machinery of 1985 • Revive the distribution channels subject to availability of funds • Continued government support so it can carry out its mandate • Inadequate technical and physical capacities • Expansion into new technologies such as aeroponics and hydroponics • Currently, the law requires that the packaging of the seeds be in 50 kg bag. However, there is emerging demand for smaller packs of 25 kg and lower. This implies review of existing regulations

	• Alternative seed inspection practices in recognition of shortcomings in KEPHIS inspection capacity (lack of inspectors)

ADC SWOT Analysis

Strengths • Cold storage facility with the capacity for 39,000 x 50 kg bags (1950 tons) of seed potato • Long term experience in seed potato production dating back to 1979 • Human resource technical capacity to handle seed production compared to its competitors • Government goodwill as evidenced by the injection of Kshs 18 m to construct a tissue culture lab and other funds to rehabilitate the cold store • Experienced networking with distributors and agro-vet dealers	**Opportunities** • High demand for high quality certified seeds • To network with other MoA parastatals like Kenya Seed Company, and KARI; and with farmers associations, e.g. KFA
Weaknesses • Inadequate distribution network • Use of old and inefficient machineries	**Threats** • Inadequate land which makes the firm unable to meet the targets and demand for the seed potato and other seeds. • Loss of land has probably led to loss of faith by donors and therefore hindered further support • Upcoming firms dealing with seed potato production and distribution

j. Kenya Seed Company

Overview

Kenya Seed Company is a state Corporation mandated to carry out focused research, promote and facilitate production of high yielding, better quality certified seed for farmers and stakeholders, to enhance food self sufficiency which is an indicator of the quality of people's lives and a condition for sustainable economic prosperity. Kenya Seed Company uses contracted farmers or institutions/organisations such as National Irrigation Board (NIB) for seed multiplication. This arrangement is fully controlled such that those used for the multiplication are not allowed to sell directly to farmers. They are supposed to sell all the seeds to Kenya Seed Company.

SWOT Analysis

Strengths • Experience in seed production • Good will from the government • A wide distribution Network in the country and beyond • Experienced staff	**Opportunities** • Growing market of seeds which is not fully exploited • Increasing demand for certified seeds
Weakness • Inadequate resources (human and financial) to address seed potato	**Threats** • Emerging companies which may pose a major challenge

k. Kenya Farmers Association (KFA) Limited

The overall mandate is to acquire and market farm inputs (seeds, fertilizers, chemicals, herbicides and all other farm inputs) at reasonable prices and declares bonuses when the company has made a profit. The Company, which is a quasi-parastatal, links livestock farmers to buy and sell their stocks such as dairy and sheep. With regard to seed potato sub-sector, KFA can only play the role of distribution and marketing due to its strength of country wide network. For many years, the Company handled government agricultural inputs e.g. seeds, fertilizers as well as cereals. Before 1982, government built cereal silos under the then Maize and Produce Marketing Board with KFA

as the main agent for buying and handling wheat and maize. This role continued up to 1995 when NCPB took over wholly the role of handling cereals.

Distribution and Marketing Network

The company distributed seed potato up to 1995. It has 36 outlets spread throughout the country as follows: -

1. **Central region** -Nakuru, Eldama Ravine, Rongai, Naivasha, Molo, Kabarnet, Kericho, Sotik, Bomet, Kisii, Nyahururu, Narok and Kilgoris.
2. **Western Region**-Kitale (two branches in town), Eldoret, Turbo, Mois Bridge, Oyugis, Kisumu, Webuye, Bungoma, Kakamega and Kapsabet
3. **Eastern Region**-Nairobi, Nanyuki, Mukurueini, Machakos, Embu, Wundanyi, Mombasa, Narumoru and Meru
4. **Small Centres** at Kapenguria, Kapcherop and Kipkelion

Short-term Needs	**Long-term Needs**
• Raising Ksh 2 billion to settle creditors especially the two banks and the staff arrears and funding of the company's operations in order to create a conducive environment for working and getting the company back on track • There is an immediate need for defining the legal status of the company to remove the current confusion that hinders the decision- making process. The clarification of the legal status will help propel the organisational efforts of revamping the company to play the much needed role of seed distribution • Introduction of ICT to network KFA	• Streamline the governance structures to empower farmers/members to make management decisions and rebuild credibility • A detailed strategic plan spelling out activities and financial restructuring to address the inherent problems affecting the organisation • Recruitment of qualified personnel to cope with the current reality • Retrain staff on current knowledge and skills to meet current performance demands • Diversification of services offered by KFA

SWOT Analysis

Strengths • Experienced personnel nurtured up from within the organisation that is capable of handling a network of 36 branches • Good will with trade creditors • It is the preferred outlet for the Kenya Seed Company • Loyalty/trust by the farmers who always buy from KFA • Quality products and competitive prices • Government goodwill seen by their commissioning studies and pledging to guarantee KFA's borrowing • There is a good working relationship with government institutions e.g. NCPB, AFC and KCC. • Government recognizes the huge role KFA plays in controlling counterfeit seeds and stabilizing prices of inputs	**Opportunities** • A huge agricultural inputs market that is not fully exploited e.g. Kenya requires about 400,000 metric tons of fertilizer and yet only 150,000 tonnes are met • Existing network which is not fully utilized • Large unexploited seed market- it is expected that the need for more seed potato will keep growing as more youth embrace farming as a business and as government seeks to make Kenya food secure • Increasing adoption of new agricultural technologies by farmers
Weaknesses • Financial inability to recruit qualified personnel • Staff drain through move to greener pastures • Lack of succession plan • Undefined legal status • Poorly functioning governance • Disenfranchised board and shareholders who have no voice	**Threats** • The company may be auctioned by her creditors • Government failure to move in and decisively define the legal status of KFA • Personal interests that may lead to failure of the company by the vested interests • Demands by interested players that government subsidized inputs distributed by KFA should be priced so as not to undermine the prevailing market rates

NB. KFA has a capacity to store up to 600,000 x 50 kg bags of seed and other inputs.

l. Midland Limited

Midlands limited is an agro-processing company concentrating on temperate climate horticultural and industrial crops. The company's operations traverse the entire value chain from the provision of inputs, crop production, processing and marketing. Target crops are Irish potatoes, peas, carrots and crucifers in the food crop category and pyrethrum, sugar beet, Artemisia and tropical herbs in the industrial crop category. The company is already involved in the production and sale of seed potatoes and has commenced trading in ware potatoes targeting supermarkets, the catering industry and large institutions.

Short term needs	**Long-term Needs**
• Improve on infrastructures (electricity, roads and water supply) • Capacitating KEPHIS to offer inspection timely and efficiently as the sub-sector grows • 50% of potato yield is lost due to poor land preparations by farmers. It is thus vital for the government and other players in the sub-sector to incorporate appropriate technologies to tap the yield potentials • There is also need to streamline marketing system of both inputs and produce in the sub-sector.	Need to fully streamline the potato sub-sector value chain all the way from the seed potato to the ware potato marketing. This will ensure a "level playing field" for all players in the chain.

SWOT Analysis

Strengths	**Opportunities**
• Diverse stakeholders bringing together small-scale farmers, business executives, academics and a variety of leaders both in public and private sector. This combination gives the company access to information of a diverse nature • The company has proximity to major production and fairly good	• Ready market with a substantial potential for growth and expansion • Support by major market outlets i.e. institutions, supermarkets and large caterers • Good will from major machinery suppliers • Potential for extended seed and

communication to the main markets • Has a good supply base supported by farmers who are also shareholders • The company has good connections to key market players e.g. buyers of pyrethrum and major consumers of horticulture • The company has a strong team of technical staff (7 agronomists) working in different parts of districts in which the company is operating who have experience in horticulture under the direction of a chief agronomist previously working for KARI-Tigoni. • Capability to produce seed potato at 20-25 shillings per kg compared to Ksh 38 for KARI	ware market in the country
Weaknesses • The company is dealing with rain fed agriculture and therefore subject to the vagaries of weather • Dealing with many small-scale farmers far flung in the growing areas leading to high overheads • It is a new player in the market without extensive long term experience in the potato sub-sector	**Threats** • Entry of competitors • Highly perishable produce • Climate change and eventual effects on rainfall availability

m. FRESHCO SEEDS

Freshco is a private seed producer that has been working mainly in producing seed for maize and other cereals using out-growers; the company is interested in seed potato production so it gets mini-tubers from aeroponics laboratories and multiplies them further into certified seeds for farmers.

Needs: Short term needs include identification of growers and sites, getting a source of mini-tubers, improving the capacity of their staff in potato production and acquiring storage facilities for the certified seed produced. The long term needs of the company are to own a cold store, to get a farm dedicated to certified seed production and to put up its own aeroponics technology.

SWOT Analysis

Strengths • Experience in the seed value chain • Good relationship with the regulatory authorities	**Opportunities** • The country has never had adequate supplies of certified seed and there is a revolving demand for seed potatoes as seed is an input that farmers will require every year
Weakness • Reduced working capital since the company will spread the available capital onto a new crop (potato). The company also lacks bulk transportation as it currently uses pickup vans	**Threats** • Current monopoly of ADC in terms of storage capacity • Competition that will come from other seed companies • Strain on the current operating capital • Weakness of the current extension service which is suppose to teach farmers about the importance of certified seed and thus keep demand for seed high • Capacity of out-growers to grow certified seeds from mini tubers which may be inadequate • The culture of impunity in the country so that out-growers may not always honour their contracts

Regulatory /policy framework and Certification in the seed potato

n. Ministry of Agriculture (MoA)

The ministry is mandated to create a policy and legal framework for the seed potato industry. There is a draft potato policy in place and a legal potato notice but which has not been implemented. The government intends to harmonise all crop policies so as to avoid having many commodity based policies as has been the case in the past. The major problems the ministry faces in the potato sub sector are implementation of the legal notice, low funding to its institutes (KARI etc.) and transfers of officers after they get potato specific training. The institutional need is establishment of a Potato Council that would focus on high level management on potato activities.

Needs: Short term needs include increase in funding to allow provision of structures for the seed industry (capacity building, (irrigation, laboratories etc.}, land for KARI-Tigoni). Political will to allow MoA to channel some of the money from the orphan crops programme to the two Tigoni sub-centres of Marimba and Marindas for installation of irrigation facilities from January 2009. In the long term the government through KARI expects to be involved in basic seed production but the private sector will carry out production of certified seeds.

SWOT Analysis

Strengths • Has a strategic plan and a strong implementation framework • Wide geographic presence in the country.	**Opportunities** • Potato is a food security crop which the ministry considers important. The ministry is thus motivated to invest in the sector
Weaknesses • Monetary constraints • Data collection and storage needs improving to facilitate monitoring and evaluation • Ministry currently does not have extensive partnership with the private sector except with KENAPOFA (Kenya	**Threats** • Displacement of potato farmers by the post election violence in early 2008. • Officers trained in potato issues at a cost by the ministry are transferred from potato growing areas and their replacements have to be retrained at

National Potato Farmers Association) which was given financial assistance by the MoA through KAPP for the potato legal notice	a cost • Climate change and global warming have negatively affected areas originally designated for potato diseases screening and seed production

In the envisioned structure KARI/ADC (and, potentially, private companies) produces basic seed and both ADC and the private companies multiply the certified seed. There would be no problem with capacity as distribution and marketing would be left to the private sector and the legal and policy framework to do this is sufficient. Ksh 250 million would be needed on a yearly basis to set up and run a potato authority and since funding would be a constraint if the potato authority was set up the only feasible option is a public/private partnership promoted by the MoA in the face of current realities. This envisioned structure will come out strongly in the potato strategic plan but for now it is more of a vision then a reality.

o. Kenya Plant Health Inspectorate Services (KEPHIS)

KEPHIS is a government institution with a certification mandate. Seed potato is under mandatory certification with the greatest challenge being diseases, especially bacterial wilt and virus diseases. Additionally, new potato varieties must be officially released by undergoing Distinctiveness, Uniformity and Stability (DUS) tests and National Performance Trials (NPTs) which are supervised and/or carried out by KEPHIS before any potato variety can be commercialised in the country, and so direct importation by growers is not permitted by law unless these are small quantities to be used for research purposes.

SWOT analysis

Strength	**Opportunities**
• Many years of experience in potato inspection	• Increased demand by industry for disease-free seeds

• Professionalism deriving in part from experience form commercial export horticulture sector.	• Aeroponics will lead to rapid multiplication of potatoes but in order to maintain seed quality there is a need for KEPHIS to maintain standards
Weaknesses • Regulation lacks flexibility and reviewing and amending is difficult and has taken a long time • Diverse interests of the various stakeholders on the seed laws/regulations.	**Threats** • Organisational capacity may not be able to keep pace with demand

Source: Master plan Institutional Evaluations

APPENDIX 6: BUDGET NOTES

General Guidelines:

The master plan period of 5 years is structured as follows: First and second years: Short Term (ST); third and fourth years: Medium Term (MT) and fifth year: Long Term (LT). Budget estimates are based on costs of production from ADC, KARI, CIP, Midlands, Farm level data, Government operational allowance rates and rates used by Development partners. There are a total of 10 Districts (old) that grow potatoes which have been used for budget purposes.

TABLE 31: BUDGET DETAILS

1. Operational Allowance for 10 weeks a year by 3 days per week at Kshs. 6,500/day
2. Allowance for 7 people @ Kshs 2000 for 10 days and lunch @Kshs 1000
3. A routine activity that can be financed under the annual KARI-Tigoni budget
4. 2 Breeders @Kshs 500,000 and 4 technicians@250,000-all in the short run
5. To consult KARI-Tigoni
6. Regular activity by MoA (no Extra cost)
7. I Ha is sufficient to bulk 40 MT in the short run at Kshs. 380,000
8. 8 NPT trials @ Kshs 100,000 x 2 years ST x 2 years MT by 1 year LT
9. Proposal development expected to cost 250,000 during the S.T
10. To bulk 100MT will require about 5 Ha for cleaning and multiplication @ Kshs 250,000 per Ha within the SR, MT and LT
11. To bulk 100MT on 5Ha every year @Kshs 250,000 per Ha x 2 years ST by 2Years MT and by 1 year long term
12. Zoning and remapping of disease free areas will require GIS and potato experts and cost estimates are based on the expenses incurred in the revision of Farm Management Hard Book to be done in MT
13. Develop business plans within the value chain @Kshs 250,000 (Consultancy fees) to attract private sector
14. Cost of producing 240,000kg of mini tubers through aeroponics which is sufficient to plant 10.8ha @Kshs 37/kg per annum per to plant 36ha per annum is Kshs 59,200,000 for ST,MT and LT
15. 60 awareness fora in 10 districts at Kshs 30,000 to cover staff, farmer allowances and transport, short term, 12 forums x2years x30,000 by 12 forums x2 years x30,000 by 12 forums x 1 year x30,000
16. Operational allowances for 6 new staff for 10 weeks x3days a week x Kshs 6,500/day on termly basis
17. One vehicle in the short run @Kshs 3,000,000
18. Authorization of Private companies to certify will not attract additional costs
19. Variable costs to multiply seed @ Kshs 152,000 per Ha on a total of 7Ha with cost increase projections of 10% in MT and Long term.
20. Out-growers will be provided with inputs by KARI at above rates sufficient for 14 ha. ST, 28 ha. MT and 35 ha. LT
21. Mobilization and recruitment of farmer groups on yearly basis i.e. 2 groups x 2 years x 30,000 by 2 groups x 2 years x 30,00 by 2 groups x 1 year x 30,000.
22. Out-growers will be provided with inputs by ADC at a rate of Kshs 152,000 per Ha to cover 14 ha in ST, thereafter proceeds to sustain production.
23. Logistical and operational costs of @ Kshs 10,000 for at least 2 companies per district per year x 2 year in the ST, and variable costs for multiplication @ Kshs 152,000 per ha, for 30 ha in the ST

24. Privatization in year Five to cost Kshs 2.5 million on logistics/ prospectus development
25. Logistics and mobilization of at least 5 multipliers x 1 district x 10 districts x Kshs 5000 x 2 years ST by 5 Multipliers x 1 district x 10 districts x Kshs 5000 x 2 years MT by 5 Multipliers x 1 district x 10 districts x Kshs 5000 x 1 year LT
26. No budget implication; Midlands to finance its operations
27. Training costs 1 inspector x 1 district x 25,000 (10 districts) x 1 year ST by 1 inspector x 1 District x 25,000 x 1 year MT by 1 inspector x 1 district x 25,000 x 1 year LT
28. Transport costs 1 Inspector x 15,000 (10 districts) x 1 year ST by 1 inspector x Kshs 15,000 x 1 year MT by Inspector x 15,000x 1 year LT
29. Cost of developing business plans for various value chain activities to be undertaken by the private sector @ Kshs 1m per year, ST and MT
30. To establish cold storage facilities with a capacity of 200MT (At least one cold storage per district with capacity of 200tons (Based on recent rehabilitation costs of ADC which was 6m now projected to 10 m)
31. Consultancy in the first year at a cost of Kshs 1.5m to establish an sms based information sharing system, Kshs 500,000 for 10 computers , Costs of staff development through short term training 1 IT personnel x 10 districts x Kshs 6500
32. Cost of logistics and planning for ST only and exhibitors to pay in subsequent years ("National Potato Council" to specifically organize potato trade fairs yearly in 8 regions @Kshs 200,000. Only in the short-term-there after Council to device sustainable ways of raising funds
33. Cost of training 500 farmers x 1 district x 10 districts x Kshs 1000 x 2 years ST by 500 farmers x 1 district x 10 districts x Kshs 1000 x 2 years MT by 500 farmers x 1 district x 10 districts x ksh1000 x 1 year LT
34. Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 10 days Allowances for the task force team
35. KARI's current budget for FY 07/08 was Kshs 2,584,000; proposal is to increase this allocation to Kshs 10,000,000 annually
36. MoA to incorporate the "Potato Council" in both the legal and policy framework. The council to operate at annual budget on Kshs. 750,000

Table 9

1. Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 5 days
2. Stationery expenses @2000 per district per year
3. No cost implications have been taken care of in the Formal system see number 31 above
4. Training of 90,000 farmers in 5 years in 10 potato producing districts (18,000 farmers per year at Kshs 1000 per farmer x 2 years ST by 18,000 x1000 x 2years MT and 18,000 x1000 x1year LT
5. At least 25 farmers per district @ksh50,000 per district (logistics and mobility)
6. At least 4 traders per district @ Kshs 1000 for 10 Districts in ST, MT and LT
7. No cost since already incurred under multiplication
8. At least half of the 90,000 farmers trained on seed production and hence 4,500 per district and 900 per year @ Kshs 1000 i.e. (900x2x1000) by (900x2x1000) by (900x1x1000)
9. Logistics, Mobilization, allowances and refreshments costs @ Kshs 500,000 ST only
10. Train 2,160 x 10 districts x 2 years (ST) x 1000 by 2,160 x 10 districts x 2 years (MT) x 1000 by 2,160 x 10 districts x 1 year LT x 1000
11. As above at a cost of Kshs 500 instead of Kshs 1000 since non-residential

Table 11

1. Kshs 8m for the survey and Kshs 2m annually to clean and multiply, based on costs of quick survey transport and aeroponics infrastructure
2. Allowances for the review committee in short run only (Funds for allowances in the short-term for 10 people @ Kshs 6,500 for 10 days)

Table 13

1. No cost implications; to make use of the existing district agricultural forums
2. Training of 20 stakeholders in each of the 10 districts during ST and MT at a cost of Kshs 1000 per person for 2 days.

APPENDIX 7: DETAILS ON STUDY METHODS USED

Activity 0: Pre-preparation

Organize meetings for master plan formulation, write-up and implementation.

a. Planning meetings

This will entail defining

i. Tasks involved
ii. Who to do what
iii. Who to finance what
iv. How and who to implement what recommendations

b. Enlist necessary organisations/ institutions and work force

Activity A: Preparation

a. Planning meetings
   i. To organize and share tasks involved
b. An in-depth desk study will be conducted to collect and collate available information on current status of the seed potato system
   ii. Identify and source relevant literature
   iii. Drafting the potato sub-sector framework used in identifying players

Activity B: Institutional Evaluations

1. Find out what is in place in every relevant institution-KARI, CIP, ADC and KEPHIS, MoA etc., in terms of problems, needs and capacities of these institutions
   i. What is the institution's mandate in the seed potato sub-sector?
   ii. What are the problems/challenges encountered when the institution is playing its role in the seed potato sub-sector?
   iii. What are the shorter and long term needs for the institution to perform optimally in terms of financial, legal, personnel and other capacity requirements?
   iv. What is the status of production of basic seed using conventional and modern technologies (conventional breeding, hydroponics, aeroponics)?
      a. How much is invested in modern and conventional technologies and cost analysis of the two technologies)?
   v. Estimates of seed production by various players in terms of-
      1. Cost of production and prices of (mini-tubers, in vitro etc.)
      2. Quantity produced per year/ season
2. What is the existing regulatory and policy framework of seed potato sub-sector (from the MoA)?
   i. Strengths, weaknesses and opportunities
   ii. What exists and is (not) in the pipe line of being implemented
   iii. Budgetary support

3. Evaluate the existing private/public companies (e.g. Kenya Seed, GTI, Midlands Ltd, Freshco Ltd):

i. Contribution in the seed potato sub-sector (technology or seeds)?
ii. What problems have they been encountering in the course of their business in seed potato sub-sector?
iii. What are the most urgent needs in terms of financial, institutional, legal, and personnel capacity requirement to allow optimal performance?

4. What are the institutional SWOT in undertaking its mandate in seed sub-sector?
5. Explore models/systems of seed potato production that would see efficiency of the role played by the institution upon enhancement and improvement of the whole sub-sector development in terms of:
   i. Seed production, quality, distribution, marketing, utilization, legal and policy framework
   ii. What are the implications of the suggested models/ systems in terms of:
      1. Cost of suggested changes in models/ systems to the institution, government, etc.?
      2. What are the weaknesses and strengths of the suggested models/ system?
      3. Get plans, strategies and budgets of each players best performance and cost, institutional and capacity shortcomings

Activity C: Rapid appraisal

1. Get an overview of the potato production sub-sector in the district visited. This will be in terms of:
   i. Give an overview of seed potato marketing channels in this district
   ii. What are the major seed sources in the district?
   iii. How is the seasonality of seed potato production in the district?
   iv. What are the major constraints/challenges/problems encountered in seed potato industry in this district?
   v. How is private sector involvement in the seed potato industry? Name those involved in this district and say what their roles are.

Name of the private sector	Roles

vi. What is the importance (e.g. economic, food security) of potato to the community in this district?

2. Estimate the total acreage (ha) under potato, total potato output (t) and yields (t/ha) in the district
3. Estimate total quantities of seed potatoes and ware potatoes marketed in the district (t)
4. Get ware and seed prices-current 2008 and for the past five years (2007, 2006, 2005, 2004 and 2003)

Years	**2008 (current)**	**2007**	**2006**	**2005**	**2004**	**2003**

Ware						
Seed prices						

5. What is the status of distribution and/ or other roles played by the institution?
    1. Quantities and quality of products
    2. Effectiveness and efficiency of the process
    3. Institutions SWOT on the product and processes
6. Identify all players and other stakeholders involved in potato sub-sector within the district
7. What ideas would make the potato industry perform better than it is performing today?
8. Identify the barriers/challenges you have been experiencing in seed production, marketing, distribution or any other activity your institution is involved in the potato industry.
9. Identify major ware and seed potato markets in the districts and number of players and also estimate average quantities handled by each player.
10. Prepare the ground for the oncoming district stakeholders' diagnostic forums.
11. Establish contact with the stakeholders in the district as much as possible.
12. A check list to be left with stakeholders or with contact person at the district level (DAO) indicating what will be discussed during district forums.
13. Randomly select 4 representative small scale potato farmers to be invited to the district forums among other stakeholders (Farmers large and small scale), private institutions (e.g. seed companies, seed stockists), KEPHIS, DAOs, development agencies involved in seed potato production such as DANIDA, Action Aid, Plan International among others in the district they operate).

Activity E: Diagnostic forums

Diagnostic forums will be held with players and other stakeholders in the potato sub-sector in each of the nine (9) major districts growing potatoes in Kenya. The activity intends to achieve the following:

1. Bring together representative potato growers and other stakeholders to small district stakeholders forums with a view to
    i. Suggesting/proposing models/systems of producing sustainable seed potato in the district that would make production, distribution and marketing of potato seed more efficient and more participative by farmers, private sector and government.
    ii. Exploring these models/ systems of seed potato production and see which would see efficiency of the role played by the institution enhanced and sub-sector development in terms of:
        a) Seed production, distribution, marketing, utilization, legal and policy framework
        b) What are the implications of the suggested models/ systems in terms of
            - Cost of suggested changes in models/ systems to the institution, government, etc.?
            - What are the weaknesses and strengths of the suggested models/ system?
            - Check if costs are comparable with other existing systems

iii. Find out the potential need for establishing seed potato production and distribution in the district
iv. Get plans and strategy budgets of each players' best performance and cost, institutional and capacity shortcomings

2. Collect information about the awareness of clean seed potato among the stakeholders and farmers participating in the forum using the following guiding questions
    a) Sources of seed potato for planting within the district?
    b) Which source is most preferred and why?
    c) Is quality of seed potato important and why?
    d) What does quality/clean potato seed mean?
    e) Where are they available in the district?
3. Estimate seed production by various players to be compared with estimated seed production from main seed producers in and outside the district
    i. Cost of production, prices
    ii. Ware and seed prices-current 2008 and for past five years (2007, 2006, 2005, 2004 and 2003)

Years	**2008 (current)**	**2007**	**2006**	**2005**	**2004**	**2003**
Ware						
Seed prices						

4. Get the divisions, sub-locations and villages growing potatoes in the district visited

Activity F: Supply and Demand Study

This will involve the development of a study design and survey instruments based on the findings from the diagnostic forums. The intention will be to fill up the missing gaps and to get the farmers to have their inputs regarding various issues.

Objectives of the study

The broad objective of this study will be to appraise constraints and other bottlenecks embedded in the seed potato sub-sector. Specifically, the study will be intended to quantify supply and demand for seed potatoes in ten (10) potato growing districts.

Methodology

A sample size of 1,300 respondents will be targeted. Questionnaires will be designed with both closed and open questions such as the status and awareness of the need to use clean seed, demand, accessibility/availability of

clean/certified seed to the farmers within each of the districts, as well as questions on the cost of seed potato production and prices of the same. These questionnaires will be administered to about 0.7% of randomly selected respondents in 10 major potato growing districts. Sampling will be done at two levels (division and village level). Divisions within a district will be sampled followed by village sampling within divisions after which respondents will be sampled at village level.

Data entry and management will done using CSPro software while description statistics and regression analysis will done using Excel, SPSS and Stata.

Activity G: Stakeholders' consultative workshop

1. After compiling the findings from the institutional evaluation, rapid appraisal, diagnostic study and the demand study a stakeholders' consultative workshop will be held where the summary of the findings will be presented (draft report). These participants will include
    i. experts from CIP (Lima and Nairobi)
    ii. experts and relevant officers from KARI, MoA, KEPHIS, etc.
    iii. Stakeholders -KENAPOFA, KENFAP, etc.
    a. The participants will be allowed to have further inputs into the draft report which will be summarized by the reporter for incorporation in the final report.
    b. It is also during the workshop that, models/systems of producing sustainable seed production system will be revisited by the participants and the best model will be agreed upon
2. After the workshop a task force of four people will sit and incorporate the deliberations from the participants into the final document before briefing the sponsors (GTZ, CIP)
3. A draft of a National seed potato master plan ready for presentation to PS will be ready by March 2009
    a. Final report accomplished incorporating PS's comments and inputs