



REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES
STATE DEPARTMENT OF AGRICULTURE

ROADMAP FOR RICE SEED DEVELOPMENT

2016 - 2026





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Fig 1: Participants to the improved rice seed strategy validation stakeholders' workshop, KALRO Headquarters, January 2016

Foreword

The Kenya Vision 2030 identifies agriculture sector as a key driver to deliver the 10 percent annual economic growth rate by contributing more than Ksh. 80 billion annually to GDP as envisaged under the economic pillar. The sector has cascaded the aspirations of the Kenya Vision 2030 through Agricultural Sector Development Strategy 2010-2020, which aims at improving the standard of living of Kenyans through improved food security, income generation and employment creation. Agricultural growth and development is crucial for Kenya's overall economic and social development. Agriculture sector directly contributes 27.3 percent to Gross Domestic Product (GDP); and in terms of contribution to the agricultural GDP, crops agriculture amounts to 77.6 percent.

The government has prioritized rice as an important food crop for promotion in order to address food security in the country. Over the years rice has been an important staple food for the majority of urban dwellers. However in the last ten years consumption of rice by Kenyans living in the rural areas has grown tremendously. This trend is likely to continue due to changes in eating habits. Currently, the per capita consumption is increasing at a rate of 12% as compared to 4% for wheat and 1% for maize, which is the main staple food.

Advancement in rice sector is increasingly becoming important to Kenya's core strategies on poverty reduction and economic development. Good quality seed is one of the vital inputs that can significantly improve total factor productivity of rice crop even in smallholder farms. Enhancement of production and supply of quality rice seeds therefore constitutes a major strategic intervention.

The purpose of this document is to assess the challenges and issues across the rice seed value chain and set out a roadmap for developing the rice seed sub-sector that shall augment the envisaged national rice production. The proposed strategic interventions will need to be supported by all stakeholders for its successful implementation.

I wish to acknowledge the support, guidance and facilitation provided by the Coalition of Africa Rice development (CARD) secretariat and the whole rice stakeholder fraternity for the continued support and provision of invaluable information that has been used to prepare this document.



Willy Bett
Cabinet Secretary
Ministry of Agriculture, Livestock and Fisheries

Preface

Setting precedence in the region, Kenya recognized the importance of quality seeds by enacting statutory laws through Seeds and Plant Varieties Act (Cap 326) in 1972. Cap 326 determined the basic rules governing the seed sector and stakeholders. It aimed to regulate transactions in seeds by including institutional frameworks for the testing and certification of seeds. It also provided guidelines for the introduction of new varieties, importation of seeds and provides proprietary rights to persons breeding or discovering new varieties.

Rice is largely cultivated by smallholder farmers under such diverse production environments as irrigated and rain fed (upland and lowland) ecosystems. Owing to a rapid growth in consumption demand for rice, Kenya annually imports about 450,000 tons of milled rice from other rice producing countries. National Rice Development Strategy (NRDS) developed in 2008 and covering the period up to 2018 aims to increase the domestic rice production by 9.3% per year in order to attain self-sufficiency.

This roadmap aims to increase the use and supply of certified seed from the presumed level of 40% to 75% by 2030 by (a) promoting the adoption of certified rice seeds of improved varieties by smallholder farmers; (b) improving the timeliness, availability, affordability and accessibility of certified seeds; (c) enhancing the quality of seeds through technical reviews and regional harmonization of seed regulations; and (d) building human- and technical capacities of stakeholders along the rice seed value chain.

The roadmap will be implemented through the existing organizational structure for National Rice Development Strategy under Rice Promotion Unit. Periodic monitoring of the progress and implementation of this roadmap will be performed by the National Rice Technical Committee based on inputs and feedback from stakeholders and technical assistance from Rice Seed Consultative Committee. Funds for the implementation of this roadmap will be sourced from the government, development partners and other public- and private stakeholders through development of project concept notes on the various proposed interventions.

I take this opportunity to call upon all the stakeholders to pool resources towards realization of strategic objectives in this roadmap so that they play their valuable role towards the attainment of what is envisaged in this document.



Dr. Richard L. Lesiyampe, PhD, CBS
Principal Secretary,
State Department of Agriculture

Executive Summary

Advancement in rice sector is increasingly becoming important to Kenya's core strategies on poverty reduction and economic development. Rice is largely cultivated by smallholder farmers under such diverse production environments as irrigated and rain fed (upland and lowland) ecosystems. Owing to a rapid growth in consumption demand for rice, Kenya annually imports about 450,000 tons of milled rice from other rice producing countries. National Rice Development Strategy (NRDS) aims to increase the domestic rice production by 9.3% per year in order to attain self-sufficiency.

Good quality seed is one of the vital inputs that can significantly improve total factor productivity of rice crop even in smallholder farms. Enhancement of production and supply of quality rice seeds hence constitutes a major strategic intervention identified under the NRDS. The purpose of this document is to assess the challenges and issues across the rice seed value chain and set out a roadmap for developing the rice seed sub-sector that shall augment the envisaged national rice production.

Kenya has recently (2011) amended its Seed and Plant Varieties Act (Cap 326; 1972) and classified rice as one of the scheduled crops for which certification of seed is compulsory. Rice seed is typically produced through a minimum of four stages of sequential multiplication. The breeding institutions which develop the variety produce small amount of initial source of seed (breeder seed) using which pre-basic, basic and certified seed of a given variety are produced. Under the current regulations, certified seed can be further multiplied for up to a total of 4 cycles.

Kenya Plant Health Inspectorate Service (KEPHIS) is the leading regulatory authority for assuring the quality of seed available in the country. The national policies recognize breeders' rights and promote active participation of private sector in production and supply of certified seeds. While the role of public institutions are limited to development of varieties and maintenance of the genetic integrity of the released public varieties, the commercial production of rice seed is carried out by registered business units of public institutions such as KALRO, NIB and private companies and rice farmers' cooperative societies.

Although the laws and policies require rice seed to be produced and distributed through a formally recognized system, the self pollinating nature of rice crop prompts the risk-averse smallholder farmers to often recycle a portion of the harvested grain as seed. By inhibiting the demand for certified seed, this predicament poses one of the biggest challenges to advancements in rice seed value chain. Nonetheless, trends in seed production suggest strong growth in demand in the recent years although the exact quantification of demand for certified rice seed is not yet made.

Most of the rice seeds of all classes are invariably produced by growers in smallholder farms. Insufficient technical appropriations, low levels of technological adoption and demographic pressure on land intrinsically exert pressure on the volumes and quality of rice seeds produced. Limited human resources and infrastructural and logistical constraints for inspection and seed testing by KEPHIS, inconsistencies in standards set for field inspection and seed testing, and lack of regional harmonization of seed regulations cloud the certification processes.

Inadequate infrastructures for seed processing and storage, lack of coordination of utilization of existing facilities, and poor adherence of the seed production contracts by the parties stifle the timely availability of seed. Higher costs involved in packing, labeling and logistics exert pressure on the uptake of certified rice seed. Lack of an effective platform for dialogues between the different stakeholders also curbs the potential of the rice seed value chain.

This roadmap aims to increase the use and supply of certified seed from the presumed level of 40% to 75% by 2030 by (a) promoting the adoption of certified rice seeds of improved varieties by smallholder farmers; (b) improving the timeliness, availability, affordability and accessibility of certified seeds; (c) enhancing the quality of seeds through technical reviews and regional harmonization of seed regulations; and (d) building human- and technical capacities of stakeholders along the rice seed value chain.

Under this roadmap, discrepancies in the current national standards of purities of field population and seed lots for the different seed classes will be reviewed. Inventory on existing drying, storage and processing facilities will be conducted, and effective utilization of such infrastructures and facilities will be promoted through public-private partnerships. Linkages between seed producers, agro-dealers, farmers and grain buyers/processors will be strengthened by establishing a forum for stakeholders engaged in rice seed value chain under the guidance of National Rice Seed Consultative Committee.

Through analytical surveys, the dynamics of demand, supply and prices of rice seed of different varieties in different rice growing regions will be established. Production of the different seed classes of the different rice varieties will be accordingly coordinated so that a critical mass of source seeds is constantly available. Rice shall be included as one of the commodities under the strategic grain reserve program in order to scale out the uptake of certified rice seeds through National Accelerated Agricultural Input Access Program.

Rice varietal catalogs will be refined and updated with descriptors of Basmati, Sindano and other popular traditional varieties. Training on seed production, field inspection and internal seed quality control measures by private seed companies shall be routinely organized. Awareness on good agricultural practices, benefits of using certified rice seeds and safety hazards in handling dressed seeds will be disseminated to farmers. New recruitments of inspectors in rice seed producing regions and capacity building of staffs engaged in production and inspection through short- and long term courses will be organized.

The roadmap will be implemented through the existing organizational structure for NRDS under Rice Promotion Unit. Periodic monitoring of the progress and implementation of this roadmap will be performed by the National Rice Seed Consultative Committee based on inputs and feedback from stakeholders and technical assistance from rice seed taskforce. Funds for the implementation of this roadmap will be sourced from the government, development partners and other public- and private stakeholders through development of project concept notes on the various proposed interventions.

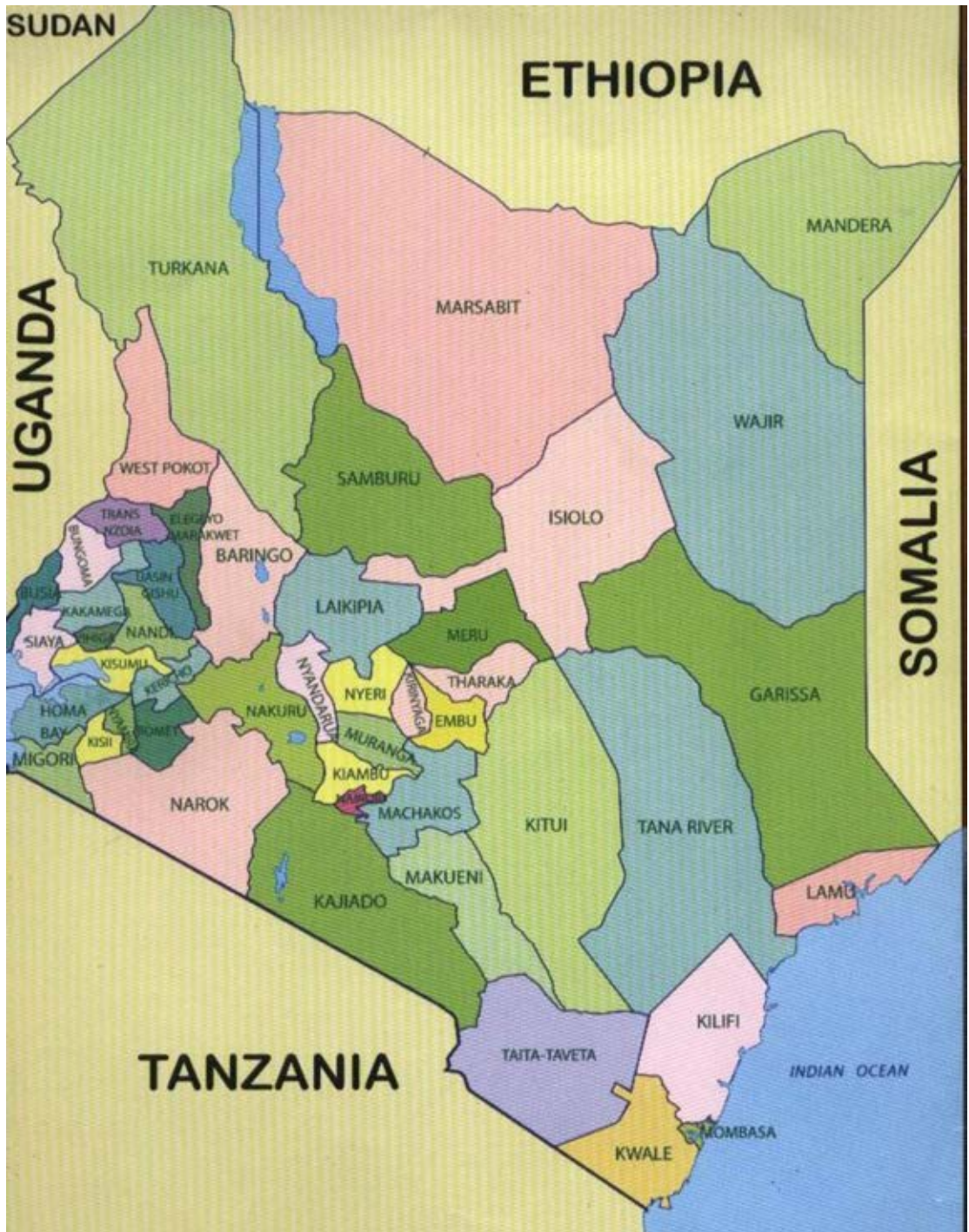


Fig 2: Map of Kenya

Acronyms and abbreviations

AFC:	Agricultural Finance Corporation
AFFA:	Agriculture Fisheries and Food Authority
ASDSP:	Agriculture Sector Development Strategy Program
COMESA:	Common Market for Eastern and Southern Africa
DUS:	Distinctness, Uniformity and Stability tests
EAC:	East African Community
IRRI:	International Rice Research Institute
JICA:	Japan International Cooperation Agency
KALRO:	Kenya Agriculture and Livestock Research Organization
KEPHIS:	Kenya Plant Health Inspectorate Service
KEBS:	Kenya Bureau of Standards
KFA:	Kenya Farmers' Association
KSU:	Kenya Agriculture and Livestock Research Organization Seed Units
MIAD:	Mwea Irrigation Agricultural Development
MOALF:	Ministry of Agriculture, Livestock and Fisheries
MRGM:	Mwea Rice Growers Multipurpose Cooperative Society
NAAIAP:	National Accelerated Agricultural Input Access Program
NCPB:	National Cereals and Produce Board
NERICA:	New Rice for Africa
NIB:	National Irrigation Board
NPT:	National Performance Trials
NRDS:	National Rice Development Strategy
NRSCC:	National Rice Seed Consultative Committee
OECD:	Organization for Economic Co-operation and Development
RIPU:	Rice Promotion Unit
STAK:	Seed Traders Association of Kenya
UPOV:	International Convention for the Protection of New Varieties of Plants

Table of Contents

Foreword	i
Preface	iii
Executive Summary	v
Acronyms and abbreviations	viii
List of Figures	xi
List of Tables	xii
1. Introduction	1
2. Review of National Rice Seed Sub-sector	5
2.1. Legislation, Policy, Institutions and Planning Aspects	5
2.1.1. Legislations	5
2.1.2. Policy	6
2.1.3. Institutional frameworks	6
2.1.4. Planning	8
2.2. Production	9
2.3. Quality Control	12
2.3.1. Methods	12
2.3.2. Human Resources	15
2.4. Supply	16
3. Challenges in National Rice Seed Sector	19
3.1. Legislation, Policy, Institutions and Planning	19
3.2. Production	20
3.3. Quality Control	21
3.4. Supply	22
4. The Strategies	23
4.1. Vision and Scope	23
4.2. Position of Rice Seed Roadmap	23
4.3. Goal and Objectives	23
4.5. Implementation Structure	23

Table of Contents

5. Strategies and Targets	25
5.1. Strategic Principles and Approaches	25
5.2. Target Setting and Gap Identification	25
5.3. Intervention Options	30
5.3.1. Legislation, Policy, Institutions and Planning (Recommendations)	30
5.3.2. Production and Inspection	31
5.3.3. Supply and Marketing	32

List of Figures

Fig 1: Participants to the improved rice seed strategy validation stakeholders’ workshop, KALRO Headquarters, January 2016	
Fig 2: Map of Kenya _____	vii
Fig. 3: Trends in rice production in Kenya _____	1
Fig. 4: Gaps between domestic rice production (paddy) and consumption in Kenya __	2
Fig 5: National Rice Stakeholders forum, KALRO Naivasha, April 2016 _____	5
Fig 6: Joint observation of newly introduced varieties by KEPHIS inspectors and other stakeholders _____	16
Fig 8: A good field of rice – It all starts with high quality seed _____	24
Fig 9: Ear to row for basmati under upland irrigated/Ear to row under Paddy condition __	29
Fig 10: Rice produce marketing _____	33

List of Tables

Table 1: Institutions responsible for rice seed production, inspection and supply	7
Table 2: Budget allocation (in Kenya Shillings) for seed production/procurement	9
Table 3: Current production (or procurement), location and cultivated area of rice seed	10
Table 4: Recommended varieties for cultivation under different production environments	11
Table 5: Procedure and methods of on-plot seed inspection	13
Table 6: Procedure and methods of harvested seed inspection	14
Table 7: Purity standards of rice seeds followed by KEPHIS	15
Table 8: Rice seed value chain actors and supporters in Kenya	17
Table 9: Market prices of certified seeds of popular varieties	18
Table 10: Production targets for the four different seed classes of rice seeds	26
Table 11: Target amounts of certified seed and the land area required for the production for the popular varieties under the different ecosystems	26
Table 12: Target amounts of basic seed and the land area required for the production for the popular varieties under the different ecosystems	27
Table 13: Target amounts of pre-basic seed and the land area required for the production for the popular varieties under the different ecosystems	27
Table 14: Target amounts of breeder seed and the land area required for the production for the popular varieties under the different ecosystems	28
Table 15: Required human resources and the gaps for achieving the targets	28
Table 16: Human resources required for inspection and certification of the targeted seed production	29
Table 17: Training needs of human resources engaged in production of seed	30

1. Introduction

Introduced in 1907, the rice crop in Kenya was until recently grown mostly under irrigated schemes¹. Following the introduction of New Rice for Africa (NERICA) rice varieties however, expansion of cultivation of rice in rain fed lowland and rain fed upland conditions have become a recent phenomenon. Presently about 78% of the total area under rice cultivation is under irrigated ecosystem². Between 2008 and 2013, the total rice production has increased by about 7-fold, from 21,881 tons to 146,696 tons (Fig. 1). While the average on-farm rice yields of 4.25 t/ Ha obtained under irrigated ecosystems³ is comparable to the average on-farm rice yield levels (3.4-5.4 t/ Ha) obtained under similar ecosystems in Sub-Saharan Africa^{4,5}, the overall increase in total production shall largely be attributed to the increase in total area under rice cultivation.

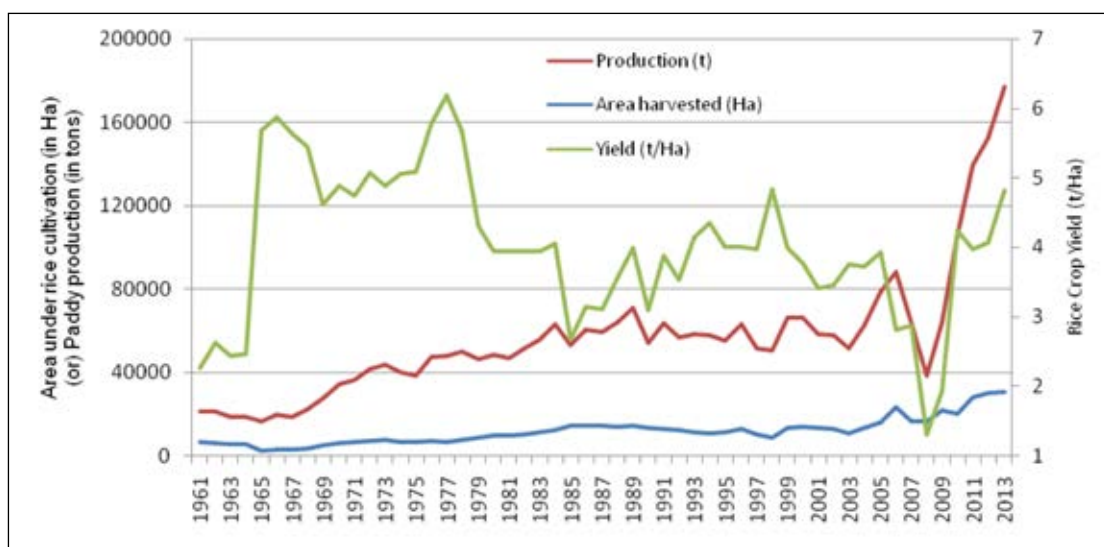


Fig. 3: Trends in rice production in Kenya

However, at an estimated growth in consumption rate of 12% per annum⁶, the market requirements for rice is set to increase to 517.5 million tons by 2030. Owing to such a rapid surge in demand, the domestic rice production has fallen short of the market demand since 1985 (Fig. 2).

¹ Ministry of Agriculture, Livestock and Fisheries (2008) National Rice Development Strategy

² Onyango AO (2014) Exploring Options for Improving Rice Production to Reduce Hunger and Poverty in Kenya, World Environment, 4: 172-179

³ Nicholas KT (2010) Agricultural Production and Irrigation Management: The Case of Irrigated Rice Production in Kenya; International Institute of Social Studies, Netherlands

⁴ Saito K et al (2015) Rice yield growth analysis for 24 African countries over 1960–2012; Global Food Security 10/2014; DOI: 10.1016/j.gfs.2014.10.006

⁵ Becker, M., Johnson, D.E., Wopereis, M.C.S. and Sow, A. (2003) Rice yield gaps in irrigated systems along an agro-ecological gradient in West Africa. Journal of Plant Nutrition and Soil Science 166, 61–67

⁶ Ministry of Agriculture, Livestock and Fisheries (2010) Economic Review of Agriculture; Central Planning and project monitoring Unit; Nairobi

Although the marketability of the locally produced rice such as Pishori is proficient, the fast widening gap between production and consumption has prompted local markets to resort to importation of milled rice grains from other rice growing countries such as Pakistan, Tanzania, India and Vietnam causing strenuous pressure on foreign exchange and trade balance. Estimates^{7,8} (Fig. 2) show that Kenya imported about 80% (450,000 tons) of the market requirements at an average cost of 87.5 million USD per annum over the past 5 years.

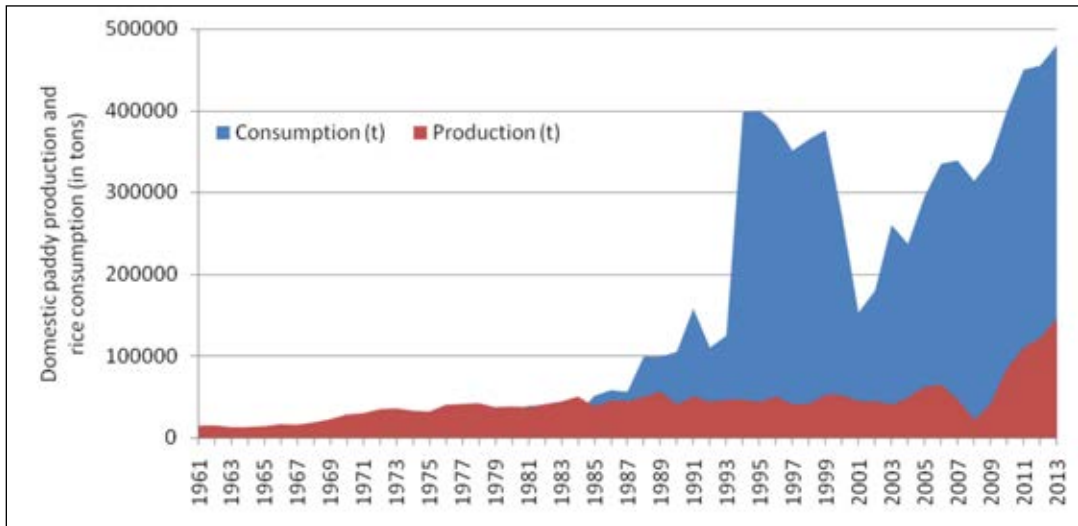


Fig. 4: Gaps between domestic rice production (paddy) and consumption in Kenya

Given the over reliance on international markets; the domestic rice production has significant implications on country’s food security and poverty reduction. Constant outbreaks of devastating maize lethal necrosis and market competition from the neighboring maize producing countries increasingly drive farmers in the upland to take up rice cultivation. Moreover, the sharp rise in consumer demand has casted rice to become the third most important cereal crop in Kenya⁹. Being a resource intensive crop, the production, post- harvest handling and processing of rice provide one of the largest sources of on-farm and off-farm employment and income generation for rural communities, including youth and women. Advancement of rice sector has thus become an integral part of the government’s strategic approaches towards poverty reduction and economic development; as outlined under the Agriculture Sector Development Strategy (2010-2020)¹⁰.

⁷ <http://www.indexmundi.com/agriculture/?country=ke&commodity=milled-rice&graph=imports>

⁸ Keya SO (2013) Can System of Rice Intensification Address Food Security in Africa? Baobab 3: 5-7

⁹ USAID (2010) Staple Foods Value Chain Analysis; Country Report - Kenya

¹⁰ Mabiso A et al (2012) Agricultural Growth and Poverty Reduction in Kenya: Technical Analysis for the Agricultural Sectoral Development Strategy (ASDS), ReSAKSS Working Paper No. 35 2012. IFPRI, Washington DC, USA

National Rice Development Strategy (NRDS) of Kenya¹¹ forecasts that in order for the country to attain self-sufficiency by 2030, the total domestic rice production must increase at a rate of 9.31% per annum. Although the local rice production has been rising in the recent past, meeting the consumption demand remains an elusive task. Implementation of NRDS in Kenya is overseen by Rice Promotion Unit (RIPU), an organizational structure under Ministry of Agriculture, Livestock and Fisheries (MOALF). NRDS taskforce comprised of different stakeholders of the rice value chain facilitates implementation of NRDS by providing technical back stopping and feedback, and resource mobilization for the implementation of NRDS. Good quality rice seed is one of the vital inputs using which the total factor productivity can be enhanced even in smallholder farms. Establishing high quality seed production and supply systems is envisaged as a key approach under the NRDS for enhancing on-farm rice crop productivity. This document analyzes the current seed policy, production and supply environments and presents a strategic plan for developing rice seed sub-sector in Kenya.

¹¹ Ministry of Agriculture, Livestock and Fisheries (2008) National Rice Development Strategy

2. Review of National Rice Seed Sub-sector

2.1. Legislation, Policy, Institutions and Planning Aspects

2.1.1. Legislations

Setting precedence in the region, Kenya recognized the importance of quality seeds by enacting statutory laws through Seeds and Plant Varieties Act (Cap 326) in 1972. Cap 326 determined the basic rules governing the seed sector and stakeholders. It aimed to regulate transactions in seeds by including institutional frameworks for the testing and certification of seeds. It also provided guidelines for the introduction of new varieties, importation of seeds and provides proprietary rights to persons breeding or discovering new varieties.

Following the ratification of International Convention for the Protection of New Varieties of Plants (UPOV) in 1991, Kenya upgraded the plant breeders' rights system by amending Cap 326 (the principal Act) through Seeds and Plant Varieties (Amendment) Act, 201112 and Crops Act, 201313. The amendment Act has further reinforced Kenya Plant Health Inspectorate Service (KEPHIS) as the national designated authority for implementation of regulations related to seeds and plant variety protection. The Act endorses the roles of private sector in multiplying and distributing seed to farmers. Farmers shall save and re-use seed of a protected variety only on their own holding. The exchange and sale of farm/farmer-saved seed amongst fellow farmers or any other seed users, as in informal seed systems of other countries in the region, is prohibited for protected varieties.



Fig 5: National Rice Stakeholders forum, KALRO Naivasha, April 2016

12 Republic of Kenya (2012) Kenya Gazette Supplement No. 217 (Acts No. 53)

13 Republic of Kenya (2013) Kenya Gazette Supplement No. 28 (Acts No. 16)

Under the Crops Act (2013), rice is described as one of the scheduled crops for which certification of seeds is mandatory. The Act prescribes government authorities to assist the development and market promotion of all the scheduled crops by the private sector. The Act also empowers county governments to provide license the actors, monitor and facilitate the enabling environment for the sustainable development of national seed production and supply systems.

2.1.2. Policy

Kenya's Seeds regulations (1995) emphasize the importance of certified seed system in the country and advocates adoption of global best practices by the stakeholders. Kenya's National Seed Policy (2010) outlines guidelines that aim to contribute to agricultural productivity through improvisation of seed production and supply systems. Seed certification is advocated as the major means of effecting quality control. The policy proposes registration of all actors along the seed value chain (including producers and suppliers/merchants) and prescribes stiffer penalties for violations of certification procedures.

The policy emphasizes that the country's seed production and supply systems should be led by the private sector and that the public sector shall be engaged in research and development of improved varieties and maintaining the released varieties. Nonetheless, it also specifies that public institutions shall only be engaged in production of seeds of those crop varieties that are not attractive to the private sector. Acknowledging the importance of creation of demand for certified seeds, the policy calls for strengthening of farmer extension and advisory services with a view to make farmers appreciate the benefits of using good quality seed.

Since Kenya's national seed laws and policies emphasize a larger role for private sector, development projects do not support informal rice seed multiplication. However projects promoting rice seed value chain developmental activities are presently supported by AGRA (Development of superior rice varieties and their seed system), JICA (Initiation of rice seed system and construction of seed store and cold room) and World Bank (East Africa Agriculture Productivity Project).

2.1.3. Institutional frameworks

The Acts and Policy instruments described above define the roles of public and private institutions in research, introduction and/or development of rice varieties, production, inspection and supply of seeds in Kenya. Both public and private institutions are engaged in development of germplasm. However they must be registered under the law for any commercial activity related to production and distribution of rice seeds. The value chain actors/stakeholders involved in rice seed production, inspection and marketing are shown in table 1.

Table 1: Institutions responsible for rice seed production, inspection and supply

		Name of Institutions	Roles/ Responsibility	Legislations/ Policies determining responsibility
Overall	Production	Public (Kenya Agriculture and Livestock Research Organization (KALRO) Seed Units (KSU) at Mwea and Kibos (Upland, hybrids), National Irrigation Board (NIB; irrigated varieties), Private Seed Companies	Seed bulking, Research	Seeds and Plant Varieties Act 326, Seeds and Plant Varieties (Amendment Act (2011), Crops Act (2013), National Seed Policy (2010)
	Inspection	KEPHIS	Seed inspection and certification	
	Supply/ distribution	KSUs at Embu and Mwea, Registered Seed Companies/ Merchants	Seed supply and distribution	
Breeder Seed	Production	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed bulking, Storage, Maintenance of varieties and parental lines	
	Inspection	KEPHIS	Seed inspection and certification	
	Supply/ distribution	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed supply and distribution	
Pre-Basic Seed	Production	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed multiplication, Storage	
	Inspection	KEPHIS	Seed inspection and certification	
	Supply/ distribution	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed supply and distribution	
Basic Seed	Production	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed multiplication, Storage	
	Inspection	KEPHIS	Seed inspection and certification	
	Supply/ distribution	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed supply and distribution	

		Name of Institutions	Roles/ Responsibility	Legislations/ Policies determining responsibility
Certified Seed	Production	Public (KSUs at Mwea and Kibos(Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies	Seed bulking	
	Inspection	KEPHIS	Seed inspection and certification	
	Supply/ distribution	Public (KSUs at Mwea and Kibos (Upland, hybrids), NIB (irrigated varieties)), Private Seed Companies and Registered seed sellers	Seed supply and distribution	

Although no exclusive forum for the stakeholders of rice seed sub-sector, rice stakeholders' forums (covering the entire rice value chain) that exist in the different rice growing counties serve as platforms for exchange of dialogues between public- and private entities could take place. At the national level, Seed Traders Association of Kenya (STAK) serves as an umbrella organization for the seed merchants. National Rice Technical Committee and National Rice Seed Consultative Committee provide technical assistance to the stakeholders of rice seed value chain. The Seeds and Plant Varieties Act(Cap 326) has also prompted the establishment of a Seeds and Plants Tribunal to address disputes arising within the seed trade. Seed users shall file complaints on their products and seek compensation through the tribunal. The decision of the Tribunal is final and conclusive except on a question of law itself, in which case a final appeal to the High Court may arise.

Kenya has also joined the Forum for Africa Seed Testing (FAST), a pan-African network of seed testing laboratories under the African Union and the African Seed Network. (FAST) is expected to harmonize the seed markets across the continent and fast track the implementation of laws in order to harmonize the sector and promote seed testing and quality control, including the drafting of seed testing protocols for major crops for both public and private companies.

2.1.4. Planning

Annual planning for production and supply of the various classes of rice seeds are done by both public- and private institutions. However, budget allocation for the activities in public institutions is usually lower than the requirement. Furthermore, annual allocation of budget for rice seed production or procurement is inconsistent and hence actual amount spent on carrying the planned activities vary from year to year. Table 1 shows the budget allocation for breeder, pre-basic, basic and certified seed production and supply in three public institutions viz., National Irrigation Board (NIB), Kenya Agriculture, Livestock and Research Organization's Seed Unit (KSU) and Rice Promotion Unit (RIPU).

Table 2: Budget allocation (in Kenya Shillings) for seed production/procurement

		2009	2010	2011	2012	2013
Breeder Seed	NIB	0	1600	3500	3500	3500
	KSU	10,000	20,000	50,000	150,000	200,000
	RIPU	0	0	0	0	0
Pre-basic Seed	NIB	0	0	60,000	83,000	70,000
	KSU	0	20,000	70,000	110,000	175,000
	RIPU	0	0	0	0	0
Basic Seed	NIB	0	0	0	83,000	75,000
	KSU	0	0	0	0	45,000
	RIPU	0	0	0	0	0
Certified Seed	NIB	0	0	0	170,000	160,000
	KSU	25,000	300,000	500,000	450,000	50,000
	RIPU	7,500,000	9,000,000	9,000,000	10,800,000	12,600,000

2.2. Production

In Kenya, four distinct classes or stages of production are followed along the rice seed production. These include the following sequence of production:-breeder seed, pre-basic seed, basic seed and certified seed. The breeder seed is directly derived from the original genetic accession or parental lines developed by the breeder. These seeds are produced under the direct supervision of breeders at the research institutions or stations operated by the registered institutions and/or private companies. Seeds obtained from the progenies of breeder seed represent pre-basic seeds from which basic seeds are obtained. Certified seeds are produced from basic seeds.

Certified seeds obtained from the basic seeds shall be used as a source seed for up to 3 further cycles of multiplication (Certified seeds I through IV). In most cases, the pre-basic, basic and certified seeds are produced in farmers' fields on contractual basis. Until recently, popular but older rice varieties for which proper breeder/pre-basic/basic seeds were not available, production of 'standard seeds' was practiced. During the production of standard seeds, selection of true type plants (showing described traits of the given variety) and bulking of seeds were allowed. Although no clear estimates are available, it is thought that about 60% of rice farmers in Kenya recycle the grains harvested as seed for the subsequent season.

Table 3: Current production (or procurement), location and cultivated area of rice seed

	Name of production stations	Total production/ procurement amount (MT)			Cultivated area per station (Ha)		
		2014	2013	2012	2014	2013	2012
Breeder Seed	KALRO-Mwea	0.050	-	0.001	0.005	-	0.0005
	KALRO - Kibos	-	-	-	-	-	-
	NIB/MIAD	-	-	-	-	-	-
Pre-Basic Seed	KEPHIS (Cumulative)	0.05589	0.03715	0.04050			
	KALRO-Mwea	0.070	0.001	0.00147	0.006	0.001	0.025
	Kenya Seed Co. Ltd.	-	-	-	-	-	-
	NIB/MIAD	0.050	-	0.001	0.005	-	0.0005
Basic Seed	KALRO-Mwea	-	-	-	-	-	-
	KEPHIS (Cumulative)	-	-	-	-	-	-
	Kenya Seed Co. Ltd.	-	-	-	-	-	-
Certified Seed	KEPHIS (Cumulative)	127.09	16.27	-	-	-	-
	KALRO-Mwea	-	-	-	-	-	-
	Kenya Seed Co. Ltd.	-	-	-	-	-	-
	KALRO-Mwea	10.00	12.00		2.00	4.00	-
Standard seeds	KEPHIS (Cumulative)	93.90	202.75	115.57	-	-	-

Seeds and Plant Varieties (Amendment) Act, 2011 has provided for the formation of seed regulations committee to oversee the monitoring of seed sector in the country. The Law also set forth national performance trials regulations for all released varieties in Kenya and the corresponding plant breeders' rights regulations. Presently there are 10 rice varieties recommended for cultivation under irrigated ecosystem, 4 rice varieties under rain fed lowland ecosystem, and 6 rice varieties under rain fed upland ecosystem (Table 4). Presently all of these varieties are produced for commercial markets as well as consumption by farm families (subsistence). Even in the rain fed upland environments where rice was introduced only recently, farmers keep aside a portion of their production by their families although a substantial amount of the grains produced are sold in the markets.

Table 4: Recommended varieties for cultivation under different production environments

Agro-Ecological Zones	Name of Varieties	Purpose
Irrigated Lowland	Basmati 217 (Nibam 10)	Market and Subsistence
	Basmati 370 (Nibam 11)	Market and Subsistence
	IR2793-80-1 (Nibam 108)	Market and Subsistence
	ITA 310 (Nibam 110)	Market and Subsistence
	BW 196 (Nibam 109)	Market and Subsistence
	Jasmine 85	Market and Subsistence
	Arize 6444 Gold (hybrid) from Bayer East Africa	Market
	Arize Tej Gold (hybrid) from Bayer East Africa	Market
	SC 213 from Afritec	Market
	Trenasse from Afritec	Market
Rain-fed Lowland	IR-05N221 (Komboka)	Market and Subsistence
	MWIR 2	Market and Subsistence
	Arize 6444 Gold (hybrid) from Bayer East Africa	Market
	Arize Tej Gold (hybrid) from Bayer East Africa	Market
Rain-fed Upland	NERICA 1	Market and Subsistence
	NERICA 4	Market and Subsistence
	NERICA 10	Market and Subsistence
	NERICA 11	Market and Subsistence
	MWUR 4	Market and Subsistence
	DouradoPrecoce	Market and Subsistence

Registered units of both public and private seed companies are engaged in multiplying the seeds of these released varieties. Presently however, Kenya Seeds Company Ltd. is almost exclusively engaged in production and supply of seeds recommended for rain fed upland ecosystems. Under irrigated ecosystem, while the public registered units such as KALRO Seed Unit (KSU), National Irrigation Board (NIB), Mwea Irrigation Agricultural Development (MIAD) Centers and Mwea Rice Growers Multipurpose (MRGM) Cooperative Society are engaged in production and supply of inbred varieties, Bayer East Africa Ltd has introduced certified seeds of rice hybrids.

2.3. Quality Control

Kenya Plant Health Inspectorate Service (KEPHIS), a government parastatal, is responsible for assuring the quality of rice seeds produced and supplied in Kenya. It is engaged in developing and implementing standards for both the locally produced rice seeds and imported rice seeds for purposes such as research, multiplication and distribution. It undertakes inspection, testing, certification, quarantine control, variety testing and description of seeds of all released rice varieties.

2.3.1. Methods

In principle, KEPHIS adheres to the standard operating procedures laid out by Organization for Economic Co-operation and Development (OECD). KEPHIS performs the following specific sets of procedures in performing inspection and certification of rice seeds:-

1. Document verification: The seed producers (or merchants) must have registered and provide proof of origin of the variety and crop that they intend to grow. Only registered Seed growers contracted by registered seed merchants can grow seed for certification.
2. Field inspection involves an examination of rice crop seed field for conformity to pre-laid standards (Table 5) as part of seed certification program. The following are checked in the field;
 - (a). Origin and identity of parent seed: It is essential that a seed crop is produced from a known parent seed source. A seed label may be used as proof of the origin of the parent seed
 - (b). Acreage: The acreage planted must be established by the field inspector. This should comply with the registered acreage
 - (c). Cropping history of the seed field: Crop rotation in seed production is a common practice to avoid cultivar contamination and disease incidents.
 - (d). Isolation distance: Proper distance of 5 m for certified rice seed and 10 m for basic, pre-basic and breeder seed crop from other crops is necessary to prevent pollination and mechanical admixtures.
 - (e). Off-types, weeds and other crop plants: Off-types are plants of the same species which do not exhibit the acceptable characteristics of the seed crop being grown must be rogued
 - (f). Diseases: A seed is one of the major ways of disease propagation; control of seed-borne disease can prevent crop disasters. While the inspector walks in the field, the general crop condition is noted including the applied crop husbandry practices.

Table 5: Procedure and methods of on-plot seed inspection

	Organizations/ institutions in charge of inspection	Frequency and timing of Inspections	Items for Inspection	Inspection Methods	Quality Standard for Inspection
Breeder Seed	Breeders/ maintainer and KEPHIS	At least two observations at flowering and grain filling	True-to -type	Individual plant observation	100%
			Uniformity		100%
			Seed borne diseases		0%
			Isolation distance	Measurement	10 Meters
			Off-types		99%
Pre-basic Seed	KEPHIS	At least two inspections at flowering and grain filling	True-to-type	Sampling and observation	100%
			Off-types	OECD Procedure	99%
			Uniformity		100%
			Seed borne diseases	OECD Procedure	0%
			Isolation	Measurement	10 Meters
Basic Seed	KEPHIS	At least two inspections at flowering and grain filling	True-to-type		100%
			Off-types	OECD Procedure	99%
			Uniformity		100%
			Seed-borne diseases	Use of symptoms and lab	0%
			Isolation	Measurement	10 Meters
Certified Seed	KEPHIS	At least two inspections at flowering and grain filling	True-totype	OECD Procedure	100%
			Off-types	OECD procedure	5%
			Uniformity		100%
			Seed borne diseases	Use of symptoms and lab	0%
			Isolation	Measurement	4-5 Meters

3. Seed sampling: Seed sampling is an important aspect of post seed harvest inspection. Established procedures for seed sampling must be strictly adhered to, failure to which may lead to a breakdown of seed quality control system. Ignoring sampling procedures during the process of sampling will most likely lead to unreliable laboratory test results.
4. Pre and Post control plot testing
 - (a). Pre-control is the term applied to variety verification of early generation seed, i.e. Breeder, pre-basic and basic seed (Table 6).
 - (b). Post-control is a term normally applied to variety verification of Certified Seed (Table 6).

Table 6: Procedure and methods of harvested seed inspection

	Organizations/ institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
Breeder Seed	KEPHIS	Moisture	Testing	11%
		Maximum Other crop seed	Counting Evaluation	1%
		Maximum Weeds seeds	Counting and Evaluation	1%
		Germination %	Germination test	70%
		Purity	Purity analysis	99%
Pre-basic Seed	KEPHIS	Moisture	Testing	11%
		Other crop seed	Counting Evaluation	1%
		Maximum Weeds seeds	Counting Evaluation	1%
		Germination %	Germination test	70%
		Purity	Purity analysis	99%
Basic Seed	KEPHIS	Moisture	Testing	11%
		Other crop seed	Counting Evaluation	1%
		Maximum Weeds seeds	Counting and Evaluation	1%
		Germination %	Germination test	70%
		Purity	Purity analysis	99%
Certified Seed	KEPHIS	Moisture	Testing	11%
		Other crop seed	Counting Evaluation	1%
		Maximum Weeds seeds	Counting and Evaluation	1%
		Germination %	Germination test	70%
		Purity	Purity analysis	99%

5. Routine seed testing and issuance of certificates: The sampled seed will be tested for quality attributes such as analytic purity, germination and seed health (Table 7). The first two attributes will be routine tests while the later will depend on the findings from field inspections.

Table 7: Purity standards of rice seeds followed by KEPHIS

	Purity Standard (impurity %; Kenya Standards)
Breeder Seed	99% purity 70% germination, free from inert matter, free from pests and diseases, complete grains-KALRO
Pre-basic Seed	99% purity >70% germination, free from inert matter-KALRO
Basic Seed	99% purity >70% germination, free from inert matter-KALRO
Certified Seed	1%-KEPHIS 70% germination, free from inert matter-KALRO

6. Cultivar assessment for new variety: In order to promote the introduction of new rice cultivars which are better in certain respects than the existing ones, KEPHIS ensures that before their release these varieties have sufficient merit to be produced. The characteristics of the new cultivars have to be assessed in comparison with the established ones. KEPHIS conducts two assessments for new cultivar:
 - (a). Distinctness, Uniformity and Stability (DUS) tests: A new rice cultivar has to be distinct, in one way or another, from other rice cultivars to be released. The distinction may be in morphological (e.g. grain shape, presence or absence of awns, presence of short or long awns), or agronomic characteristics (maturity, lodging, and days to 50% heading)
 - (b). Value for Cultivation and Use tests conducted in the National Performance Trials (NPT). The tests of cultivar's value for cultivation are the most important assessments. These include yield, maturity, regional adaptation, tolerance to abiotic stresses such as drought and lodging, resistance to rice seed borne diseases.

2.3.2. Human Resources

Adequate human and infrastructural capacities for inspection are crucial in improving the efficiency and effectiveness of delivery of services related to seed quality control. At KEPHIS, presently there are about 70 staffs engaged in inspection of fields and seeds/propagation materials of all crops. The human resources are distributed amongst 6 operational regions across the country. These include Mombasa, Nakuru, Kitale, Embu, Kisumu and Nairobi (the headquarters). Although rice is grown in some of these regions, inspectors are not exclusively assigned for rice seed. Budget for field inspection and seed testing is allocated annually by KEPHIS.



Fig 6: Joint observation of newly introduced varieties by KEPHIS inspectors and other stakeholders

KEPHIS has a mix of experienced and relatively less experienced (new recruits) of inspectors. KEPHIS organizes training programs for inspectors from KEPHIS and private seed companies every year during the off season. The program covers various aspects of crop management, field inspection of seed crops, inspection of processed seeds, seed sampling, seed testing and varietal testing. Through a trainer of trainee module, the inspectors trained at these programs provide training to other inspectors from KEPHIS and private seed companies in their respective regions.

2.4. Supply

Presently farmers predominantly use inbreds, although rice hybrids from private seed companies such as Bayer EA Ltd. and Afritec are gaining attention. These hybrids are adopted by progressive farmers whose grain production is aimed at markets. Inbred varieties are cultivated by both the market-oriented rice growers and subsistence farmers. While seeds of hybrid varieties are supplied to the farmers directly by the private seed companies, seeds of inbred varieties flow through a series of production cycles involving breeder, pre-basic, basic and certified classes through the hands of both the registered public- and private seed merchants.

Almost all the breeder seeds and most of the pre-basic and basic seeds of inbred varieties are supplied mainly by the seed units of KALRO located at Mwea and Kibos and NIB. Certified seeds are supplied by private seed companies and registered seed units of public institutions and organizations such as MIAD, Mwea Rice Growers Multipurpose (MRGM) and other registered cooperative societies. While the supply or distribution of seeds is managed entirely by the registered seed unit or merchant, the seeds of pre-basic, basic and certified classes are produced in farmers' fields under the supervision and guidance of the registered seed unit or merchant.

Marketing and sales of certified seeds are done through agro-dealer network systems in rice growing areas. The network of outlets is usually comprised of registered agents, sub-agents and stockists. Seeds in response to an emergency (drought or flood) and during promotion of new varieties are given through registered relief agents and/or outlets under the projects/schemes of governmental, non-governmental organizations and development partners. Table 8 shows the various stakeholders and their roles along the rice seed value chain. Financial support for some of the activities of these stakeholders is provided by financial institutions such as Agricultural Finance Corporation (AFC), commercial banks, agricultural cooperatives/societies, and projects/initiatives development partners.

Table 8: Rice seed value chain actors and supporters in Kenya

	Stakeholders			
	Market varieties	Roles played	Subsistence varieties	Roles played
Breeder seed development/ Production/ supply	KALRO, NIB/MIAD, Afritec	Maintenance, Multiplication, Supply	KALRO, NIB/MIAD, Afritec	Maintenance, Multiplication, Supply
Pre-Basic seed production/ Supply	KALRO, NIB/MIAD, Kenya Seed Co.	Production, Supply	KALRO, NIB/MIAD	Production, Supply
Basic seed production/ Supply	KSU, NIB/MIAD, Kenya Seed Co.	Production, Supply	KSU, NIB/MIAD, Kenya Seed Co.	Production, Supply
Certified seed production	KSU, NIB/MIAD, Kenya Seed Co., Seed growers	Production, Supply	KSU, NIB/MIAD, Kenya Seed Co., Contract seed growers	Production, Supply
Distribution of seeds	KSU, NIB/MIAD, Kenya Seed Co., Bayer EA, NCPB, Agro-dealers (Agents, Sub-Agents, Stockists), Ministry of Agriculture	Marketing	KSU, NIB/MIAD, Kenya Seed Co., Bayer EA, NCPB, Agro-dealers (Agents, Sub-Agents, Stockists), Ministry of Agriculture	Marketing
Financing	Ministry of Agriculture, Financial Institutions (AFC, Commercial banks), Cooperatives, Development Partners and Projects/Initiatives	Facilitation	Ministry of Agriculture, Financial Institutions (AFC, Commercial banks), Cooperatives, Development Partners and Projects/Initiatives	Facilitation,

	Stakeholders			
	Market varieties	Roles played	Subsistence varieties	Roles played
Others	Ministry of Agriculture, Development Partners, Initiatives	Policy, Certification, Technical assistance	Ministry of Agriculture, Development Partners, Initiatives	Policy, Certification, Technical assistance

Seed prices are determined by the market forces and are based on the costs involved in production, storage, transportation and profit margins of the seed merchants. Seeds of breeder, pre-basic, basic and certified classes are not yet developed for varieties such as Komboka, SARO 5, MWIR 2 and MWIR 4. The current prices of the certified seeds for the established varieties under the three rice production environments are shown in table 9. Although presently no direct subsidy program for rice seeds is available in Kenya, National Accelerated Agricultural Input Access Program (NAAIAP) is presently piloting a support program under which subsidy for fertilizer use is provided in the form of certified seeds to rice farmers.

Table 9: Market prices of certified seeds of popular varieties

	Name of Varieties	Price KES/Kg (Information from the year of 2014)
Irrigated Low-land	Basmati 370	80
	Basmati 217	80
	IR 2793-80-1(Nibam 110)	75
	BW 196 (Nibam 109)	75
	ITA 310	75
	Arize 6444 Gold (Hybrid) from Bayer East Africa	800
	Arize Tej Gold (Hybrid) from Bayer East Africa	800
Rain-fed Low-land	Komboka	Seed system not yet developed
	SARO 5	Seed system not yet developed
	MWIR 2	Seed system not yet developed
	Arize 6444 Gold (Hybrid) from Bayer East Africa	800
	Arize Tej Gold (Hybrid) from Bayer East Africa	800
Rain-fed Upland	NERICA 1	155-210
	NERICA 4	155-210
	NERICA 10	155-210
	NERICA 11	155-210
	MWIR 4	Seed system not yet developed

3. Challenges in National Rice Seed Sector

3.1. Legislation, Policy, Institutions and Planning

By classifying rice as one of the scheduled crops for which the certification of seeds is compulsory, Kenya's seed legislation and policies intend to transform rice seed value chain into a formal sector. However in reality, rice seed systems in the country exhibit plurality wherein farmers continue to save a portion of their harvest, exchange and re-use grains as seeds. Given the self pollinating nature of rice flowers, the slow pace of erosion of genetic integrity makes it rather difficult for farmers to appreciate the advantages of certified seed. Hence the demand for certified rice seeds is low, inconsistent and less predictable, as judged from the current levels of seed production (table 3).

Although the present seed regulations allow up to four cycles of reproduction of certified seeds, there is a lack of clarity on the differentiation of the seed products (C-1 through C-4) and their marketability. Despite the rise of rice as the third most important cereal crop, rice is presently not classified as one of the commodities under the government's strategic grain reserve program. Hence, National Cereals and Produce Board (NCPB) do not buy rice from rice producers. It is possible that the demand for rice grains from NCPB shall uplift the demand for certified rice seeds and adoption of quality seeds.

The present laws and policies also call for the continued support of public breeding institutions to maintain varieties and produce seed for those varieties that are not attractive to the private sector. This places rice seed sub-sector in a rather delicate position wherein it is not clear if seeds of some of the older and subsistent rice varieties which may not appeal to private seed companies require attention from public institutions despite the classification of rice as a scheduled crop.

Registration of seed merchants require that at least 75% of their business is either in processing, production or marketing of seeds. This however limits general agro-dealers from becoming seed merchants and thus limits the scopes of expanding the networks in rural areas. The seed regulations committee does not have substantial representation of private seed companies to efficiently respond to the needs and changes in the rice seed value chain and thereby improve the sustainability of demand and supply of formal production of rice seeds.

Despite a greater demand for SARO 5, the certified seeds could neither be produced nor imported from Tanzania in the recent past, due to lack of harmonization of seed regulations. Cross border exchange of rice seeds needs orientation under broader regional economic policies. Informal exchanges of paddy grains through cross-border family exchanges serve as informal source of seeds of exogenous rice varieties. Rice distributed under relief programs/schemes (e.g. Pakistan Basmati, Tanzania rice) contain un-milled and partially milled grains; which are then handpicked and bulked to multiply and supply seeds through informal farmer-to-farmer exchanges.

Lack of an effective platform for voicing of the issues and challenges amongst the different stakeholders of rice seed value chain is affecting appropriate policy revisions. The seed

production sub-committees of the different rice growing county governments are weakly integrated with each other. Although public facilities and utilities for producing, processing (e.g. Lake Basin Development Authority) and storing of seeds are available in key production areas, they remain under or un-utilized due to poor coordination and integration between the stakeholders of different rice producing counties.

KEPHIS is an independent regulatory agency under Agriculture Fisheries and Food Authority (AFFA) which was created under the Crops Act (2013).¹⁴ Kenya Bureau of Standards (KEBS) is another parastatal which was established under the Standards Act (Cap 496)¹⁵ with a mandate for establishing and enforcing quality standards of all products, both locally produced and imported, in the Kenyan market. The roles of KEPHIS, AFFA and that of KEBS often overlap and thereby creating perplexities amongst actors along the rice seed value chain.

3.2. Production

A clear estimate of demand from farmers for the certified seeds for the different rice varieties under the three ecosystems in the different regions of the country is not yet available. Lack of projections on seed demand restrains seed merchants from firming up a business investment plan for production and acquisition of breeder seed for the required varieties. In the absence of regular planning and budgeting mechanisms, the seed unit of KALRO is also not able to produce adequate fresh stocks of breeder seeds of the varieties that can meet the actual demand. Lack of adequate lands with the required soil type and supplementary irrigation affects routine maintenance and production of seeds of other classes at public research institutions. Presently the commercial production of the rice seeds is largely driven by the anticipated demand for newly introduced varieties or for a newly expanded area/scheme under rice cultivation where the first-time rice farmers ought to seek sources of seeds afresh. It is also not clear how frequently the experienced and first-time users of certified seeds renew their seeds.

Since most of the pre-basic, basic and certified seeds are produced in smallholder farmers' fields, the quality of production is intricately linked to the experience and knowledge of the producer. Since seed production requires specialized skills and management practices, the inadequate and incomprehensive training programs and extension services for the out-growers affects the quality of seeds produced is important. Lack of effective screening procedures for controlling seed borne diseases in the existing seed lots of all classes poses a serious threat in several rice production areas. The heightened vulnerability to climate change induced erratic weather patterns and incidences of pests and diseases also affect the on-farm productivity (seed yield) levels. Absence or low levels of mechanization by smallholders during production, processing and handling reduce the productivity and quality of seeds.

Manuals/guides outlining standard seed production practices and descriptors illustrating characteristics of the approved varieties are generally not available to the producers. Presently official catalog of rice varieties does not include varietal description of some of the older and popular irrigated varieties such as Sindano. Lack of communications on the availability and/or insufficiency in the availability of the required volumes of source seeds (especially the breeder and

¹⁴ USDA (2014) Changes in Kenya's Agricultural Sector - Update

¹⁵ Republic of Kenya (1974) Gazette Notice No. 5032; The Standards Act (Cap. 496)

pre-basic seeds) of some of the popular varieties (e.g. SARO 5) hinder the production of certified seeds in rain fed lowland ecosystems where private seed companies are yet to scale out their involvement.

Demographic pressure on land and the limitations in land holdings with records of proper cropping history, appropriate land use pattern and adequate isolation distance (10 m for breeder, pre-basic and basic seed and 5 m for certified seed) in the rice growing areas also limit production of adequate quantities of seed on time. Under some circumstances, production (under quarantine) of breeder seeds and/or initial stages of multiplication of imported rice accessions or varieties is performed in stations and areas where rice is not fully adapted.



Fig 7: Healthy hybrid rice crop in Mwea

3.3. Quality Control

Due to the limited human resources and limited number of vehicles for transportation under KEPHIS, the inspectors are generally overwhelmed by the requests for inspection of seeds/propagative materials. This makes it difficult for the inspectors to be physically available to verify every out-grower and check the fields and seed lots of all out-grower fields. However, when inspectors cannot arrive at the field in time, critical harvesting and processing time is lost. Given the other costs in adhering to the regulatory protocols on the seed industry, the delays in inspection and testing often impose additional financial strain on seed companies and thus raising the average cost of the certified seed to the users.

Presence of counterfeit certified seeds poses serious threats to the viability of seed markets. Although KEPHIS is empowered to penalize offenders along the rice seed value chain, the vigilance and monitoring roles of KEPHIS are challenged by the limited human capacities and lack of training of the concerned staffs. Higher attrition rate amongst staffs of KEPHIS is also affecting the continuum and value of experience under KEPHIS. Owing to limited infrastructures, their centralized locations of seed testing laboratories and human resources, the testing of seed lots takes longer time affecting the release and availability seed in time, especially during the peak season.

Inconsistencies in the current standards in field inspection and seed testing also affect implementation of quality control in rice seed value chain. For instance, the permitted seed germination percentage for breeder seed class is set at a meager 70%. Furthermore, inconsistencies exist between on-field standards and off-field standards. For example, the permitted off types in a basic seed multiplication plot stands at 1 in every 100 square meter (0.02% at the rate of 36 plants at 20 x 20 sq. cm spacing), and yet the maximum permitted seeds from other crops in the corresponding seed lots stands at 1%. Such discrepancies could create room for relaxed handling (posts harvest) procedures that could seriously afflict the quality of seeds supplied in the markets.

Packing and labeling regulations add significant costs to the certified seed. For instance, labels are currently provided only by KEPHIS. At Kshs.15 per label, it constitutes 10-15% of the seed prices (table 9). Certified seed lots which have met the prescribed minimum standards are required to carry a certificate label (describing the seed class, seed lot number, date, weight, etc) inside the bag instead of displaying visibly clearly on the packet itself. Certified seeds are generally dressed with chemicals that protect against diseases. Due to lack of awareness on health hazards associated with the chemicals, seed users often soak the seeds in open/public irrigation canals prior to sowing. The dissolution of dressed chemical into open water resources could affect community health.

3.4. Supply

The demand for seeds of the various rice varieties (table 4) is invariably different under the three rice growing ecosystems. The lack of a regular forum or meeting of rice seed value chain actors also denies formal exchanges of insights or inputs from the stakeholders to the breeders. In the absence of a survey or forecast on demand, the timeliness of the supply of breeder and pre-basic seeds often does not meet the expectations. Lack of long term storage facilities and delays in signing memorandum of understanding (MoU) and contracts with individual farmers hinder the supply of basic and certified seeds.

Conflicts arising from the lack of knowledge on the legalities of the contract and poor adherence to the terms and conditions agreed with the seed merchant affect the supply chain of certified seeds. Furthermore, delays in settlement of payment by the seed merchant promote retention, hoarding and side-selling of seeds by the producers themselves. This affects the mainstream supply of certified seeds in the market. Owing to the dynamic changes in market preferences and other gaps in communication along the production and/or supply chain, mismatch between the supply/availability and demand arises in some places, wherein the farmers compromise to the use of the certified seed stocks of the available rice varieties in place of their own preferred varieties.

Long distances and the scarce and fragile rural road networks between the rice seed producing areas and markets or sales points delay the movement of certified seed. Moreover, the reduced accessibility affects timely supply of certified seed to seed users through agro-dealers located in remote areas and in small the irrigation schemes that are managed by cooperatives/communities themselves (in the absence of NIB) are operational. There is also a shortage of seed suppliers in rice producing areas of Coastal, Western and Rift valley regions. Relatively shorter period of expiry (1-year) of seeds and lack of direct subsidy for using certified seeds also limiting the supply of rice seeds as agro-dealers prefer fast moving and long shelf life products such as fertilizers over seeds.

4. The Strategies

4.1. Vision and Scope

This document outlines a roadmap for developing the rice seed value chain which would augment the productivity enhancement envisaged under the National Rice Development Strategy. Hence, the vision of the roadmap is to transform the rice seed value chain into a vibrant sub-sector contributing to food security and economic development in the region. The scope of the actions proposed under this roadmap seamlessly encompasses research for development, production and distribution of the various rice seed classes.

4.2. Position of Rice Seed Roadmap

The roadmap is aligned with the existing broader strategic frameworks of the government that aim at economic development through agriculture transformation. The approaches proposed in this document are in consistence with the guidelines elaborated under macro policy instruments such as Vision 2030, Poverty Reduction Strategy Paper (PRSP), the Second Medium Term Plan 2013-2017 (MTP; 2013-2017) for agriculture sector, Agriculture Sector Development Strategy Program (ASDSP; 2014-2018) and National Rice Development Strategy (2008-2018). Thus the roadmap presented here is hierarchically positioned under the above strata.

4.3. Goal and Objectives

The overall goal of the activities proposed under the roadmap is to increase the supply and use of certified rice seeds from about 40% to 75% by 2030. For attaining this goal, the roadmap sets out the following specific objectives:-

- i. Promotion of the use of certified rice seeds of improved varieties by smallholder farmers in all ecosystems
- ii. Improvement of the timeliness, availability, affordability and accessibility to certified rice seeds by rice growers
- iii. Enhancement of the quality of certified rice seeds by reviewing and harmonizing seed regulations; and improving the technologies along the seed value chain
- iv. Building of human-, physical- and technical capacities of all the relevant stakeholders along the rice seed value chain

4.5. Implementation Structure

The alignment of rice seed roadmap directly under the NRDS and ASDSP allows the implementation of the roadmap through the existing organizational structure of NRDS. Rice Promotion Unit (RIPU) of Ministry of Agriculture, Livestock and Fisheries will lead the implementation of the roadmap presented in this document. It will play a pivotal role in interacting with relevant public- and private stakeholders in rice seed sub-sector, information collection and sharing, performing gap analysis and developing concepts and project proposals towards the implementation of the activities proposed under this roadmap. National Rice Seed Consultative Committee (NRSCC), currently chaired by the Seed Trade Association of Kenya (STAK), will provide guidance on implementation by setting overall directions and priorities under this roadmap. The seed taskforce that is set up for the purpose of elaboration of this



Fig 8: A good field of rice – It all starts with high quality seed.

roadmap will provide technical backstopping to both RPU and NRSCC in assessing the issues and opportunities along the rice value chain. The implementation of the roadmap shall also be supported by donors, development partners and regional and international research and development institutions through projects and feed backs on policies, strategic approaches and monitoring and evaluation of the roadmap.

5. Strategies and Targets

5.1. Strategic Principles and Approaches

In conformity with the current national policies and legislations, this roadmap will strategically shore up the envisaged transformation of rice seed sub-sector by fully embracing the formal system of certified seed usage. This serves as the strategic principle of the roadmap presented in this document.

Since rice is cultivated under the diverse ecosystems; the approaches shall be differentiated according to the challenges and opportunities presented by the three following production environments:-

1. Irrigated

Buoyed by the profitability of the rice cultivation over other crops, the farmers under irrigated schemes show greater willingness to adoption of the certified seeds. The approaches under this ecosystem will involve strengthening of production and supply of quality seeds of high yielding, market preferred varieties that will further enhance the productivity and marketability of paddy grains.

2. Rain fed Upland

Since rice provides a potential alternative to traditional food crops, farmers are rapidly shifting to rice cultivation. Thus the demand for certified seeds in the uplands is largely driven by the expansion of area under rice cultivation. With the expected further increase in area under rice cultivation and increased participation of private sector, this roadmap will endeavor increased awareness of the certified seeds and improve the production and supply of certified seeds of NERICA and other rice varieties that are in pipeline.

3. Rain fed Lowland

With low levels of uptake of certified seeds, rice farmers under the rain fed lowland largely recycle the grains as seeds and hence suffer from low levels of productivity. Given the vulnerability to climate change, farmers under this ecosystem resort to low-risk low-input farming. Through extension services, training and support to seed merchants, this roadmap will promote the use of certified seeds through linkages between the stakeholders and improve the accessibility of seeds of climate resilient, high yielding rice varieties.

5.2. Target Setting and Gap Identification

The roadmap's goal targets to increase the supply and use of certified rice seeds from about 40% to 75% by 2030. To achieve this target; intermediate targets of 55% by 2018 and 65% by 2024 are set. Kenya's NRDS envisions self-sufficiency in rice by 2030, if the total grain production could increase by 9.3% per year. This roadmap accordingly sets targets for the production of breeder, pre-basic, basic and certified seed in order to increase the availability in the markets (Table 10).

Table 10: Production targets for the four different seed classes of rice seeds

Seed Class	Target amount (g or Kg or MT/year)			Area of land required for production (Sq.m or Ha)		
	2018	2024	2030	2018	2024	2030
Breeder Seed (gram or Sq. m)	424.6	705.2	1267.0	0.000105	0.000176	0.000319
Pre-basic Seed (Kg or Sq m)	46.5	77.7	141.8	112.25	190.29	357.95
Basic Seed (tons or Ha)	8.1	13.4	23.9	2.30	3.83	6.98
Certified Seed (tons or Ha)	1198.1	1961.4	3424.8	362.15	596.35	1054.90

The expected increase in demand for rice seed needs to be coherently met by increased availability of seed so that the shifts in supply and demand dynamics does not affect the market sustainability of the price equilibrium. Based on the current preferences of farmers for the available rice varietal options under irrigated, rain fed upland and rain fed lowland ecosystems, the requirements of land area and the target amounts of certified (Table 11), basic (Table 12), pre-basic (Table 13) and breeder (Table 14) for the different varieties are shown in the tables below. It shall be noted here that given the dynamic nature of market preferences for rice consumption in Kenya, it is acknowledged that the varietal options referred in tables 11-14 are indicating only the present preferences and are therefore subject to change during the course of implementation of this roadmap.

Table 11: Target amounts of certified seed and the land area required for the production for the popular varieties under the different ecosystems

Ecosystem	Varieties	Target amount of Certified Seed Production (MT/year)			Area of land required for Certified Seed Production (Ha)		
		2018	2024	2030	2018	2024	2030
Irrigated	Basmati 370	409.79	658.78	1102.53	117.08	188.22	315.01
	Basmati 217	153.67	247.04	413.45	43.91	70.58	118.13
	IR2793-80-1	102.45	164.70	275.63	29.27	47.06	78.75
	ITA 310	153.67	247.04	413.45	43.91	70.58	118.13
	BW 196 (Nibam 109)	204.89	329.39	551.26	58.54	94.11	157.50
Rain fed Lowland	Komboka	26.86	67.17	210.77	10.74	26.87	84.31
	MWIR 2	11.51	28.79	90.33	4.60	11.51	36.13
Rain fed Upland	NERICA 1	54.10	87.41	146.94	21.64	34.96	58.78
	NERICA 4	20.29	32.78	55.10	8.11	13.11	22.04
	NERICA 10	27.05	43.71	73.47	10.82	17.48	29.39
	NERICA 11	6.76	10.93	18.37	2.70	4.37	7.35
	MWUR 4	13.52	21.85	36.74	5.41	8.74	14.69
	DouradoPrecoce	13.52	21.85	36.74	5.41	8.74	14.69
	Total	1,198.08	1,961.44	3,424.78	362.15	596.35	1,054.90

Table 12: Target amounts of basic seed and the land area required for the production for the popular varieties under the different ecosystems

Ecosystem	Varieties	Target amount of Basic Seed Production (MT/year)			Area of land required for Basic Seed Production (Ha)		
		2018	2024	2030	2018	2024	2030
Irrigated	Basmati 370	2.56	4.12	6.89	0.64	1.03	1.72
	Basmati 217	0.96	1.54	2.58	0.24	0.39	0.65
	IR2793-80-1	0.64	1.03	1.72	0.16	0.26	0.43
	ITA 310	0.96	1.54	2.58	0.24	0.39	0.65
	BW 196 (Nibam 109)	1.28	2.06	3.45	0.32	0.51	0.86
Rain fed Lowland	Komboka	0.27	0.67	2.11	0.11	0.27	0.84
	MWIR 2	0.12	0.29	0.90	0.05	0.12	0.36
Rain fed Upland	NERICA 1	0.54	0.87	1.47	0.22	0.35	0.59
	NERICA 4	0.20	0.33	0.55	0.08	0.13	0.22
	NERICA 10	0.27	0.44	0.73	0.11	0.17	0.29
	NERICA 11	0.07	0.11	0.18	0.03	0.04	0.07
	MWUR 4	0.14	0.22	0.37	0.05	0.09	0.15
	DouradoPrecoce	0.14	0.22	0.37	0.05	0.09	0.15
	Total	8.14	13.44	23.91	2.30	3.83	6.98

Table 13: Target amounts of pre-basic seed and the land area required for the production for the popular varieties under the different ecosystems

Ecosystem	Varieties	Target amount of Pre-basic Seed Production (Kg/year)			Area of land required for Pre-basic Seed Production (Sq. m)		
		2018	2024	2030	2018	2024	2030
Irrigated	Basmati 370	12.81	20.59	34.45	25.61	41.17	68.91
	Basmati 217	4.80	7.72	12.92	9.60	15.44	25.84
	IR2793-80-1	3.20	5.15	8.61	6.40	10.29	17.23
	ITA 310	4.80	7.72	12.92	9.60	15.44	25.84
	BW 196 (Nibam 109)	6.40	10.29	17.23	12.81	20.59	34.45
Rain fed Lowland	Komboka	2.24	5.60	17.56	7.46	18.66	58.55
	MWIR 2	0.96	2.40	7.53	3.20	8.00	25.09
Rain fed Upland	NERICA 1	4.51	7.28	12.25	15.03	24.28	40.82
	NERICA 4	1.69	2.73	4.59	5.63	9.11	15.31
	NERICA 10	2.25	3.64	6.12	7.51	12.14	20.41
	NERICA 11	0.56	0.91	1.53	1.88	3.04	5.10
	MWUR 4	1.13	1.82	3.06	3.76	6.07	10.20
	DouradoPrecoce	1.13	1.82	3.06	3.76	6.07	10.20
	Total	46.48	77.67	141.84	112.25	190.29	357.95

Table 14: Target amounts of breeder seed and the land area required for the production for the popular varieties under the different ecosystems

Ecosystem	Varieties	Target amount of Breeder Seed Production (grams /year)			Area of land required for Breeder Seed Production (Sq. m)		
		2018	2024	2030	2018	2024	2030
Irrigated	Basmati 370	53.36	85.78	143.56	0.0000089	0.0000143	0.0000239
	Basmati 217	20.01	32.17	53.83	0.0000033	0.0000054	0.0000090
	IR2793-80-1	13.34	21.44	35.89	0.0000022	0.0000036	0.0000060
	ITA 310	20.01	32.17	53.83	0.0000033	0.0000054	0.0000090
	BW 196 (Nibam 109)	26.68	42.89	71.78	0.0000044	0.0000071	0.0000120
Rain fed Upland	Komboka	15.99	39.98	125.46	0.0000046	0.0000114	0.0000154
	MWIR 2	6.85	17.13	53.77	0.0000020	0.0000049	0.0000512
Rain fed Lowland	NERICA 1	107.33	173.44	291.55	0.0000307	0.0000496	0.0000833
	NERICA 4	40.25	65.04	109.33	0.0000115	0.0000186	0.0000312
	NERICA 10	53.67	86.72	145.78	0.0000153	0.0000248	0.0000417
	NERICA 11	13.42	21.68	36.44	0.0000038	0.0000062	0.0000104
	MWUR 4	26.83	43.36	72.89	0.0000077	0.0000124	0.0000208
	DouradoPrecoce	26.83	43.36	72.89	0.0000077	0.0000124	0.0000208
	Total	424.57	705.15	1,267.01	0.0001054	0.0001759	0.0003346

Although the certified and basic seeds are largely expected to be produced by the private seed companies or merchants, the seed unit of KALRO is expected to play a supporting role in the production and supply of source seeds (breeder and pre-basic) and also the basic and certified seeds of public varieties. Given the emphasis laid under this roadmap on the quality and timely supply of these source seeds, human resources and their skills are paramount. The estimated human capacities for seed production at the different KALRO units and the gaps between these estimations and the currently available human resources are shown in below (Table 15).

Table 15: Required human resources and the gaps for achieving the targets

Name of Seed Producing Units	Researcher		Gap	Technician		Gap	Workers/ Laborers		Gap
	Required	Available		Required	Available		Required	Available	
Kibos	4	2	2	4	2	2	800	800	0
Mwea	4	2	2	6	2	4			
Mtwapa	2	1	1	4	0	4			
Total	10	5	5	14	4	10	800	800	0

Human capacities that are involved in inspection are equally important to effectively and efficiently authorize the production into marketable products. The number of inspectors required in the different regional offices of KEPHIS and the difference between the available and the required number of inspectors for certification process of the targeted seed production are shown in table 16.



Fig 9: Ear to row for basmati under upland irrigated Ear to row under Paddy condition

Table 16: Human resources required for inspection and certification of the targeted seed production

Geographical area	Number of Inspectors		Gap in number	Gap in Capacity
	Required	Available		
Central Kenya	4	1	3	Training on seed production, practices, field inspection and seed testing
Western Kenya	8	2	6	
Rift Valley	8	4	4	
Coast	4	2	2	
Eastern	6	1	5	
Total	30	10	20	

Both the existing and the expected fresh recruits of staffs for production and inspection need to upgrade their capacities. Training of the staffs in their respective areas of service delivery shall lead to efficient utilization of human resources by their relevant organizations/institutions. The fields in which training will be required for improving inspection and production are shown in tables 16 and 17 respectively.

Table 17: Training needs of human resources engaged in production of seed

	Number of (existing + new) technical personnel to be trained	Areas for training
Researchers	5 (new) +5 (existing)	i. Short term (2-weeks) courses on rice seed production ii. Special 3-week courses (IRRI/AfricaRice/JICA) on maintenance, certification
Technicians	10 (new) + 4 (existing)	i. Short term (2-weeks) courses on rice seed production, seed quality ii. Long term courses on rice seed production, seed quality
Workers/ Laborers	800	1-day field workshops on field procedures & protocols
Farmers	Registered producers	2-days training program on crop Husbandry

5.3. Intervention Options

Achieving the goals and targets set under this roadmap requires addressing of several challenges faced along the rice seed value chain. The following interventions are envisaged to improve the policy environments, institutional roles, planning, quality seed production and supply of rice seeds:-

5.3.1. Legislation, Policy, Institutions and Planning (Recommendations)

- The seed regulations committee which advises government on matters related to policy and legislations shall also include representatives from private seed industry for the sustainable development of crops such as rice which may be less attractive when compared to other cash crops such as maize and vegetables
- Establish a transparent policy framework that allows seed companies to sub contract farmers to produce seed on behalf of seed companies
- Address attrition and transfer related woes of KEPHIS staffs to enhance productivity and morale of inspectors by improving conditions of service so as to increase staff retention
- Recovery of public lands belonging to government institutions/organizations intended for seed production, seed testing and quarantine
- Allocate parcels of lands exclusively for seed production in all public irrigation /rice schemes through lease with scheme management committees
- Take stock of existing facilities to enable usage; procedure /regulations, review and enable access through public-private partnerships
- Provide grants/loan guarantee to private sector for establishing drying, storage and processing facilities through Agriculture Finance Corporation
- Develop financial schemes/products that could expand operations of seed industry/enterprises into rain fed lowland rice production environments
- Implementation of rice as one of the commodities under the national strategic food grain reserve, Reviewing of the 75% rule for registration of seed actors to attract and increase the participation of agro-vets and agro-dealers with larger scales of business in other farm

inputs (such as fertilizers) in rice seed business

- The requirement of 75% of business investments for registration of seed merchants shall include costs related to sub-contracting in production and logistics
- Harmonization of Kenya's rice seed production standards with that of other countries under the different economic unions in the region (EAC, COMESA, OECD)
- Review the current national standards of purities of field population and seed lots for the different seed classes
- Review packaging and labeling of rice seed by consulting stakeholders
- Delineate the functions of KEPHIS, AFFA and KEBS through amendments of the corresponding policies/legislations that shall define the roles of staffs of KEPHIS, AFFA and KEBS to avoid overlapping of responsibilities
- Coordination of investments by county governments on infrastructures (small scale irrigation, underground/river water pumping) that can provide supplementary irrigation in rice seed producing areas that are prone to drought and water stress
- Setting up of a stakeholders' forum for rice seed producers and organizing regular meetings of value chain actors to discuss issues (costs of production, seed prices) and feed backs and financial strengthening of National Rice Seed Consultative Committee

5.3.2. Production and Inspection

- Capacity building of existing staffs engaged in production and inspection through short- and long term training activities
- Increase the transportation capacities and infrastructural facilities for field inspection and seed testing at regional levels
- Recruitment of new staffs for production and inspection of rice seed and improve their retention through attractive career advancement programs
- Training of seed producing out growers including potential smallholder farmers who prefer to grow rice seed
- Increase technical and management capacities of farmers under the registered business units of farmers' association that will enable marketing to other farmers
- Ascertain the handling of dressed seeds in the context of direct seeding versus soaked seeds and dry seeding versus wet seeding in different production environments Validate the existing descriptors of Basmati varieties and update rice catalogs with descriptions of characteristics of older varieties such as Sindano
- Introduction of appropriate machineries/tools (including transplanters, hand held/ motorized row weeders, harvesters and threshers) in smallholder rice seed production systems
- Establish and disseminate good agricultural practice manual that will improve the quality and yields of seed production to all seed producers (contracted farmers, seed companies) and KEPHIS seed inspectors
- Create awareness on the advantages of using certified rice seed amongst farmers through training, demonstration trials
- Educate seed users on handling of dressed seeds in the context of direct seeding versus soaked seeds; and dry seeding versus wet seeding in different ecosystems
- Strategic positioning of seed processing facilities in rice seed producing areas – through public-private partnerships or hiring/sharing mechanisms

- In all major rice growing schemes, allocate and develop appropriate and exclusive land for rice seed multiplication
- Upgrading and scaling up of existing drying, processing and storage facilities under the administration of different rice growing counties
- Establish cost effective packaging material for rice seeds using locally available materials through research and development
- Regularize annual planning, budgeting for development of new varieties and production of breeder seed of improved varieties
- Promote internal quality control mechanisms by seed producing companies and merchants


5.3.3. Supply and Marketing

- Establish demand and use of certified seeds of different rice varieties and farmers' preferences by conducting analytical surveys (government & counties)
- Promote supply of rice seeds through national strategic grain reserve by allocating more funds to buy good quality rice from farmers, facilitating fertilizers and regulating rice imports
- Fast-track the processing of memorandum of understanding between breeder and commercial seed producer/merchant by improving the transparency and reducing bureaucracy
- Enhance coordination between the production of the different seed classes of the different rice varieties so that a critical mass of source seeds (breeder and pre-basic) are constantly available
- Increased vigilance and enforcement of standard practices by seed regulations committee and seeds and plants tribunal by strengthening their capacities and widening their presence
- Promote linkages between seed producers, agro-dealers, farmers and grain buyers/processors so as to synergize their mutual interests and benefits along the rice value chain
- Promote uptake of certified rice seeds by:-
 - scaling up and scaling out National Accelerated Agricultural Input Access Program to other rice producing areas
 - improving extension services on seed production and seed usage
 - strengthening surveillance on sale of farm saved seed
- Labeling details (seed class; species and varieties of seed lot number, date of sealing, weight of the packet, bag or container, whether the seed is dressed, and test certificate number) shall be made available on the packaging material of seed instead of the label which is in the packet most of the time
- Create awareness on legal aspects of contract farming for rice seed out growers, seed companies/merchants and seed traders
- Improved coordination amongst the different rice growing counties on seed requirements (plans), current stocks/availability and sources through increased supply of rice seeds, sensitization of county governments on national rice development strategy and the roadmap on rice seed
- Consolidation and coordination of existing seed producing facilities, infrastructures, institutional capacities in different rice growing regions [For example, Lake Basin Development Authority (LBDA), National Cereal & Produce Board (NCPB), Kenya Farmers' Association (KFA)] for effective utilization of their drying, processing and storage facilities

- Accelerate the process of privatization of inspection services to improve the timeliness of supply of rice seeds in the markets
- Capacity building of seed merchants and traders on rice seed business and financial management practices coordinated by staffs of Ministry of Agriculture and other stakeholders



Fig 10: Rice seeds marketing



Ministry of Agriculture, Livestock and Fisheries
Kilimo House, Cathedral Road
P.O. Box 30028-00100
Nairobi, Kenya
Tel: +254 20 2718870
Fax: +254 20 273884
Website: www.kilimo.go.ke

