Federal Democratic Republic of Ethiopia

Rice Seed Sector Development Strategies of Ethiopia

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Ministry of Agriculture and Natural Resources
(MoANR)
Addis Ababa

Contents

Executive Summary

Rice has become a major contemporary food crop in Ethiopia. In a span of 7 years (2006-2013), the area under rice cultivation has increased by 9-fold and the production has increased by 16-fold with an average on-farm productivity level of 2.73 t/Ha. The demand shift towards rice in the markets however has far outpaced the local production; entailing a modest self-sufficiency rate of only about 26.8% and prompting domestic markets to import rice from other rice growing countries.

Evidences from green revolution in Asia reveal seed as an important facet in raising productivity in smallholder farms. Quality seed also plays a pivotal role in enhancing the competitiveness and profitability of rice production. In Ethiopia, rice is largely grown by resource constrained small scale (<1 Ha) farmers mainly in rain fed and to some extent in irrigated environments; where raising productivity remains a harsh challenge.

In an effort to comprehensively develop the domestic rice value chain, the government has formulated National Rice Research and Development Strategy of Ethiopia (NRRDSE) which aims to increase the on-farm productivity to double the level of productivity by 2019. This document analyzes the current situation of rice seed sub-sector, identifies the challenges and intervention options in developing the rice seed value chain; and thereby contribute to achieving the goals of NRRDSE and other overarching national strategic frameworks on agriculture development.

The development of rice seed sub-sector is facing several challenges along the continuum of production, processing, storage, marketing and usage. Being a self-pollinated crop, a majority of Ethiopian rice farmers (89.5%) use and/or exchange grains from previous seasons as seeds informally. The formal rice seed production which is subject to inspection and certification processes by federal and regional authorities is managed by public seed enterprises and a few private seed companies. In the recent years, an intermediate seed system involving Quality Declared Seeds (QDS) produced and distributed on the basis of trust and reputation, has also gained traction.

Lack of adequate human resources, infrastructures and transportation logistics for inspection services affect implementation of quality standards and timely certification. The multiplication of nucleus breeder, pre-basic and basic seeds of the varieties undertaken by the federal (EIAR) and regional research institutions (RARIs) are largely entrusted with the internal quality control measures. However, shortage of rice seed technologists and lack of adequate and timely access to funds affect the timeliness of production and depreciate the quality of these early generation seeds.

Adequate incentives for the use of quality seeds and commercial windows for accessing finance by the seed producers and end users including individual farmers, cooperatives and seed unions curb the demand for quality seeds. The planning process for certified seed production by public seed enterprises and private seed producers is largely centralized and based on uncertain desires rather than effective demands that are backed with financial

commitments from the *woredas*; perturbing the economic viability of the production and supply chains.

Strategies proposed in this document aim to facilitate transition of farmers from using informal seeds to intermediate and/or formal seed systems by (a) improving the awareness amongst farmers and thereby spurring the demand; (ii) building technical and human resources for production and inspection; and (iii) bolstering the linkages amongst the stakeholders along the value chain including the various actors and supporters in order to increase the accessibility of quality seeds to the end users.

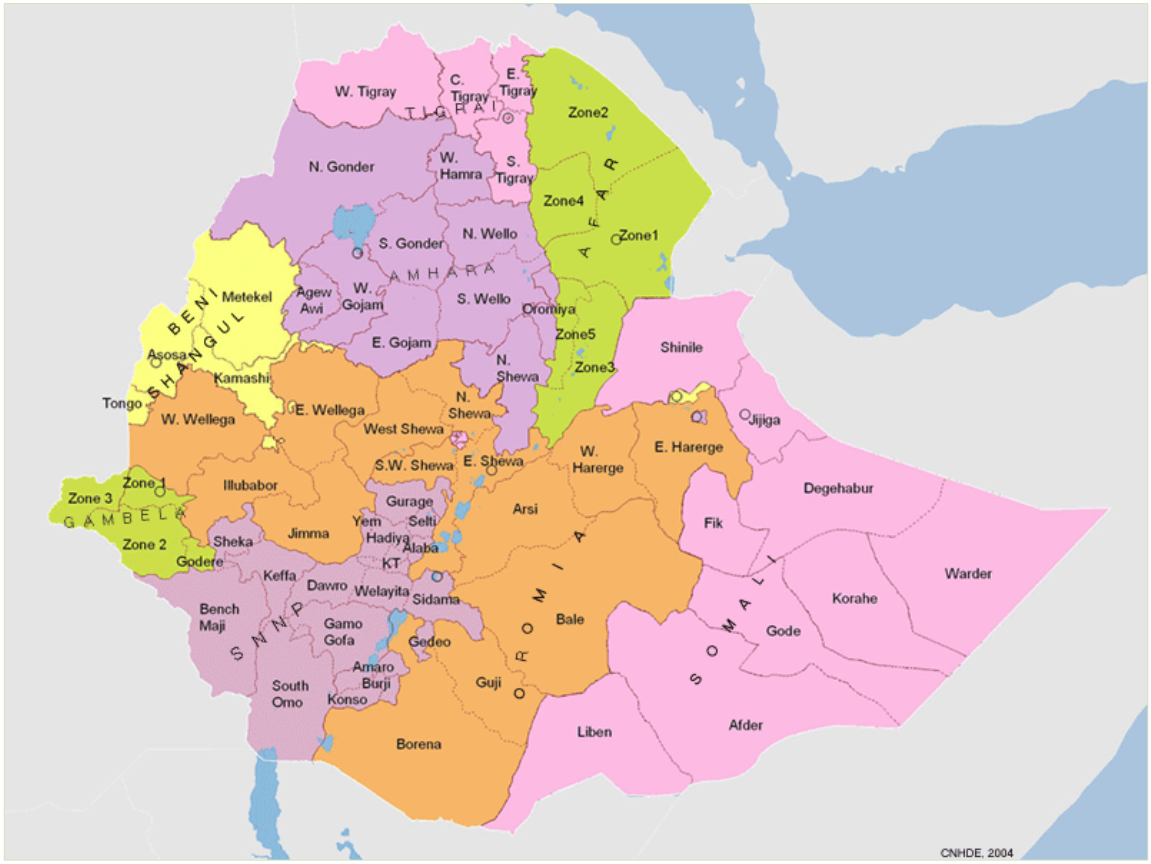
Standards and regulations on QDS and certified seed production and marketing will be harmonized within the country and with the regional economic blocs such as COMESA. Institutional planning on seed production will be refined by basing it on the effective demand assessed through analytical surveys from the region. Coordination and linkages amongst the stakeholders will be strengthened by facilitating dialogues through rice innovation platform and exerting synergies with Agriculture Transformation Agency (ATA)'s interventions at federal, regional, zonal and *woreda* levels.

Human resource capacities on early generation seed production and inspection capacities will be increased in rice seed producing areas by deploying new staff, training on modern technologies and upgrading production and storage infrastructures. Technical capacities of QDS producing farmers, cooperatives and unions, and certified seed producing cooperatives, public enterprises and private companies will be upgraded through training. Public-private partnerships on sharing resources for production, storage and marketing of QDS and certified seeds will be developed.

Demand for quality seeds will be promoted by sensitizing farmers on the economic advantages of the use of certified seed in rising rice farm revenues through various extension approaches. Contractual agreements and honoring of agreements on seed production and procurement through conventional indirect seed marketing will be reinforced through institutional linkages. Direct seed marketing of QDS and certified seed producers will be promoted by strengthening the capacities of the seed distribution network and improving the accessibility by farmers. Uptake of quality seeds through incentives such as voucher based subsidies will be scaled up and scaled out to rice producing areas.

It shall be expected that the demand for quality seeds will annually increase by 8% and that every other rice farmer (50%) will resort to QDS or certified seeds by 2020. The proposed strategies will be implemented through the same governance structure as the NRRDSE. Funds for execution of the proposed interventions will be sourced from the government and development partners by the National Rice Technical Committee (NRTC) under the guidance of National Rice Steering Committee. Projects developed by NRTC will be deployed through relevant public and private partner institutions.

Administrative Map of Ethiopia



ABBREVIATIONS AND ACRONYMS

AGP:	Agricultural Growth Program
ASE:	Amhara Regional Seed Enterprise
ATA:	Agricultural Transformation Agency
BoA:	Regional Bureau of Agriculture
EIAR:	Ethiopian Institute for Agricultural Research
ESA:	Ethiopian Standards Agency
ESE:	Ethiopian Seed Enterprise
ESGPA:	Ethiopian Seed Growers and Processors Association
GTP:	Growth and Transformation Plan
MoANR:	Ministry of Agriculture and natural resources
NARS:	National Agricultural Research System
NGO:	Non-Governmental Organization
NVRC:	National Variety Release Committee
OSE:	Oromia Regional Seed Enterprise
PSE:	Public seed enterprise
QDS:	Quality declared seed
RARI:	Regional Agricultural Research Institute
RSE:	Regional seed enterprise
SNNP:	Southern Nations, Nationalities and Peoples Region
SSE:	South Regional Seed Enterprise

1. INTRODUCTION

Rice is recognized as a 'millennium crop' bearing significance on food security, poverty reduction and economic development strategies in Ethiopia.[1] Federal Government of Ethiopia has set out National Rice Research and Development Strategies of Ethiopia (NRRDSE) for an integrated development of the rice value chain by 2019. Although traditional crops such as teff, maize, wheat, sorghum and barley have long dominated cereal production and consumption in Ethiopia; rice production has begun to gain significance in the recent years. The area under cultivation has increased from 6,421 Ha in 2006 to 58,506 Ha in 2013. During the same period, the total paddy (rough rice) production has increased by about 16-fold from 11,244 tons to 184,210 tons; due largely to the physical expansion of cultivated area and a modest increase in on-farm productivity (Fig. 1).

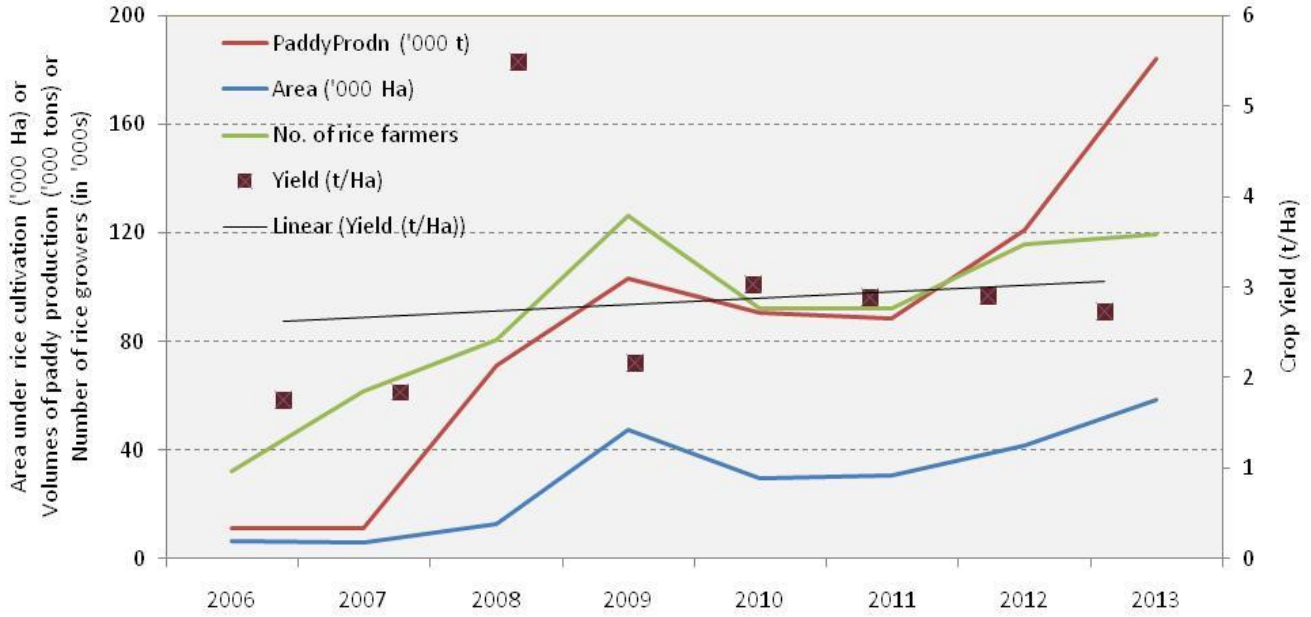


Fig. 1: Trends in rice cultivation and production in Ethiopia.[2] Actual trends in changes in numbers of growers, cultivated area and production are shown as lines. The on-farm yield levels are represented as scattered points (squared markers) against secondary axis and a simple regressive linear trend on yield data is also shown.

Introduced in the 1970s through Korean missions, rice was initially recognized as the most suitable crop for cultivation especially during the flooding rainy seasons by the Jigna and Shaga cooperatives in the Fogera plains.[3] The ensuing progress on research and technological dissemination have rendered rice cultivation a valuable livelihood option for farmers under such diverse ecosystems as irrigated, rain fed lowland and rain fed uplands. Rice is largely cultivated by resource constrained farmers in small land holdings (<1 Ha)[4] under a subsistence environment, although a few large scale commercial rice farming has become recently active.

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[1] The Federal Republic of Ethiopia (2009) National Rice Research and Development Strategies of Ethiopia

[2] Alemu D (2015) In: 6th General meeting of Coalition for African Rice Development, Nov 18-19, 2015, Accra, Ghana

[3] Temesgen Y et al (2014) Production expansion, competitiveness and comparative advantage of upland rice production: Case of Fogera and Libkemekem plain in Ethiopia, The International Journal of Applied Economics and Finance 8:43-50

[4] Hegde et al (2013) Assessment of global rice production and export opportunity for economic development in Ethiopia, International Journal of Science and Research 2:257-260

By virtues of the relative versatility with which rice grains can be stored, cooked and consumed, and the rice by-products (straw, husks, bran) can be utilized by farm families; cultivation of rice is gaining popularity in the recent years in Ethiopia. Rice can also partially substitute teff in the making of enjera, a popular customary cuisine in Ethiopia. The rising income of the population has further propelled the demand shift towards rice. The socio-economic benefits of growing rice amongst the rural livelihoods in Ethiopia are testified by a 3.7-fold increase in number of rice growers between 2006 and 2013 (Fig. 1).

Despite a substantial increase in local rice production in the recent years however, the consumption requirements (market demand) have outpaced the domestic production in both quantitative and qualitative terms. The resultant widening of gap between production and consumption has prompted national markets to import rice from other rice growing countries (Fig. 2).

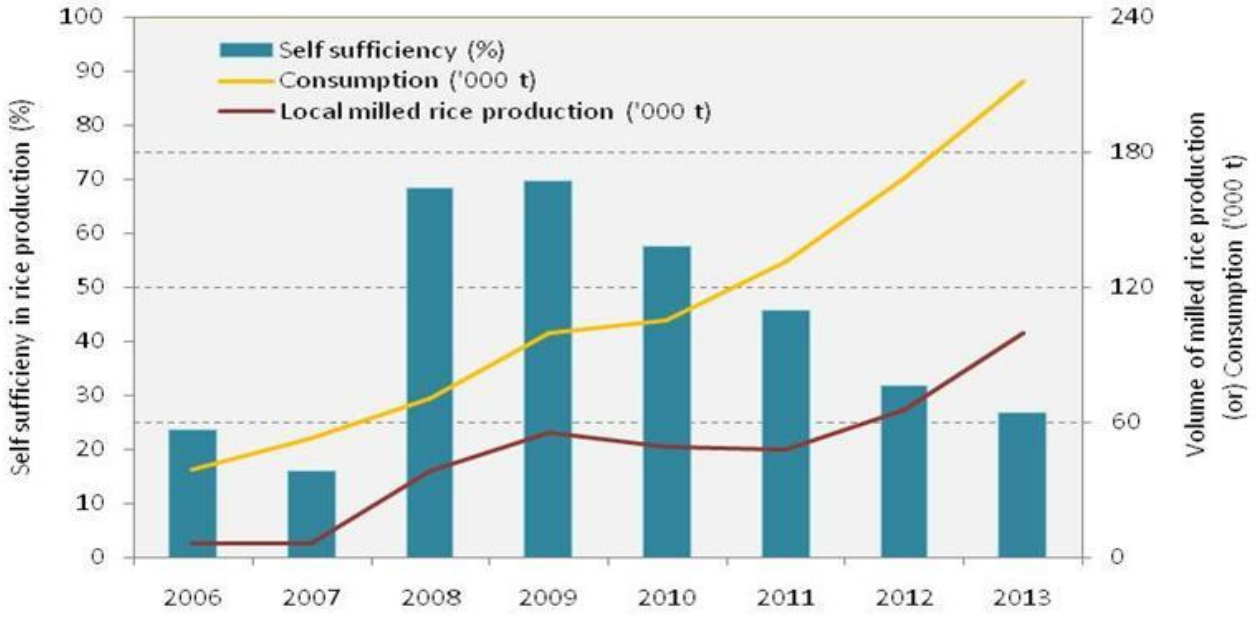

Fig. 2: Self-sufficiency levels in rice production and the growing gap between domestic production of milled rice and domestic consumption in Ethiopia.[5]

Given the large variations in climatic factors (such as altitude, temperature, rain fall) under these divergent ecosystems and a largely subsistent nature of rice farming, raising on-farm productivity in small holder farms remain a major challenge in achieving the targets set out under the NRRDSE. Green revolution in Asia was spearheaded by a significant overhaul of the rice seed systems through which seeds of improved varieties where efficiently produced and delivered to farmers. One of the priority interventions identified under the Ethiopia's NRRDSE include promotion of production, multiplication and dissemination of certified seed. It focuses on increasing the availability of improved seeds to smallholder farmers in order to increase the quantity, quality and marketability of local rice production. This document analyzes the current situation of rice seed sub-sector and identifies issues and solutions in order to improve the rice seed value chain in the country.

[5] The milled rice volumes were estimated using a standard 60% head rice recovery on the total paddy production (shown in fig. 1), after subtracting 10% for seed and feed losses

2. Review of National Rice Seed Sub-sector

2.1. Legislation and Policy Aspects

Ethiopia has established plant breeders' rights[6] based on the principles of international agreements on Trade Related Intellectual Property Rights (TRIPS) and International Convention for the Protection of New Varieties of Plants (UPOV). The proclamation aims to stimulate breeding and direct introduction of foreign varieties into the country, with the expectations that these provisions will ultimately bring more varieties to the market. Rice, being a food security crop however, the smallholder farmers also keep the right to exchange and sell seed amongst themselves under the law. The proclamation also makes provisions for the granting of rights of public rice varieties through licenses by the Ministry, registration, revocation and transfer of a right, and to legal action in the case of infringement of a right. However, the proclamation is currently under review and it is expected that it will be enacted early 2017.

A separate proclamation outlining intellectual property rights and granting access to national and international rice germplasm for research and development[7] also enables public and private participation in varietal development. Ministry of Agriculture and Natural Resources (MoANR) provides permits for importing international genetic accessions of rice after meeting the plant quarantine regulations.[8] Following the testing and evaluation of performances of such international germplasm or locally bred lines, accessions shall be released as varieties. Variety registration and performance are managed by Variety Release, Protection and Seed Quality Control (VRPSQC) Directorate, which subjects the performance data supplied by the breeder and on-farm verification trials conducted by the breeder and/or regional research stations to scrutiny by a special technical committee. It is however planned to introduction of DUS, which will be done fully by VRPSQC without the involvement of breeders.

Government of Ethiopia has reviewed its laws governing seed sector[9] with a purpose of providing new regulatory framework in which both public and private seed producers shall actively promote the seed markets across the country. Under the proclamation, the MoANR is responsible for setting standards on seed trade, while regional authorities implement most of these standards (Ethiopian Standard: seed sampling (ES 471:2000), Seed Purity test (ES 4050), Seed Germination text (ES 474:2000), seed health test (ES 476:2000), Determination of Seed moisture content (ES 478:2000)) and regulations through contacts with private companies, growers, and dealers. Criteria for granting license to produce, whole sale and retail are set under the new seed law (782/2013) and its regulation (375/2016) and entrusted with MoANR. Based on the competence of the producers, quality declared seed (QDS) production is also permitted by the MoANR.[10] The regional authorities are responsible for inspection and certification of seeds in domestic trade. The Proclamation requires seed growers, processors, or traders to be registered with the Ministry or a regional authority.

Although the national seed industry policies drawn in 1992 remains to be updated, the Agricultural Transformation Agency (ATA) plays a lead role in providing policy options for the federal government on seed sector development. Recently, ATA has outlined strategic approaches for developing the national

[6] Plant Breeders' Rights Proclamation No: 481/2006, Federal Negarit Gazeta, Year 12, No. 12.
[7] Access to Genetic Resources and Community Knowledge, and Community Rights Proclamation No. 482/2006
[8] Plant Quarantine Regulation (No. 4/1992)
[9] Seed Proclamation No. 782/2013
[10] Quality Declared Seed production directives (2015)

seed systems[11] which aim to transform seed sector into a well-functioning system that enables farmers' access to seeds of improved varieties at the right quality, quantity, time, and price, from a range of producers and distribution channels in order to increase agricultural production and productivity.

2.2. Institutions and Planning

Several public and private institutions are engaged in rice seed multiplication and dissemination (Table 1). MoANR is involved in variety release, planning of seed production, allocation to seed through other public institutions, and both domestic and foreign seed trade. National Agricultural Research System involving Ethiopian Institute for Agricultural Research (EIAR) and Regional Agricultural Research Institutes (RARIs) is responsible for supply of initial/early generation seed. Ethiopian Seed Enterprise (ESE), and private seed producing companies and registered seed producer cooperatives a federal seed venture, and regional seed enterprises (RSEs) are responsible for mass production of basic and certified seeds. Regional Bureaus of Agriculture (BoA) are responsible for inspection and certification of seeds and implementation of seed regulations. MoANR helps determine the quantity, quality, and cost of seeds passing through the public seed system.

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

Indicator		Name of institutions	Roles/ Responsibility	Legislations/Policies determining responsibility
Overall	Production	MoANR	Planning and Supervision of the whole process	Seed Law, MoANR directives
	Inspection	Regional BoAs	Planning and overall management of inspection Implementation of inspection	Seed Law, MoANR directives Ethiopian Seed Standard
	Supply/ distribution	MoANR, Agricultural Inputs Directorate	Planning and overall management of seed supply	MoANR directives
Breeder Seed	Production	EIAR (varietal research unit) and regional Agricultural Research Institutes, Universities, Private Companies	Maintenance/Production and supply of seeds of released varieties	National Seed Proclamation (2013)
	Inspection	EIAR (varietal research unit) and regional Agricultural Research Institutes, Private Companies	Internal seed quality control	MoANR directives
	Supply/ distribution	EIAR (varietal research unit) and regional Agricultural Research Institutes, Private Companies	Supply of breeder seed for Pre-Basic Seed production	MoANR directives
Pre-Basic Seed	Production	EIAR (varietal research unit) and regional Agricultural	Production of Pre-basic seeds	National Seed Proclamation (2013)

[11] Seed System Development Strategy (2013-17)

Indicator		Name of institutions	Roles/ Responsibility	Legislations/Policies determining responsibility
		Research Institutes, Universities, Private Companies		
	Inspection	EIAR (varietal research unit) and regional Agricultural Research Institutes, MoANR, Plant Variety Release, Protection and Seed Quality Control Directorate (VRPSQC)	Internal seed quality control, External seed quality control	Ethiopian Seed Standards
	Supply/ distribution	EIAR (varietal research unit) and regional Agricultural Research Institutes, Private Companies	Production of Pre-basic seeds and supply to seed enterprises	MoANR directives
Basic Seed	Production	Federal and regional Agricultural Research Center EIAR (varietal research unit) and regional Agricultural Research Institutes, Private Companies, Ethiopian Seed Enterprise (ESE), Regional Seed Enterprises (RSE)	Production of basic seeds	MoANR directives
	Inspection	Regional BoA	Supervision and inspection of basic seed producers (to be done in the future)	Seed law (782/2013) MoANR directives, Ethiopian Seed Standard
	Supply/ distribution	MoANR, Agricultural inputs directorate, EIAR and RIARs	Allocation of produced basic seed to certified seed producers	MoANR directives
Certified Seed	Production	Public seed Enterprises (ESE, ASE, OSE, SSE), Private seed companies, Registered Seed Producer cooperatives	Production of certified seed and supply to cooperatives	MoANR directives
	Inspection	Regional Seed Regulatory Institutions	Field Inspection, Lab inspection, Certification of produced Seeds	MoANR directives, Ethiopian Seed Standard
	Supply/ distribution	(i) Conventional: MoANR, BoA (ii) Direct Marketing: Public seed Enterprises (ESE, ASE, OSE, SSE), Private seed companies, Registered Seed Producer cooperatives	National appropriation of produced certified seed Setting price setting mechanism, Distribution to agricultural cooperatives, farmers	MoANR directives

Indicator		Name of institutions	Roles/ Responsibility	Legislations/Policies determining responsibility
Quality Declared Seeds (QDS)	Production	Registered Community based Seed producers, Private Companies, Registered individual seed producer farmers	Production of QDS	Seed Proclamation (2013), Quality Declared Seed production directives, MoANR, 2015
	Inspection	Regional Seed Regulatory Institutions, Federal Seed Regulatory Authority (if the producer operates in more than one region)	Field Inspection Lab inspection Declaration of produced Seeds	Seed Proclamation (2013), Quality Declared Seed production directives, MoANR, 2015
	Supply/Marketing	Registered Community based Seed producers, Private Companies, Registered individual seed producer farmers	Supply of QDS	Seed Proclamation (2013), Quality Declared Seed production directives, MoANR, 2015

While the planning for early generation seed is done by the breeders at the institutional level, the planning for certified rice seed production is largely centralized and done at the federal level by MoANR and EIAR (Table 2). An integrated production planning including quantities for the various rice growing regions, varieties and responsibilities of actors are identified by MoANR and distributed through direct public distribution/marketing channels. There is growing interest of the private sector to engage in rice seed production and marketing in different parts of the country. Seed producer cooperatives and private seed companies engage in annual planning of rice seed production according to the available resources and demand in their markets. Public-private dialogues involving private seed producing companies, farmer groups and cooperatives take place through (i) Agricultural Development Partners' Linkage Advisory Council (ADPLAC) at federal, regional, zonal and *woreda* levels; (ii) National rice research and development steering committee meetings; (iii) Regional rice stakeholders' platforms promoted by MEDA (in Amhara and SNNPR); and (iv) several ad hoc seed stakeholders' meetings of the Ethiopian Seed Association (ESA).

Table 2: Budget allocation for various seed classes and targeted amounts of certified seed production

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Budget for breeder Seed (Birr)	1,644	1,414	6,292	7,007	5,684
Budget for pre-basic Seed (Birr)	2,546,821	1,038,781	1,050,907	1,047,189	612,150
Budget for basic Seed (Birr)	148,077	412,100	3,723,148	407,264	2,709,493
Budget for certified Seed (Birr)	3,831,588	9,611,543	8,918,000	5,032,300	4,216,150
Amount of certified rice seeds (tons)	1,646	2,000	2,910	3,300	3,790

2.3. PRODUCTION

Seed systems are broadly classified in Ethiopia as formal, informal and integrated (intermediate) systems. Under **formal system**, the seeds are produced under an institutional framework involving a series of multiplication phases from breeder seed to pre-basic seed to basic seed and to certified seed. Since

almost all the cultivated rice inbred varieties registered in Ethiopia are public goods, the early generation seed classes involving breeder and pre-basic seeds are exclusively produced by EIAR and/or RARIs. ESE, and the 3 RSEs viz., Amhara regional Seed Enterprise (ASE), Oromia regional Seed Enterprise (OSE), South regional Seed Enterprise (SSE) are engaged in basic seed production. Certified seeds are produced by the public seed Enterprises (ESE, ASE, OSE, SSE), private seed companies and registered seed producer cooperatives. The number of cycles of certified seed production shall vary between 1 and 4, depending on the demand, urgency and availability of source seeds. About 5 private seed companies and one registered seed producer cooperatives are routinely involved in producing certified seeds of rice varieties. Inspection and other regulatory mechanisms governing the quality of all the seed classes are overseen by the VRPSQC Directorate at the federal level. At the regional level, BoAs enforce these regulations and standards through decentralized field inspections, sample collection and laboratory testing for certification. The area under rice seed production and the total volume of rice seeds produced through the public production systems in various stations across the country between 2010 and 2012 are shown in table 3. The area and volume of production of seeds for the three popular varieties under rain fed upland ecosystem in 2012 are shown in table 4.

Table 3: Current production, location, and cultivated area of certified rice seed under public systems

Seed Class	Name of production stations	Production amount per station (ton)			Cultivated area per station (Ha)		
		2016	2015	2014	2016	2015	2014
Breeder Seed	Fogera	1.20	1.80	0.41	0.40	0.60	0.20
	Pawe	0.10	1.10	0.10	-	-	-
	Shire- Mytsebri	0.10	-	-	-	-	-
	Sub- total	1.40	2.90	0.10	0.40	0.60	0.20
Pre-Basic Seed	Fogera	7.60	12.50	10.20	-	5.00	8.30
	Shire- Maytsebri	23.10	23.90	14.50	10.00	9.60	4.70
	Pawe	5.60	7.00	5.80	2.20	4.90	2.30
	Bonga	-	2.40	15.60	3.50	-	6.00
	ESE	1.50	0.10	0.10	0.60	0.50	0.50
	Sub- total	37.80	45.90	46.20	16.30	20.00	21.80
Basic Seed	Pawe RC	7.40	5.50	1.30	3.00	3.50	1.00
	Bako	6.00	6.50	7.00	2.50	3.00	2.00
	Fogera	15.50	12.00	15.00	5.00	4.00	5.00
	Gonder	2.00	3.00	2.50	1.00	1.20	1.00
	Maytsebri	9.00	4.00	6.00	3.00	2.00	2.00
	ESE	-	0.40	0.40	-	1.60	1.60
	Sub- total	39.90	31.40	32.20	14.50	15.30	12.60
Certified Seed	ESE	-	2.10	2.10	-	5.00	5.00
	SSE		540.00				18.00
	ASE	170.30	150.00	314.00	60.00	50.00	100.00
	OSE	10.00	9.80	5.90	3.00	3.00	2.00
	Private	-	47.90		-	15.90	-
	Sub- total	180.30	749.80	322.00	63.00	73.90	125.00

Table 4: Seed production for rain fed upland ecosystem in 2012

Year 2012	Name of Varieties	Name of producing organization	Cultivated Area (Ha)	Amount produced (ton)
Rain-fed Upland	NERICA 4	ESE	3.148	78.7
		Tigray BoA	5.192	129.8
		SSE	0.604	15.1
		ASE	3.624	90.6
	NERICA3	Tigray BoA	118.68	296.7
	Superica1	Tigray BoA	30.12	75.3
Total			161.368	686.2

Under **informal system**, rice farmers either re-use the grains produced from the erstwhile season(s) unassumingly or through their own selection practices. Institutional engagement and seed certification process are typically absent in this system. Such seeds may also be exchanged or sold amongst farmers without any official records of sales. Although no analytical survey revealing the share of informal seed system in the total rice seeds used in the country is available, the actual distributed volumes of certified seed in the country in 2012 suggest that about 89.5% of rice farmers fall under the informal system. Following recent MoANR's directives on quality seed production (QDS), an **integrated (intermediate) system** of rice seed production has also gained prominence in the recent years. Unlike the informal seed system, the QDS production involves conventional inspection and authorization processes. Under the QDS system, registered community seed producers multiply by subjecting the production to a rather less stringent process by regional BoAs. In this semi-formal system, producers declare the quality of their seed and officially sell their production to farmers in the same community/cooperative and other non-registered cooperatives and individual farmers. The list of names of varieties recommended for cultivation under the various ecosystems and hence their seed production through formal and intermediate systems is shown in table 5.

Table 5: List of names of officially certified rice varieties under the three rice ecosystems in Ethiopia

Agro-Ecological Zones	Name of Varieties
Irrigated lowland	NERICA-14
	NERICA-15
	NERICA-6
	Kallafo-1(FOFIFA3737)
Rain fed Lowland	NERICA 13
	Hiber (IRGA370-38-1-1F-B1-1)
	Chewaqa (YIN LU20)
	Ediget (WAB189-B-B-B-HB)
	Gumara(IAC-164)
	VRH 606
	VRH 640
	VRH 654

Agro-Ecological Zones	Name of Varieties
Rain fed Upland	Adet (WAB450-1-B-P-462-HB)
	NERICA 12(WAB880-1-38-2-17-P1-HB)
	Hidassie (WAB515-B-16A1-2)
	Getachew (AD01)
	Andassa (AD012)
	Tana (AD048)
	NERICA-3(WAB-450-IB-P-28-HB
	NERICA-4(49WAB-450-IB-P-9/1)
	SUPERICA-1(WAB-4507)
	Tigabe(IREM-194)
	Kokit(IRAT-209)-
	Pawe-1(M-55)
Upland irrigated	NERICA-1
	NERICA-2
	Shebele (IR688059-76-3-3-3-2)
	GODE-1(BG-90-2)
	HODEN (MTU-1001)

2.4. Quality Control

2.4.1. Methods

Rice seed production involves a specialized set of practices which are not generally practiced under grain production. Seed regulations in Ethiopia impose several guidelines during the production and handling. Some of the regulations specify that (i) the rice seed production plots are isolated from other plots by at least 3 meters in distance; (ii) seed rates used for seed production are generally lower than that for grain production; (iii) spacing between plants are wider than that for grain production; (iv) roguing is done more frequently (at least 3 times) than that for grain production; (iv) the seed production plots are subject to crop rotation. Supervision of rice seed production in each station is managed by a farm manager who is responsible for seed produced in the respective research institutions or seed enterprises. A rice variety register providing characteristic features of all the released varieties is now available (section 2.1. under the working tool).

Quality control is made through on-field inspections during the production and through laboratory testing of seeds after harvest. While field inspection is done to verify if the seed is grown on land where the previous crop will not cause contamination from volunteer plants and/or seed transmitted diseases and isolation distance, and to confirm the source of seeds, identity of the variety and such production practices as roguing. Specifications for minimum purity standards of the various classes of rice seed are prescribed under the Ethiopian Seed Standard ES 493:2012. Laboratory tests are done to verify these standards of seed purity (ES 4050), seed germination (ES 474:2000), seed health (ES 476:2000) and seed moisture content (ES 478:2000). At the marketing stage, inspection is made to check tagging, labeling

and sealing of seed bags. The least standard limits for the various parameters of field and laboratory tests are shown in table 6.

Table 6: Minimum purity standard required for the various classes of rice seeds in Ethiopia

Standards	Seed class					
	Breeder/ Pre-basic	Basic	Certified Seed 1 (C1)	C2	C3	C4
Field standards:						
Rotation (min. years)	2	2	1	1	1	1
Isolation (m)	5	3	3	3	3	3
Off types & other varieties (max; %)	0.02	0.04	0.08	0.08	0.1	0.1
Laboratory standards:						
Pure seed (min %)	99	98	97	97	97	97
Other crop seed (max. %)	0.03	0.05	0.06	0.06	0.07	0.07
Weed seed (max %)	0.05	0.05	0.07	0.07	0.08	0.08
Infected/infested/seed (max %)	N.S	N.S	N.S	N.S	N.S	N.S
Inert matter (max %)	1	2	2	2	2	3
Germination (min %)	90	85	80	80	80	80
Moisture content (max %)	14	14	14	14	14	14

While in general, the federal VRPSQC directorate of the MoANR is responsible for ensuring varietal release and registration, the quality of early generation seed classes are assured through internal inspection by researchers at their respective institutions viz., EIAR or RARIs. The authorities at the regional BoAs oversee the quality control in the production of certified seeds. The inspection stages and methods employed by the regulatory authorities on seed producing fields are illustrated in table 7.

Table 7: Procedure and methods of on-field seed inspection

Seed Class	Organizations/ institutions in charge of inspection	Frequency and timing of Inspections	Items for Inspection	Inspection Methods
Breeder Seed	VRPSQC Directorate, Internal Inspection by the corresponding institutions (EARI, RARIs)	A minimum of 3 times at - Vegetative, -Flowering -Pre-harvesting stages	Other varieties of the same species	Observation, Sampling
			Objectionable weed plants	Observation, Counting
			Seed-borne disease	Sampling, Observation
			Existence of other crop species or off-types	Observation, Counting
Pre-basic Seed		A minimum of 3 times at - vegetative, - flowering - pre-harvesting stages	Other varieties of the same species	Observation, Sampling
			Objectionable weed plants	Observation, Counting
			Seed-borne disease	Observation, Sampling
			Existence of Other crop species or off-types	Observation, Counting

Seed Class	Organizations/ institutions in charge of inspection	Frequency and timing of Inspections	Items for Inspection	Inspection Methods
Basic Seed		A minimum of 3 times at - vegetative, - flowering - pre-harvesting stages	Objectionable weed plants	Observation, Sampling
			Seed-borne disease	Observation, Counting
			Existence of Other crop species or off-types	Observation, Sampling
			Other varieties of the same species	Observation, Counting
Certified Seed	VRPSQC Directorate, Regional Bureau of Agriculture, Regional Regulatory Institutions	A minimum of 2 times at flowering, pre-harvesting stages (Other stages of visits include Site selection, Land preparation, and Vegetative stages)	Seed-borne disease	Observation, Sampling
			Existence of Other crop species or off-types	Observation, Counting
			Other varieties of the same species	Observation, Sampling
			Objectionable weed plants	Observation, Counting
			Seed-borne disease	Observation, Sampling

After harvesting, the quality of seeds is tested at the national or regional seed testing laboratories. The procedures and methods employed for testing the seeds are outlined in table 8.

Table 8: Procedure and methods of harvested seed inspection

Seed Class	Organizations/ institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
Breeder Seed	Internal control (Researchers)	Germination rate	Inspection by seed technology researchers. & quality control personnel in research centers Put 10 grains on wet papers in a dish and keep them in incubator at 28 C, and check germination rate at 5th, 7th and 10th days.	Minimum 90% germination rate
		Purity Rate	Inspection by seed technology researchers& quality control personnel in research center Sample testing. Pick samples of seed randomly and check the color of grain, appearance, etc	98% or above
		Contamination by other varieties	Inspection by seed technology researchers & quality control personnel in research center Observation, Sample counting Randomly pick pieces of plots and count the contaminated hills	0.03

Seed Class	Organizations/ institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
		Contamination by other species	Inspection by seed technology researchers & quality control personnel in research center Observation, sample counting	0.03%
		Contamination by pests and diseases	Inspection by seed technology researchers & quality control personnel in research center Observation Chemical test: Check the virus and diseases	NS
Pre-basic Seed	Internal control (Researchers)	Germination rate	Inspection by seed technology researchers. Put 10 grains on wet papers in a dish and keep them in incubator at 28 C, and check germination rate at 5th, 7th and 10th days.	Minimum 85% germination rate
		Purity Rate	Inspection by seed technology researchers Sample testing. Pick samples of seed randomly and check the color of grain, appearance, etc	98% or above
		Contamination by other varieties	Inspection by seed technology researchers Observation Sample counting Randomly pick pieces of plots and count the contaminated hills	0.03
		Contamination by other species	Inspection by seed technology researchers Observation	0.03
		Contamination by pests and diseases	N/A	NS
Basic Seed and Certified Seed	Internal control (Researchers)	Germination rate	Inspection by seed technology researchers, Internal inspection is handled by own inspector for ESE, Inspection by Inspectors from Ministry of Agriculture Put 10 grains on wet papers in a dish and keep them in incubator at 28 C, and check germination rate at 5th, 7th and 10th days.	Minimum 80% germination rate
		Purity Rate	Inspection by seed technology researchers, Inspection by Inspectors from MoANR, Sample testing. Pick samples of seed randomly and check the color of grain, appearance, etc	Min. 97%

Seed Class	Organizations/ institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
		Contamination by other varieties	Inspection by seed technology researchers Inspection by seed inspector who has national inspection license (ODVS - Other distinguishable variety seeds) Observation Sample counting Randomly pick pieces of plots and count the contaminated hills	0.05%
		Contamination by other species	Inspection by Inspectors from Ministry of Agriculture at federal level and Bureau of Agriculture in regional states Observation	0.05%
		Contamination by pests and diseases	Health test	NS
	Plant Variety Release, Protection and Seed Quality Control Directorate (VRPSQC), Regional Seed Regulatory Authorities	Germination rate	Lab testing:- Put 10 grains (replicated) on wet papers in a dish and keep them in incubator at 28 C, and check germination rate at 5th, 7th and 10th days.	Minimum 80% germination rate
		Purity Rate	Lab testing	Min. 97%
		Contamination by other varieties	On-plot inspection	0.05%
		Contamination by other species	On-plot inspection	0.05%
		Contamination by pests and diseases	On-plot inspection	NS
		Seed Sourcing and Verification	On-plot inspection	NS
		Rotation	On-plot inspection	NS
		Isolation distance	On-plot inspection	NS
		Varietal Characteristics Uniformity of the crop stand - Conformity of phenotypic characteristics of the crop	On-plot inspection	NS

Seed Class	Organizations/ institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
		Presence of off-types	On-plot inspection	NS

2.4.2. Human Resources

The formal rice seed value chain in Ethiopia engages several research and extension agents at federal and regional levels. Varietal development is undertaken by researchers engaged in a range of scientific disciplines at EIAR and RARIs. Recently, a National Rice Research and Training Center (NRRTC) with an objective of spearheading research and dissemination of rice related technologies has become operational in Fogera. For inspection services, about 44 inspectors are working under the federal government (Table 9). It is however important to note that these inspectors are responsible for the inspection of all crops that are multiplied through seed and other propagation methods. Although a few researchers are provided with opportunities for upgrading their technical capacities on rice seed production through overseas workshops, training programs and/or visits; no regular training modules are available for a focused building of capacity on rice seed production.

Table 9: Available human and logistical resources for seed inspection at federal level

	Number of inspectors	Capacity of inspectors		Size of land covered per inspector	Geographical areas covered per inspector	Means of transport (with Remarks)
		Knowledge (with Remarks)	Experience			
Breeder Seed	1	MSC With national license for inspection	1-5 years	2 Ha	Whole country	Vehicle from research station
Pre-basic Seed				10 Ha	Whole country	
Basic Seed				20 Ha	3-5 districts	
Certified Seed	43	MSc, BSc	1-30 years	50 -500 Ha	1-5 districts	Motorcycle
Total	44					

In addition to the above mentioned federal human resources, regions where rice seeds are produced (Amhara, Oromio, Tigray and SNNPR) also employ a total of 143 staff including 66 technical staff and 77 support staff for carrying out on-field inspection and laboratory testing services for the seed producers and seed suppliers in their respective regions (Table 10). A total of 10 regional seed testing laboratories are available in the four rice growing regions viz., Amhara (4), Oromiya (2), SNNPR (2) and Tigray (2). Like in the case of their federal counterparts, the regional staffs are responsible for quality control of all seed and vegetative propagated crops. Although the regional staff learn seed production and inspection procedures from each other and/or from their interactions with quality control staff at the federal level, routine training programs for upgrading their capacities are presently not in place. Nevertheless, they transfer available knowledge and technologies to seed producers from their regions through scheduled annual/seasonal meetings.

Table 10: Human resources available for regional seed inspection and testing services

Name of the region	Technical Staff	Support Staff
Oromia	13 staffs, 1 technical staff covers 1909 Ha	20
Amhara	35 staffs, 1:325 Ha	32
SNNPR	13 staffs, 1:1105	23
Tigray	5 staffs, 1:688 Ha	2
Total	66	77

2.5. Seed Supply

When opting for the certified seeds, farmers generally prefer to access seeds from the seed unions through farmer cooperatives rather than individual sellers/traders. This is due to the lack of trust on the quality and the difficulties in accessing finance for procuring from individual seller/trader. Such conventional seed distribution often takes place through public networks. Public Seed Enterprises (including ESE and RSEs) have a large share of marketing of rice seeds through this marketing system. The demand for certified seeds of rice varieties is proposed by *woreda* to the regional BoAs which is then relayed to the regional and federal governments. Credit financing is facilitated by the federal and regional governments in the form of guarantee against a commercial bank's loan for the seed unions and/or directly to cooperatives in some cases. The seed unions procure seeds from the producers and distribute to farmers through cooperatives. This system is blamed to create good amount of seed carry-over due to mismatch between demand and supply, and also late delivery.

Under formal and intermediate seed systems, certified or quality declared seeds are also directly marketed to the sellers by the producers or traders. Through such **direct seed marketing** (DSM), the public seed enterprises and private seed companies (including QDS producers), the seed producers take an active role in the distribution of seed through multiple channels such as the primary cooperatives, direct producer's outlets, agro-dealers/retailers and independent seed stores. DSM thus shall potentially facilitate timely access of adequate quantities of quality rice seeds to the needy farmers with a competitive price. Recently a voucher system is being piloted by the ATA in four regions to promote input marketing including seed. There is ambition further integrate DSM with this system. Farmer access to finance for input purchase is addressed by microfinance institutions. The various stakeholders engaged in rice seed supply and their roles are shown in table 11.

Table 11: Rice seed supply chain actors and supporters

	Stakeholders (for both market oriented and subsistence rice varieties)	
	Institutions	Roles played
Breeder seed development/ Production/ supply	EIAR RARIs	Variety Development or Introduction, Early generation seed production, Procurement
Pre- Basic seed production/ Supply	EIAR RARIs	Supply to Basic seed producers
Basic seed production/ Supply	ESE Regional Seed Enterprises Private seed producers	Production of EGS Supply to registered certified seed producers Distribute it to Agriculture Cooperatives for multiplication

	Stakeholders (for both market oriented and subsistence rice varieties)	
	Institutions	Roles played
Certified seed production/ Supply	Regional Seed Enterprises, Registered Private Seed Companies, Registered Primary Cooperatives	Production and multiplication of seed Multiplication of seed and return to seed enterprises/distribute to farmers
Distribution of seeds	Input Marketing Directorate (MoANR), Regional Input marketing process owners, Private Seed Companies	Sales to farmers through Cooperatives and Unions Procurement, sales of certified seeds
Financing	Development Bank of Ethiopia (DBE), Commercial Bank of Ethiopia (CBE), Micro Credit Institute for Agriculture	Provide loan services (initial investment from DBE; working capital from CBE) to public and private sector seed multipliers, Micro Financial Institutions (MFI) provide loan services to farmers, cooperatives and unions

Several government and non-government initiatives are presently engaged in developing the seed value chain in the country. The government's Growth Transformation Plan (GTP) – II through ATA program is presently piloting the distribution of seed by engaging micro financial institutions (MFI) through voucher systems. Through Quality Seed Promotion Project (QSPP) Japan International Cooperation Agency (JICA) had endorsed production of quality seeds by providing inputs and technical knowledge on production through seed farmers school (SFS). Presently JICA has planned to support rice seed value chain development through EthioRice project. Fogera plain is also chosen as a hub for promoting rice sector development by AficaRice. Eastern Africa Agricultural Productivity Project (EAAPP), funded by the World Bank also has engaged in multiplication of quality seeds of improved rice in potential areas of the country. Alliance for Green evolution in Africa (AGRA) intends to promote private stakeholders' engagement in production and distribution of seeds in Ethiopia through Scaling Seed and Technology Partnership (SSTP) project that is carried out in collaboration with AGRA's Program for Africa's Seed System (PASS). Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is aiming to foster harmonization of seed regulations of Ethiopia with the Common Market for Eastern and Southern Africa (COMESA).

An Integrated Seed Sector Development (ISSD) project, supported by Dutch Embassy, promotes entrepreneurship and market orientation, and facilitates the development of the different seed systems in Ethiopia. Mennonite Economic Development Associates (MEDA), funded by Canadian International Development Agency (CIDA), is promoting entrepreneurship in production and marketing of seeds of improved rice varieties through Ethiopian Driving Growth through Trade and Entrepreneurship (EDGET) project. Both these projects support farmers' groups in the development of viable local seed businesses producing seeds for their local and/or regional markets; besides facilitating collaboration with other value chain actors and supporters in enhancing productivity through quality seed production and uptake.

Communication between public and private seed value chain actors and supporters through dialogues in limited forums such as the (i) national forum organized by MoANR for both public and private sector on production, planning and supply, pricing of seeds; (ii) discussion forum and training sessions (at least

once a year) between private seed associations and regional BoAs on regulations; (iii) National Rice Industry Innovation Platform under EthioRice project facilitates stakeholder interactions; and (iv) Ethiopian Seed Association (ESA) on policy and technical issues.

Although analytical surveys on the frequency of renewal of rice seed sources by farmers are not available, it is believed that farmers renew with a new source once in 2 years under irrigated and once in 3 years under rain fed environments. The common sources of seed renewal include (i) purchase of certified seed, (ii) seed exchange among farmers; (iii) farmer saved seed through selection. The average price of certified rice seed for all varieties between 2010 and 2012 is 9.5 Birr/Kg. The price of certified seed sold through public and private seed enterprises is decided based on the production costs. The proposal is submitted to the 'Board of Public Seed Enterprises' by each producer. Negotiations on the market price are then mediated through discussions between public seed enterprises and private stakeholders considering other costs on transportation, storage and logistics.

3. Challenges in Rice Seed Value Chain Development

3.1. Legislation, Policy, Institutions and Planning

Low participation of private sector in rice seed industry accentuates the deficiency in public research system in developing improved rice varieties (including hybrids) and thereby widening the choice of productive cultivars to farmers. Experiences in Asia indicate that the private sector played a lead role in hybrid rice variety development and its commercialization with the backstopping from IRRI and NARS.

Although variety registration and release process has evolved in Ethiopia over several years; the NVRC committee is presently comprised of representatives from only public institutions. Though varietal laws insist on 2 seasons of distinctiveness, uniformity and stability (DUS) and value in cultivation and use (VCU) tests, or 1 season for varieties registered in another country; the absence of private entities in the NVRC committee allow space for discretionary judgment. Accessibility to early generation seed (especially the breeder seed) of public rice varieties by private companies is also limited.

With the introduction of 2013 proclamation; Ethiopia's seed regulations still remain to be revised. Several of the regulatory instructions for the seed industry are presently provided through MoANR directives. However, clarity on several regulatory aspects still remains to be resolved. For instance, it is unclear if certification process will be required for early generation (breeder and pre-basic) seed classes. Guidelines on contractual agreements on seed production under out-grower schemes between public/private seed enterprises and producers remain to be explicitly outlined so as to enhance the engagement of private seed companies in rice seed production.

Furthermore, regional differences in implementation of QDS regulations on field inspection and laboratory testing for QDS; and QDS marketing by non-producers require to be normalized. For instance, while the inspection of QDS is perceived as not compulsory in Oromia, it is compulsory in Tigray. Clarity is also needed on the cross-border movement of certified seeds and QDS between the regions as the seeds certified/declared by one regional seed regulatory authority needs to be re-checked/verified by the other. This demands to bring harmonization on seed certification procedures and marketing among regional certifying agencies as well as between federal and regions.

Inadequate integration and harmonization of Ethiopia's plant breeder rights, seed laws, policies and regulations with that of Organization for Economic Cooperation and Development (OECD) and regional block such as Common Market for Eastern and Southern Africa (COMESA) also affects further public and private investments in rice seed trade. Harmonization of Ethiopia's seed regulations may however require amendments in the current seed proclamation. For instance, the requirement of at least 1 season of VCU and DUS tests for varieties registered in another country under Ethiopia's current seed regulations would pose a challenge to allow harmonization. Accreditation of national and regional seed testing laboratories by International Seed Testing Association (ISTA) also poses challenges on cross-border trade of seeds produced in Ethiopia.

Institutional coordination and alignment of rice seed related interventions amongst EIAR, RARIs, MoANR's Extension services, BoAs and ATA remain weak. Lack of institutional coordination between rice seed production and supply by public enterprises affects the efficiency of formal seed system. For instance, the seed processing, cleaning, testing and storage facilities are not aligned to major rice seed producing areas. Concentration of such resources increases the logistics costs and delays the supply of seeds to remote areas; and also minimizes the scope of sharing with private seed companies and seed producing cooperatives.

Lack of business diversification and inadequate professional capacity of farmers' cooperatives and seed unions increases the financial risks and reduces the economic viability of the cyclical seed business. Inadequate financial services and allocation of funds for seed related businesses under the agriculture portfolio restrains potential entrepreneurs, especially rural youth and women, from entering into seed industry. Evaluation of technical and financial risks involved in local seed business by the banks and micro financial institutions need to be reviewed and supported by appropriate monetary and fiscal policies. Moreover, the requirement of physical assets as collateral, commercial interest rates and other difficult terms for accessing credit services from the banks and microfinance institutions make it hard for smallholder seed producers and resource-poor cooperatives to enter into local seed business and/or scale up the seed trade.

Being a self-pollinated crop, the seed sub-sector of rice face several challenges as the low demand for certified seed by farmers weakens the tenacity of the entire value chain as the demand for certified seed is low. Lack of reliable surveys on the real demand for certified seed or QDS affects the planning and budgeting processes of both the public and private seed enterprises. Presently the officials in the *woreda* BoA and the development agents assess the demand for seeds through personal interaction with farmers in the various *woredas* and *kebeles* and forward the seed demand to regional and federal levels. Due to extrapolation of the rough estimates, such planning of seed production often leads to over production of seeds in the system. The resultant over production and over procurement often discourage seed unions and cooperatives from engaging in formal rice seed production. This demands the need for application of scientific demand forecast tools. The current approach in effective seed demand assessment has led to shortage of seed in one hand and leftover of seed on the other hand. Thus, strengthening the weak demand assessment system will be very crucial.

3.2. Production and Quality Control

Several challenges exist in improving the production and inspection of the various rice seed classes. Breeder seeds are produced through continuous recycling instead of refreshing from original nucleus seeds of accessions from international genbanks (AfricaRice, IRRI). Although X-Jigna is one of the popular traditional variety showing wider adaptations to the various rice growing conditions of Ethiopia, it is not yet registered as an official variety. Pure lines of popular traditional cultivars such as X-Jigna are not established through pedigree research; affecting the production and distribution of its seeds through formal and intermediate systems. Lack of glasshouse and cold storage infrastructures at RARIs exacerbates the deterioration of existing breeder and pre-basic seed stocks.

Quality of pre-basic and basic seeds of rice seeds is also becoming a growing concern amongst the private producers of certified seeds. Given the inadequate human and technical resources, researchers often engage technical assistants in early generation seed production. Under these circumstances, lack of external inspection by the VRPSQC Directorate during the production of early generation carried out at EIAR/RARIs affects the quality of seeds supplied through the system. Inadequate human resources and constrained access to means of transportation for inspection of rice seed producing fields their field visits affect the timeliness of certification processes. Furthermore, the insufficient technical and investment capacities render supplementary internal inspection by the local rice seed producing companies less tenable.

Weak business and financial management skills of local private seed companies, registered cooperatives and community seed producers impede the transformation of intermediate seed system into formal seed producing organizations. Inadequate financing mechanisms through commercial banks for private seed producers constrain outsourcing of seed production through organized out grower schemes. Inadequate engagement of farm machineries during the production, harvesting and post-harvest handling processes by the seed producers lowers the efficiency and quality of seeds. Budget constraints limit the public seed enterprises from expanding the seed production through contract seed grower schemes through which progressive farmers can be engaged in rice seed production.

Registered seed producing cooperatives engaged in QDS production do not have the sufficient technical and financial capacities in organizing an efficient marketing network for their seeds. The informal (farmer saved) seed system lacks adequate attention from the stakeholders. Creating awareness on the advantages of using certified seed on productivity inculcating knowledge on seed selection amongst seed users could improve the demand for quality seeds, which in turn shall revitalize the value chain development activities. Furthermore, lack of incentive for quality grain production in the rural markets discourages farmers from using quality seed. Lack of exclusive varietal rights by public or private enterprises negatively impacts demand creation efforts by private enterprises as the demand created by one entity is indiscriminately absorbed by the other producers.

3.3. Seed Supply

Supply chain of seeds for rice largely involves indirect seed marketing, and is tightly associated with the centralized planning process. Since the varietal choice for the production of basic seed classes is often pre-determined during the year; the reduced flexibility in the planning process affects the supply and accessibility of seeds of those rice varieties that are not included in the plans. Moreover, since the planning is done on the basis of requests from *woredas* that are not often pre-backed with financial

commitments, the uptake of seed stocks often falls behind the expectations. This forces the seed unions and cooperatives to accumulate some carry-over unsold stocks. The problem is further compounded by lack of appropriate storage facilities and poor market linkages; leading to deeper indebtedness and higher financial risks.

In the absence of a regulatory framework on contractual agreements between buyer and producer of seeds, the private seed companies are often hesitant to scale out the supply of rice seeds via out grower schemes. The difficult terms and conditions for accessing credit services by smallholder seed producers and economically underprivileged seed producing cooperatives affects the supply of quality seeds in the required quantities. Delay in release of credit by banks and micro financial institutions for those cooperatives, seed unions and other private seed producers who manage to secure loans affects the credit use efficiency and the supply of seeds.

Private seed producing companies and cooperatives lack effective channels to market and distribute their seeds. The limited quality regulatory resources along the production chain leads to variable quality of seed available through the supply channels. Fixed pricing of seeds and insufficient incentives for seed marketing agents, agro-dealers and rural stores for distributing seeds in remote areas affect the efficiency of existing supply channels through further investments in marketing networks. Lack of access to finance, transportation and storage infrastructures along the marketing channels also affect the supply of seeds rural areas.

Due to weak institutional coordination, the QDS producing farmers and cooperatives suffer from poor accessibility to wider and sustainable rice seed markets. QDS producers are presently engaged only in supplying a limited number of rice varieties. The weak linkages between QDS producing communities and research institutions (EIAR and RARIs) and public seed enterprises (ESE, RSE) limit the access to source seeds of all the rice varieties; and thereby limits the supply of QDS of farmers' choices. Constraints in implementing quality control system through the various post-production marketing phases of certified seed also affect the supply of seed. Several adulteration practices including mixing of grains and non-certified seeds into bags of certified seed during distribution are reported.

4. Rice Seed Value Chain Development

Given the importance of quality seed in advancing the productivity and competitiveness of local production, development of rice seed value chain plays a pivotal role in achieving the goals and targets set under national rice research and development strategy. A 5-year strategic framework (2016-2020) for an integrated development of rice seed value chain wherein the formal, intermediate and informal systems shall exhibit cohesion and synergy in order to raise on-farm rice productivity is outlined below.

4.1. Position of Rice Seed Development Strategy

The rice seed development strategies described in this document will be positioned under the National Rice Research and Development Strategies of Ethiopia (NRRDSE) and thereby mainstreamed within the overall fabric of agriculture and socio-economic developmental frameworks of the country. The planned activities under this document will also contribute to the rice specific value chain system approaches through agricultural commercialization clusters and the overall seed development strategies of ATA.

Since NRRDSE is placed under the government's Agricultural Growth Transformation Program (GTP) – II (2016-2020), it is expected that the rice seed value chain development strategies will contribute to the overall Agriculture Development Led Industrialization (ADLI) Strategy by increasing rice production and productivity, boosting food security, reducing poverty, and reinforcing commercialization of rice seed value chain.

4.2. Vision and scope

The rice seed development strategies outlined in this document envisions a vibrant seed system for the advancement of Ethiopian rice industry. The scope of the strategies covers the entire rice seed value chain including its actors and supporters. The key elements of the strategy encompass research and development on varieties and technologies, seed related legislations, policies and institutions, seed production, seed conditioning (cleaning, drying, treating and packing), quality control, seed supply and seed marketing.

4.3. Goal & objectives

The overall goal of the strategy is to enhance availability, accessibility and uptake of quality seeds by rice producers in Ethiopia. While the general objective is to attain an integrated development of the rice seed value chain in the country, the following specific objectives are set:-

(i) Increase effective demand and uptake of quality seeds amongst rice farmers through capacity building of seed users and seed producers and market information and extension delivery systems
(ii) Improve the technical capacities, infrastructure and human resources involved in production and inspection of all seed classes; and
(iii) Empower rice seed value chain actors and supporters through public-private-farmer partnership, institutional engagement, planning and coordination

4.4. Implementation Structure

The proposed strategic interventions will be implemented by the MoANR in close collaboration with the different directorates within the ministry and the EIAR at the federal level, and by the regional BoAs together with the respective RARIs. The same governance structures for NRRDSE will oversee the implementation. While the National Rice Technical Committee will provide the necessary technical inputs; the overall implementation will be guided by the National Rice Research and Development Steering Committee. The technical committee will be responsible for ensuring a cohesive coordination amongst stakeholders by organizing a national platform and providing feedback to the steering committee on such contexts as policy, laws, human resources, production, supply and finance for the advancement of the rice seed sub-sector. The required funds for carrying out the proposed activities will be mobilized by the MoANR through government budget and financial support from development partners and other public and private stakeholders of the rice seed sub-sector. The technical committee will also engage in further refinement of the strategic approaches described in this document and modify interventions according to dynamics of the rice seed value chain in the country and the regions.

5. Strategies

5.1. Strategic Principles and Approaches

Informal seed usage is the most prevalent system amongst rice farmers in Ethiopia. Facilitating a shift towards the formal seed system by creating a sustainable environment that shall enable advancements in the production and uptake of certified and QDS forms the strategic principle.

In Ethiopia, rice is generally grown for subsistence purpose and yet the surplus production is sold in the market. The surplus however is not assured in any of the ecosystems as all the ecosystems in which rice is grown in Ethiopia face climatic risks. For instance, since the rice grown in irrigated lowlands largely rely on natural drainage and seasonal flow of water (rather than through controlled infrastructures), the climatic risks in irrigated ecosystems bear similar weightage to that in rain fed ecosystems on production. Although the infrastructures under irrigated ecosystems are under development, it is rather tenuous to draw different sets of strategies of seed development for the irrigated and rain fed ecosystems. Hence strategic approaches proposed in this document are based on the existing nature (informal, intermediate and formal) of seed systems that cut across the irrigated and rain fed rice ecosystems.

Under the formal system, private sector (including private seed companies, registered cooperatives and seed unions) -led certified seed production and marketing will be promoted. Under the intermediate (integrated) system, the role of public seed enterprises in promoting certified seed value chain and QDS production by registered farmer groups will be envisaged. Public-private partnerships will be emphasized with a focus on rapid expansion of the intermediate system by absorbing individual farmers and farmer groups/communities under the current informal system. Farmers and communities who use grains as seeds under the informal system will be motivated to produce seeds through formal registration, use QDS and certified seeds by facilitating knowledge and accessibility. Empowering farmers and farmer groups through such principles as that of Quality Seed Promotion Project (QSPP) of JICA and seed farmer school (SFS) will form part of the strategic approaches in transforming the informal rice seed sector.

5.2. Target Setting

Intending to achieve the stipulated targets for grain production under NRRDSE, the proposed strategies in the document aspires to achieve a balanced increase of 8% in annual usage of certified seeds across the different rice ecosystems; as conceived under the country's Agricultural GTP-II. The total amount of seeds of the different classes required; and the area required for the production to achieve this target between 2016 and 2020 are shown in table 12. It is assumed that farmers will recycle the seeds once every 2 years; and accordingly targets are derived so that at least one out of every two rice farmers in Ethiopia will seek QDS or certified seeds by 2020.

Table 12: Seed production targets and the area required for the seed production by 2020

Seed Class	Target amount (g or Kg or tons/year)			Area of land required for production (Sq. m or Ha)		
	2016	2018	2020	2016	2018	2020
Breeder Seed (gram or Sq. m)	928.3	2495.6	4339.0	1.61	4.55	6.50
Pre-basic Seed (Kg or Sq. m)	103.3	235.3	405.0	105.6	415.9	723.2

Basic Seed (tons or Ha)	10.2	22.9	39.0	3.4	7.6	12.9
Certified Seed (tons or Ha)	771.1	1727.7	2951.2	255.4	572.0	975.7

The effective demand for quality seeds is different for the various available varietal options under the different ecosystems in which rice is cultivated. The total volumes of certified, basic, pre-basic and breeder seeds and the area required for the production of these varieties are shown in table 13, 14, 15 and 16 respectively.

Table 13: Targeted volumes and areas for the production of certified seeds of the different varieties under the rice growing ecosystems (in tons)

Ecosystem	varieties	Share (%) of demand	Required volumes of Certified seed			Required area for the certified seed production		
			2016	2018	2020	2016	2018	2020
Irrigated	NERICA 14	15%	11.6	32.4	66.4	3.8	10.7	22.0
	NERICA 15	20%	15.4	43.2	88.5	5.1	14.3	29.3
	Others	65%	50.1	140.4	287.7	16.6	46.5	95.1
	Total	100%						
Rain fed Lowland	Ediget	15%	69.4	142.5	221.3	23.0	47.2	73.2
	X-Jigna	70%	323.9	665.2	1032.9	107.3	220.2	341.5
	Others	15%	69.4	142.5	221.3	23.0	47.2	73.2
	Total	100%						
Rain fed Upland	NERICA 4	50%	115.7	280.8	516.5	38.3	93.0	170.8
	SUPERICA 1	20%	46.3	112.3	206.6	15.3	37.2	68.3
	Others	30%	69.4	168.5	309.9	23.0	55.8	102.5
	Total	100%						
Grand Total			771.1	1727.7	2951.2	255.4	572.0	975.7

Table 14: Targeted volumes and areas for the production of basic seeds of the different varieties under the rice growing ecosystems (in ton)

Ecosystem	varieties	Share (%) of demand	Required volumes of basic seed			Required area for the basic seed production		
			2016	2018	2020	2016	2018	2020
Irrigated	NERICA 14	15%	0.2	0.4	0.9	0.1	0.1	0.3
	NERICA 15	20%	0.2	0.6	1.2	0.1	0.2	0.4
	Others	65%	0.7	1.9	3.8	0.2	0.6	1.3
	Total	100%						
Rain fed Lowland	Ediget	15%	0.9	1.9	2.9	0.3	0.6	1.0
	X-Jigna	70%	4.3	8.8	13.7	1.4	2.9	4.5

Ecosystem	varieties	Share (%) of demand	Required volumes of basic seed			Required area for the basic seed production		
			2016	2018	2020	2016	2018	2020
	Others	15%	0.9	1.9	2.9	0.3	0.6	1.0
	Total	100%						
Rain fed Upland	NERICA 4	50%	1.5	3.7	6.8	0.5	1.2	2.3
	SUPERICA 1	20%	0.6	1.5	2.7	0.2	0.5	0.9
	Others	30%	0.9	2.2	4.1	0.3	0.7	1.4
	Total	100%						
Grand Total			10.2	22.9	39.0	3.4	7.6	12.9

Table 15: Targeted volumes and areas for the production of pre-basic seeds of the different varieties under the rice growing ecosystems (in kg)

Ecosystem	varieties	Share (%) of demand	Required volumes of pre-basic seed			Required area for the pre-basic seed production		
			2016	2018	2020	2016	2018	2020
Irrigated	NERICA 14	15%	1.5	4.4	9.1	1.6	7.8	16.3
	NERICA 15	20%	2.1	5.9	12.2	2.1	10.4	21.7
	Others	65%	6.7	19.1	39.5	6.9	33.8	70.5
	Total	100%						
Rain fed Lowland	Ediget	15%	9.3	19.4	30.4	9.5	34.3	54.2
	X-Jigna	70%	43.4	90.6	141.8	44.3	160.1	253.1
	Others	15%	9.3	19.4	30.4	9.5	34.3	54.2
	Total	100%						
Rain fed Upland	NERICA 4	50%	15.5	38.2	70.9	15.8	67.6	126.6
	SUPERICA 1	20%	6.2	15.3	28.4	6.3	27.0	50.6
	Others	30%	9.3	22.9	42.5	9.5	40.6	75.9
	Total	100%						
Grand Total			103.3	235.3	405.0	105.6	415.9	723.2

Table 16: Targeted volumes and areas for the production of breeder seeds of the different varieties under the rice growing ecosystems (in grams)

Ecosystem	varieties	Share (%) of demand	Required volumes of breeders' seed			Required area for the breeders' seed production		
			2016	2018	2020	2016	2018	2020
Irrigated	NERICA 14	15%	13.9	46.8	97.6	0.02	0.09	0.15
	NERICA 15	20%	18.6	62.4	130.2	0.03	0.11	0.19
	Others	65%	60.3	202.8	423.1	0.10	0.37	0.63
	Total	100%						
	Ediget	15%	83.5	205.9	325.4	0.15	0.38	0.49

Ecosystem	varieties	Share (%) of demand	Required volumes of breeders' seed			Required area for the breeders' seed production		
			2016	2018	2020	2016	2018	2020
Rain fed Lowland	X-Jigna	70%	389.9	960.8	1518.6	0.68	1.75	2.27
	Others	15%	83.5	205.9	325.4	0.15	0.38	0.49
	Total	100%						
Rain fed Upland	NERICA 4	50%	139.2	405.5	759.3	0.24	0.74	1.14
	SUPERICA 1	20%	55.7	162.2	303.7	0.10	0.30	0.45
	Others	30%	83.5	243.3	455.6	0.15	0.44	0.68
	Total	100%						
Grand Total			928.3	2495.6	4339.0	1.61	4.55	6.50

5.3. HUMAN RESOURCES

Building human capacity along the entire rice seed value chain is one of the pivotal strategic elements in developing the rice seed sector. Several technical and enumerative gaps exist in the available human resources for rice seed production (table 17) and inspection (table 18) under the public domain at federal and regional levels.

Table 17: Requirements of human resources in rice seed research

Name of Seed Producing Stations	Researcher		Gap	Technician		Gap
	Required	Available		Required	Available	
Fogera	3	0	3	3	0	3
Pawe	1	0	1	2	0	2
Mai-tsebre	1	0	1	2	0	2
Worrer	2	0	2	2	0	2
Bako	2	0	2	2	0	2
Total	9	0	9	11	0	11

Table 18: Requirements of human resources in inspection of seed production fields and seed testing

Geographical area	Number of Inspectors		Gap in number	Gap in Capacity
	Required	Available		
Axum	9	2	7	Limited experience in rice, Lack of specific roles on rice inspection - cover inspection of all crops
Bahir Dar	10	6	4	
Gonder	7	3	4	
Ambo	8	5	3	
Bonga	7	n/a	7	
Welkite	14	9	5	
Addis Ababa (National Seed Lab)	10	n/a	10	
Total	65	25	40	

Human and technical capacities of private seed companies and QDS producers also need to be strengthened on seed production and internal quality control. The technical capacities of EIAR's and RARI's staff need to be trained on seed production (table 19) and that of inspection staff at federal (VRPSQC) and regional BoAs (table 20).

Table 19: Requirements of training, recruitment and budget for building human resources on seed production

Profession	Number of technical personnel to be newly employed	Required Budget (recurring) for employment	Number of technical personnel to be trained	Areas for training	Required Budget for training per year
Researchers	9	1,944,000	10	Maintenance breeding, Seed technologies	$25,000
Technicians	11	660,000	Overseas training: Public Sector (15) Private Sector(10)	Crash course on rice seed production, handling	$50,000
			In-country training: Public Sector (20 technicians) + Private Sector (50 technicians)		$35,000
Workers/ Laborers	n/a	n/a	In-country training: 25 labors (public (20) + private (5))	Land preparation, Roguing, Machineries, Harvesting, Post harvest handling	$,10,000
Total					$120,000

Table 20: Requirements of training, recruitment and budget for human resources on inspection of seed production fields and seed testing

Geographical Area	Number of inspectors to be newly employed	Required Budget (recurring) for employment	Number of Inspectors to be trained	Areas for Training	Required Budget for training per year
Axum	9	2,136,000 Birr	2	Varietal identification, Planning, Field inspection, Seed sampling & testing, Customer management	$85,000
Bahir Dar	10		6		
Gonder	7		3		
Ambo	8		5		
Bonga	7		n/a		
Welkite	14		9		
Addis Ababa (National Seed Laboratory)	10		n/a		
Total	40	2,136,000 Birr	25		$85,000

In addition, the technical knowledge on seed production and seed quality, and operational capacities in managing climatic risks and in accessing finance, logistics (storage infrastructure and transportation) and direct and indirect seed supply networks by the private seed producers (including the informal farmer groups/communities, the QDS producers, primary cooperatives, seed unions and the certified seed producing companies) will be reinforced through innovation platforms, specialized training courses, seed farmer schools, seed fairs and regional and national workshops on rice seed.

5.4. Supply

Creating demand through awareness creation and enabling timely supply of quality rice seeds in adequate quantities in rice growing areas will form the key strategic principles in improving the rice seed supply chain. Emphasis will be laid on efficient targeting of farmers through gradual move from the conventional means of targeting to market led production and client targeting with active participation of private sector in production, processing, storage, and distribution of quality seeds under the formal and intermediate system. Monitoring of the quality and market determined pricing mechanisms will be facilitated through appropriate deployment of human resources and implementation of regulatory policies along both the public- and private supply network will play critical roles in reinforcing quality rice seed production. Promoting seed related extension services and strengthening traditional genetic conservation and seed management practices through innovation platforms will be emphasized under the informal seed system.

Farmers, farmer groups, and non-registered community rice seed producers will be sensitized on the socio-economic advantages and demand for the uptake of quality seeds will be stimulated. Accessibility of seeds along the supply chain will be enhanced by bolstering the linkages amongst the stakeholders along the entire spectrum of rice seed value chain, including source seed providers, research and technical service providers, extension agents, regulatory authorities, seed producers, seed unions, financing institutions, indirect/government and direct marketing agents, and rice farmers (seed users).

5.5. Intervention Options

Ethiopian rice sector is well poised for a significant development due to its rising local rice production, rice consumption, favorable geographic and climatic diversity for seed production and marketing (both local and regional) for quality seeds of improved rice varieties. To achieve the goal and targets set under this strategic document, the following intervention options are proposed:-

5.5.1. Legislation, Policy, Institutions and Planning

- Ensure access to early generation seed (EGS) through contractual agreements between public and private seed producers;
- Outsource pre-basic seed production to private seed companies
- Put in place incentive mechanism to encourage private sector engagement
- Policy directive on the need for registration of seed production activity in order for the CBS to market the seeds
- Internal (between the regions) and external (COMESA) harmonization of seed regulations amongst the regional seed regulatory authorities
- Insist registration of seed production activities by the primary cooperative in order to join the 'seed union'

- Provision of incentives for registration to community seed producers by means of public services (easy access to source seeds, training, credit, market)
- Embrace ATA's roadmap on transformation of farmer groups, primary cooperatives, seed unions, and formal sector in rice seed clusters
- Strengthen (financial, administrative) the linkages of different actors by National Rice R&D Steering Committee/ Rice Secretariat by engaging:-
    - EthioRice project's 'Innovation Platform'
    - Agricultural Transformation Agency (ATA)
    - Ethiopian Seed Association (ESA)
    - Other projects engaged in rice R&D
- Establish linkages between Unions, private seed companies, farmers and other seed markets at national level through such interventions as 'rice sector innovation platform'
- Engage Unions, private seed companies in performing demonstration/popularization trials of popular rice varieties
- Conduct periodic (annual) analytical surveys by engaging seed distributors or marketers and farmers
- Promote advanced contractual agreements with PCs, PCs-member farmers, and non-PC farmers
- Establish an efficient/simultaneous distribution – to avoid delays and consequent 'change of mind/preferences'
- Put in place mechanisms for honoring/enforcement of the contractual agreements between seed producers and seed users:-
    - Conditional linkage between vouchers with certified seed suppliers who had entered contractual agreement with buyers
    - Advanced 'contractual agreements on purchase of seeds' with member-PCs, non-member PCs and farmers
- Build business management capacity of Seed Unions
- Enforcement of contractual agreements between private seed companies and out growers
- In line with ATA's model, promote 'rice seed union' in rice niches/hubs
- Calibrated encouragement of seed unions in diversifying/extending the business activity to fertilizers, pesticides and other related inputs

5.5.2. Production and Inspection

- Acquire pedigree lines and genetic accessions of all the registered varieties and through selection of pure lines, stock fresh nucleus and breeder seeds for reinforcing the quality of seeds produced and supplied through the rice seed value chain in the country
    - Conduct pure line/pedigree research for traditional cultivars such as X-Jigna and purify and/or verify purified candidate lines that are already available and generate characteristics (passport data) for official registration
    - Long-term capacity building of existing breeders through MSc/PhD courses
    - Short-term capacity building of breeders, seed researchers and technicians on
        - maintenance breeding
        - Seed technology including seed testing procedures
        - Seed processing and packing

- Collaborative research and development with international and regional rice research institutions
- Establish glass house and cold storage facilities for breeder and pre-basic seeds at
  - NRRTC, Fogera
  - Pawe
  - Mai-tsebri
  - Bako
  - Gode
- Through in-country training programs, the recipient(s) of the international training program will train the relevant rice seed researcher and technicians at EIAR, RARIs, ESE, regional SEs, private seed companies and seed producer cooperatives
- Recruit and train existing and fresh researchers and technicians on seed production and maintenance breeding
- By engaging private seed companies, breeders at EIAR and RARIs identify parental lines and test the adaptability of hybrid vigor
- Recruit seed technicians, seed farm managers
  - NRRTC, Fogera (RF Upland, Lowland)
  - Pawe (RF Upland)
  - Mai-tsebri (RF Upland)
  - Werrer (Irrigated)
- Accelerate the land acquisition process for NRRTC, Fogera
- Given the resource constraints of VRPSQC and regional regulatory authority, improve the 'internal quality control measures' during pre-basic seed production
- Raise the human and technical capacities of VRPSQC
- Provide short-term in-country training courses to existing technicians at ESE, OSE, ASE, SSE on:-
  - seed production
  - internal seed quality control measures
- Enforce 'inspection and certification processes' of the basic seeds supplied
- Arrange lease service and/or other access mechanisms of machineries for land preparation, harvesting, threshing, seed cleaning/sorting and packaging to OSE, ASE and SSE
- Provide regular training to all certified rice seed producers (registered seed producer CBS/PCs, Unions, Private companies) on quality seed production practices including crop management (pest, diseases, water stress) and post-harvest handling
- Engage 'certified rice seed producers' under the 'National Rice Industry Innovation Platform' under EthioRice project
- Facilitate sharing of information on 'effective' market demand (seed and grain), market (government and direct) accessibility, finance and regulations
- Enhance quality of QDS production through:
  - Technical capacity building for seed producing farmer groups
  - Improve access to market, finance, business management through
    - information sharing
    - regular training and

        - inclusion under the government and DP sponsored development projects (e.g. ATA)
- Improve non registered community based seed production by:-
    - facilitating recognition as community based seed production by the relevant authorities (so that they become registered);
    - technical capacity building for seed producing farmer groups and
    - improving the access to market, finance, business management through:-
        - information sharing;
        - regular training and
        - inclusiveness under the government and DP sponsored development projects (e.g. ATA)
- Upgrade farmer saved seed production and handling (informal system) by:-
    - capacitating farmers on saving quality seed selected from their own production using such models as QSPP's Seed Farmer School (SFS) approach and
    - sensitizing farmers on the advantages of using quality certified seed on productivity and profitability
- strengthening of the capacities – human and material – of the seed certification agencies

5.5.3. Supply and Marketing

- Stimulate demand for quality seeds by promoting:-
    - voucher system for seeds
    - incentives (price difference) for quality 'grains'
    - linkages between producer and grain processors that will increase the uptake of improved seed
    - leasing of production and processing machineries
    - responding to demands for traditional and popular rice varieties such as X-Jigna
    - promoting new, high yielding varieties
    - creating awareness on the advantages of using quality seed on productivity and profitability
- Organize joint planning of annual seed requirements by including breeders while planning the requirements by the Crop Directorate
- Establish cold storage facilities for distribution of seeds at:-
    - Fogera (NRRTC)
    - Pawe
    - Mai-tsabire
    - Bako
    - Werrer
    - Bonga
    - Gode
- Single window of approval by the basic seed producer (research institutions) for the registered 'certified seed producers'
- Improve the planning process by engaging 'certified seed producers' and 'basic seed suppliers'
- Establish 'online database' on availability of all seed classes of rice varieties

- Promote contractual agreement between certified seed producers and seed users (farmers, farmer groups, primary cooperatives, seed unions)
- Assess demand based on genuine revealed demand, current rainfall and socio-economic factors, memorandum of understanding and/or written forms of demands
- Seed production should be recognized as one of the priority areas/sub-sectors under rural/agricultural financial systems
- Promote and scale up the voucher system (piloted in Amhara in 2014-15) to other regions in the country
- Sensitize financial institutions and policy makers on the economic importance of seed production and distribution business activities in promoting agriculture led transformation by organizing:-
  - national workshops
  - innovation platforms and/or seed innovation sub-forums
  - information exchange (pamphlets, electronic media)
  - seed fairs
- Explore regulatory mechanisms by which the supply chain can be monitored for any foul plays
- Scaling out and scaling up of the pilot voucher system for seed distribution to all rice producing areas and regions
- Training on seed marketing concepts such as market segmentation, market intelligence, product profile of the variety, and complaint handling for rice seed producers.

6. ANNEXURE

6.1. WORKING TOOL (QUESTIONNAIRE) ON ETHIOPIA'S SEED SUB-SECTOR