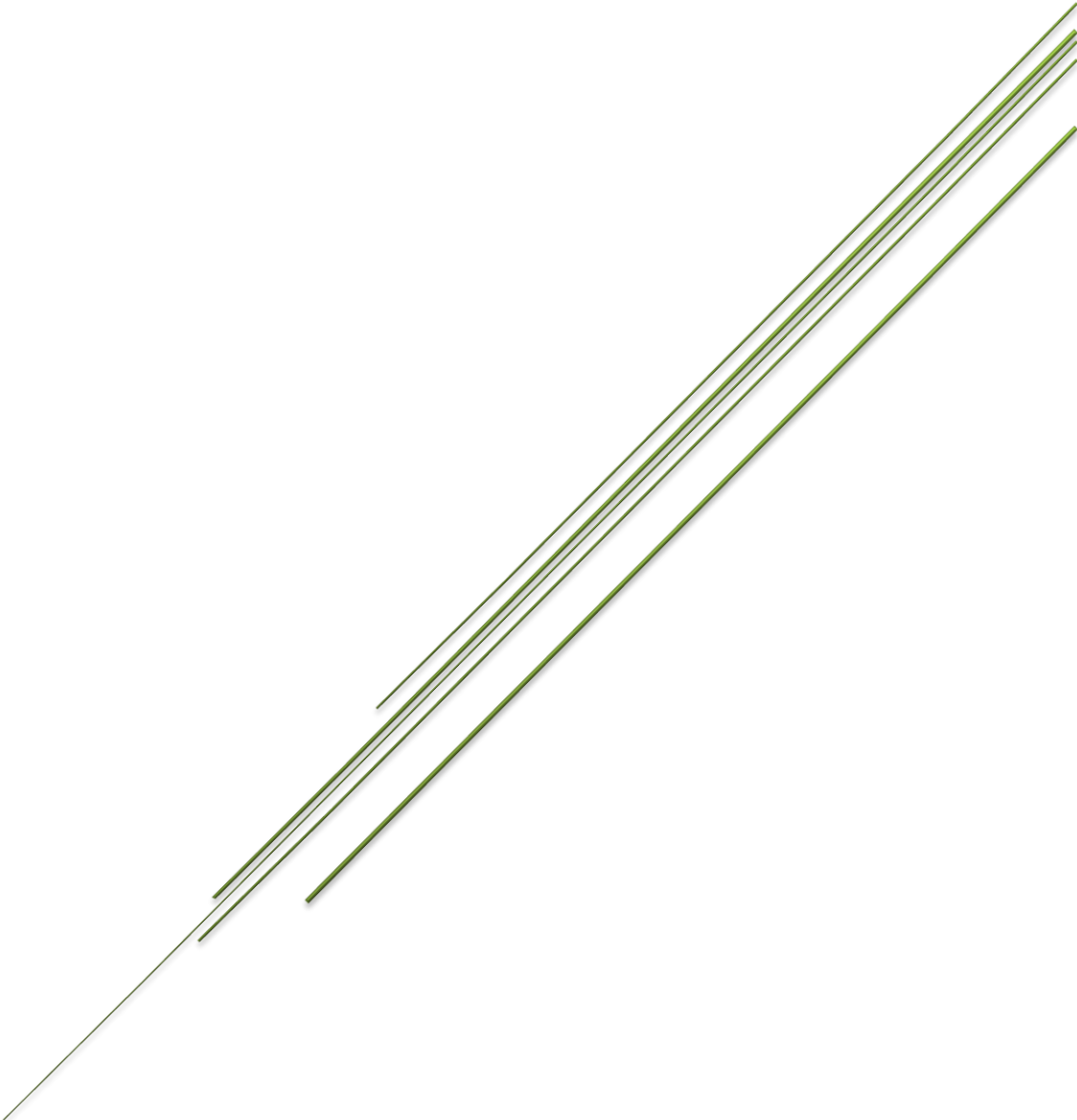


ROADMAP FOR RICE SEED SUB-SECTOR DEVELOPMENT IN ZAMBIA

Draft_0 (15 December 2017)



MINISTRY OF AGRICULTURE AND LIVESTOCK
REPUBLIC OF ZAMBIA

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Executive Summary

Rice has emerged as one of the important food and cash crops in Zambia. Rice production in Zambia is largely driven by smallholder farmers in rainfed lowland and rainfed upland production environments. Recent upsurge in market demand for rice consumption has outstripped the local rice production; leading to a 5-year average deficit of 28% in 2015. Government of Zambia has recognized rice as a strategic priority crop and had recently promulgated second National Rice Development Strategy (NRDS; 2016-2020). The NRDS envisages 'enhancing the access to quality seeds to farmers' as one of the major strategic axes in the development of the rice sector in Zambia. This document assesses the current situation and challenges along the rice seed value chain, and outlines a roadmap for the advancement of the rice seed sub-sector, in alignment with the NRDS.

Plant Variety and Seeds Act (CAP 236) and its regulations govern the various functions of the national seed sector at large. Although a national seed sector policy is not yet made available, the overall agriculture sector policy provides the guiding principles for increasing the accessibility of farmers to improved seeds. Seed Control and Certification Institute (SCCI) under the Ministry of Agriculture and Livestock (MoAL) oversees the implementation of the seed related regulations. SCCI is also responsible for organizing the varietal testing, registration and protection, seed systems and inspections, laboratory seed testing and certification of seeds.

Due to the self-pollinating nature of the rice flowers, the farmers are often deceived by the prolonged generations over which genetic breakdowns accumulate. Hence a vast majority (>90%) of the rice farmers in Zambia use grains saved from their previous harvest as seeds in the subsequent season(s); resulting in a perpetuated reduction in on-farm productivity. Such informal farmers' recycling of seeds does not involve any institutions and is not recorded. Formal seed system on the other hand involves licensed production, inspection and marketing processes; in which the relevant institutions and stakeholders are expected to follow the prescribed regulations.

Under the formal system, the rice seeds are multiplied sequentially from breeder to pre-basic to basic to certified seeds. While the certified seed (C-1) can be multiplied through 2 further cycles (C-2 and C-3), quality declared seeds (QDS) shall be produced from the certified seeds. In the recent years, QDS is increasingly becoming popular amongst rice farmers. SCCI issues license for seed production, conducts field inspection and laboratory testing and endorses the quality of seeds. Production and supply of breeder seeds and pre-basic seeds are carried out by Zambia Agriculture Research Institute (ZARI). Participation of private sector in the rice seed value chain is presently self-limited to the multiplication and marketing of basic and certified seeds (including QDS). This is largely due to a weak demand for certified seeds amongst the rice farmers. Constrained by the budget and a perpetual weak demand, the ZARI stations are not engaged in annual planning of the production of early generation seeds; causing uncertainties on the seasonal volumes along the supply chain of certified rice seeds.

The roadmap proposed in this document aims to increase total production and productivity through increased usage of certified seeds by:- (a) introducing varieties with climate resilience and market-preferred traits that can drive the demand for certified seeds, (b) spurring the production and supply chains of rice seeds through public extension services and in partnerships with private seed companies, (c) improving the field inspection service provisions and increasing the access to seed testing and certification processes, (d) stimulating effective demand for rice seeds and encouraging entrepreneurships in production and marketing. It is expected that the implementation of this roadmap will increase in adoption of certified rice seed from the current level of 10% to 40% of the rice growers by 2020.

By expanding collaborations with regional and international research and development institutions, newer rice varieties with the desirable traits will be evaluated, tested for its adaptability to local production environments, and released for cultivation. Technical capacities of researchers, inspectors, producers of the various seed classes will be built through hands-on training courses. Farmers' accessibility to rice seeds and market information will be enhanced by developing a database over which the stakeholders can share the details on production, inspection and available stocks and their locations. Production, management and marketing skills of QDS producers will be improved by providing training and stakeholder-linkages.

Agro-dealer networks in remote areas will be strengthened through incentives, training and support services on information, storage and marketing. Demand for certified rice seeds will be fomented in partnerships with private seed companies by employing various proven extension approaches. Government of Zambia has been using Farm Input Subsidy Program (FISP) as a vehicle for stimulating the demand for certified seeds amongst rice farmers. This roadmap will further improve the targeting of subsidies and help the beneficiaries fully embrace the formal seed system. Areas under certified seed usage will be further enhanced by rehabilitating the existing dambos and establishing new irrigation schemes.

Implementation of the roadmap will be monitored by Zambia Consortium for Accelerated Rice Development (ZCARD). The seed taskforce that was engaged in preparing this roadmap will provide the necessary technical consultations to ZCARD by developing project concepts that shall lead to concrete execution of the proposed strategies by the relevant public institutions in partnerships with private seed companies and other stakeholder organizations. ZCARD will engage federal and local governments, development partners, non-government organizations and the relevant private stakeholders in mobilizing funds for the implementation of this roadmap.

1. Introduction

Rice is increasingly becoming an important staple food crop in Zambia. Rice is almost exclusively grown by smallholder farmers with an average farm size of 0.57 Ha. Amongst the three major agroecological regions in Zambia, rice is largely cultivated in the Central and Northern regions, where most of the agriculturally productive rainfall is received. Owing to semi-arid dry environment, the rice cultivation in the dry Southern region is negligible. Until the early 2000s, the demand for rice consumption in Zambia was largely concentrated in urban markets; and rice cultivation was recognized as one of the profitable smallholder cash crops. In 2007, the 7-year average paddy (un-milled rice) production was about 15,712 t/year. Since 2008 however, the 7-year average production has increased by 3-fold to 47,117 t/year. Yet, the average crop productivity level has remained stagnant at around 1.41 ± 0.23 t/Ha through these periods, indicating that the recent increase in local production has largely come from expansion of area under rice cultivation in Zambia (Fig. 1). Nevertheless, the cumulative demand for milled rice consumption across the national markets has also surged from 23,848 tons in 2008 to 58,4711 tons per year in 2014; leading to a significant increase in deficit (Fig. 1).

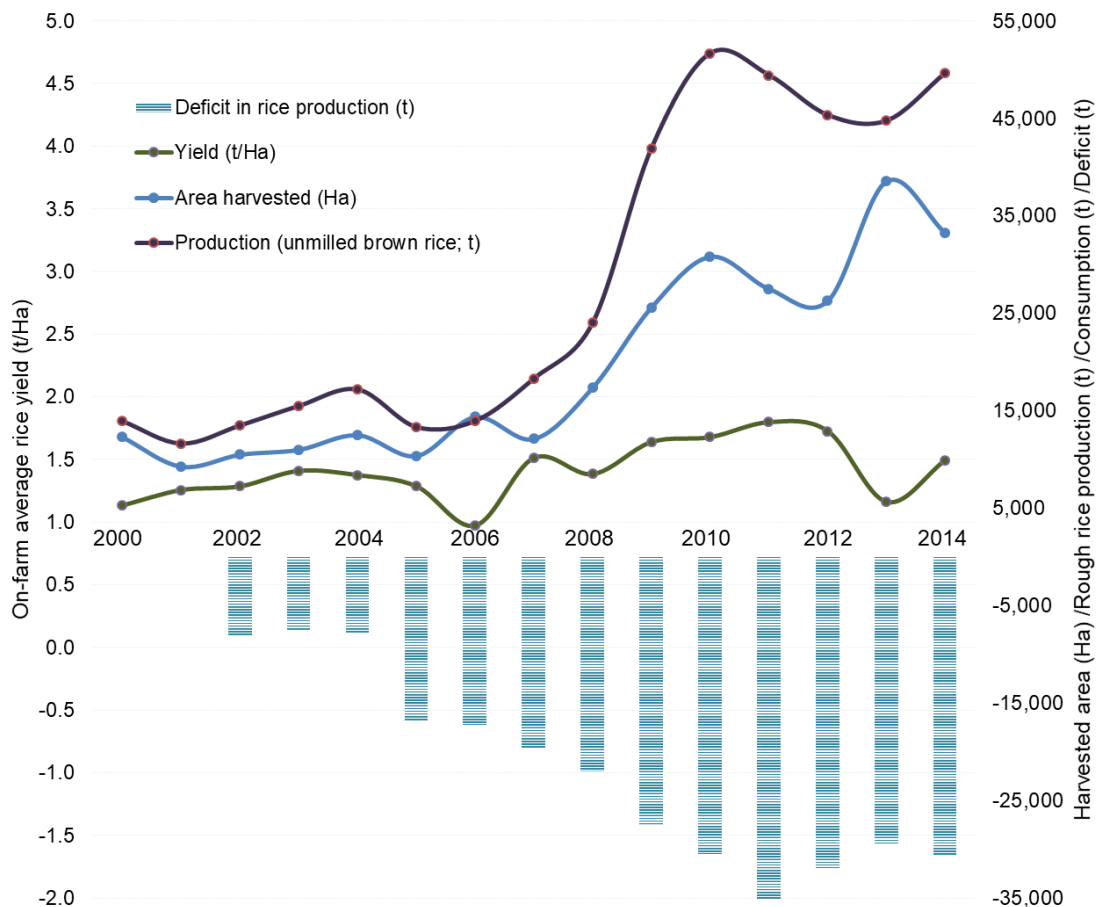


Fig. 1: Changes in area under rice production (Ha), on-farm yield (t/Ha), paddy (un-milled rice) production (t) and deficit¹ (milled rice; in t) in Zambia since 2000²

¹ Local production of milled rice was calculated using 65% milling degree; after deducing 10% of the local paddy (un-milled) production volumes for seed and feed losses

² FAOSTAT data; accessed on 20-11-2017

National markets have addressed the deficit in local rice production through importation of milled rice from other rice growing countries in the region and elsewhere in Asia. Besides exerting pressure on the food trade balance and foreign exchange³, the importation of rice has also imposed a growing challenge on the price- and quality competitiveness of the locally produced rice. Market surveys nevertheless also show that there is a significant potential for marketing the Zambia-grown rice in local markets and in the neighboring countries such as Namibia, Botswana, Zimbabwe and Angola.⁴ Rice has thus emerged as a new millennial alternative for enhancing the smallholder farmers' livelihoods and income generation in Zambia; for by serving as both a food and cash crop, the rice cultivation has widened the scopes in improving the national food security, poverty reduction and economic development. Evidences from Asia reveal that the labor-intensive production, processing and marketing processes of the rice value chain could also provide ample job opportunities for men and women in both rural and urban areas.⁵

Government of Zambia has recognized rice as one of the strategic food crops under its crop diversification program⁶ and has recently launched the second 'National Rice Development Strategy (NRDS-II; 2016-2020)'. The NRDS-II aims to achieve a 50% increase in local rice production by 2020 and enhance the market competitiveness. Major strategies for achieving this goal envisage (a) a 25% increment in on-farm crop yield and (b) a 20% increase in land area under rice cultivation. Both these strategic elements require increased availability and usage of quality seeds. This document assesses the current situation of the rice seed sub-sector, and puts forth a roadmap for the advancement of the rice seed value chain in Zambia.

2. Review of rice seed value chain in Zambia

2.1. Legislation, Policy and Planning

Zambia's seed sector is governed by the Plant Variety and Seeds Act (CAP 236)⁷. The Act provides for regulations and control through local variety testing and release; local production and marketing of seed; import and export of seed; seed quality control, and coordination of the seed industry in Zambia. The Law designates Seed Control and Certification Institute (SCCI) as responsible for the administration of this Act and implementation of the various provisions of Plant Variety and Seeds Regulations⁸ under the CAP 236. The regulations outline that no seed shall be offered for sale unless it has been certified and that no seed shall be commercially sold unless its production has been inspected, sampled and tested. Marketing of counterfeit seeds is a punishable offence in Zambia and shall attract up to 3 months of imprisonment and revoking of defaulter's license.

³ Food balance and Trade balance sheets, <http://zambia.opendataforafrica.org>

⁴ SNV Zambia (2007) Building production, marketing and processing capacity in the rice value chain in Zambia.

⁵ Pingali PL (2012) Green Revolution: Impacts, limits, and the path ahead. PNAS 109: 12302–12308

⁶ Kankwamba H et al. (2012) Determinants and spatiotemporal dimensions of crop diversification in Malawi. International Food Policy Research Institute (IFPRI).

⁷ Plant Variety and Seeds Act (1995), Chapter 236 of the Laws of Zambia

⁸ Plant Variety and Seeds Regulations (No. 108 of 1997), Chapter 236 of the Laws of Zambia

Under the stewardship of the Ministry of Agriculture and Livestock (MoAL), the SCCI is also the administrator of the Plant Breeder's Rights Act (No. 18 of 2007)⁹ under which rice varieties with demonstrable values are registered and released for cultivation in Zambia. A National Variety Release Committee comprised of the representatives from a spectrum of research and development is responsible for crop variety release in Zambia. The candidate varieties are evaluated for distinctness, uniformity, and stability (DUS) and value for cultivation and use (VCU) over two cropping cycles at multiple locations, prior to registration. These tests help ascertain the identity and credentials of different varieties, make informed choices on the varieties by the farmers, and also protect the breeder's rights.

While the CAP 236 provides the legal framework of operations of the seed industry; an all-exclusive national seed policy outlining the guidelines for the various stakeholders is not yet available in Zambia. However, the National Agricultural Policy (2016-2020) provides adequate major thrusts for the seed sector by emphasizing liberalization, commercialization, promotion of public and private partnerships, and provision of effective inspection and certification services that will ensure sustainable increase in trading and adoption of quality seeds. The NAP envisages increased supply of seeds through multiplication by smallholder seed growers.

A multitude of public and private stakeholders are engaged along the rice seed value chain in Zambia (Table 1). Zambia Seed Traders Association (ZASTA) represents an alliance of the private seed companies in the country. ZASTA plays a key role in liaising with the government on seed related policies and programs. By working with the SCCI, the ZASTA is also engaged in improving the quality of seeds supplied in the market and raising awareness on seed production and seed access to other value chain actors and supporters. Zambia Rice Federation (ZRF) represents another platform for all the stakeholders in the rice sector to engage in policy dialogue with the government. Agricultural Consultative Forum (ACF), an association of stakeholders serves as an important forum for policy debates in Zambia's agricultural sector.

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

		Name of institutions	Roles/Responsibility	Legislations/Policies determining responsibility
Overall	Production	ZARI, Seed Companies and Seed Grower Associations	Seed research and production and maintenance of parent seed	National Agriculture Policy (NAP), The Seeds Act (CAP 236) and its regulations, Seed production guidelines
	Inspection	SCCI, Seed companies	Seed quality control	NAP, CAP 236 and its regulations
	Supply/distribution	Seed companies, farmer associations, Agro dealers	Seed supply for production of rice grain	NAP, CAP 236 and its regulations
Breeder Seed	Production	ZARI, Seed companies	Seed research, production and maintenance of parent seed	NAP

⁹ Plant Breeder's Rights Act (2007), Chapter 239 of the Laws of Zambia

		Name of institutions	Roles/ Responsibility	Legislations/Policies determining responsibility
		(public/private registered varieties)		
	Inspection	ZARI, Seed companies	Seed quality control	NAP
	Supply/ distribution	ZARI, Seed companies	Supply of rice parent seed to seed companies	NAP
Pre-Basic Seed	Production	ZARI, Seed companies	Multiplication and maintenance of parent seed	NAP, CAP 236 and its regulations, seed production guidelines
	Inspection	SCCI, Seed companies	Seed quality control	NAP, CAP 236 and its regulations
	Supply/ distribution	ZARI, Seed companies	Supply of rice parent seed to seed companies	NAP, CAP 236 and its regulations
Basic Seed	Production	ZARI, Seed companies	Multiplication and maintenance of parents	NAP, CAP 236 and its regulations
	Inspection	SCCI, Seed companies	Seed quality control	NAP, CAP 236 and its regulations
	Supply/ distribution	ZARI, Seed companies	Supply of rice parent seed to seed companies	NAP, CAP 236 and its regulations
Certified Seed (including Quality Declared Seeds)	Production	Seed companies, Farmer associations	Produce, increase seed volume	NAP, CAP 236 and its regulations
	Inspection	SCCI, Seed companies	Seed quality control	NAP, CAP 236 and its regulations
	Supply/ distribution	Seed companies, farmer associations, Agro dealers	Seed trade for production of rice grain	NAP, CAP 236 and its regulations

Planning for production of early generation seed classes is largely confined within the public sector. Although not routine, the Zambia Agricultural Research Institute (ZARI) plans for production of breeder seeds whenever demand is received from commercial seed producers. The community-based efforts of cooperatives, non-government organizations (NGOs) and development partners on seed production and distribution are subject to planning on an ad hoc basis. The private seed companies however structure the production, storage and marketing of rice seeds more rigorously on an annual basis. SCCI plans the provision of training in seed production practices and crop management; seed inspection and quality control activities through seed inspectors, and seed certification processes on a seasonal basis. Annual budget allocation for the production of various classes of rice seed between 2012 and 2016 is shown in table 2.

Table 2: Annual budget allocation for rice seed production in the past 5 years in Zambia

Seed Class\Budget ^a	2012	2013	2014	2015	2016
Breeder Seed	30,000	30,000	45,000	45,000	50,000
Pre-basic Seed	45,000	45,000	50,000	55,000	65,000
Basic Seed	50,000	50,000	60,000	70,000	80,000
Certified Seed, QDS ^b	148,400	254,650	418,020	329,240	949,840

^a in Zambian Kwacha ZMW (Approximate exchange rate: 1= 0.10 USD); ^b includes budget allocation from the private companies and DPs

Rice related projects that are involved in rice seed production and supply include World Bank’s Agricultural Productivity Program for Southern Africa (APPSA; Sub project: Strengthening Rice Seed Delivery System for Improved Rice Production among smallholder Farmers), Japan International Cooperation Agency (JICA)’s Rice Dissemination Project, Food and Agriculture Organization (FAO)’s Strengthening Rice seed Production and Enhancing Extension Services to Increase Rice Production in Zambia, IFAD’s Smallholder Productivity Promotion Program (S3P) on Enhancing Extension Services and Smallholder Agribusiness Promotion Program (SAPP – phase II).

Zambia has signed a memorandum of understanding (MoU) with members of the Southern African Development Community (SADC) over the harmonization of its seed related policies and regulations.¹⁰ It establishes commonly agreed regulatory standards, rules and procedures for crop variety release, seed certification, quality control, quarantine and phytosanitary measures. Although the alignment of regulations is yet to be reflected in the CAP 236; the harmonization has already started to remove technical barriers on seed trade in Zambia. Through the common standards, and regulations, the harmonized seed regulatory system is expected to provide economies of scale by widening the movement of seed as a commodity amongst the countries in the SADC region.

2.2. Seed Production

Rice seed is produced in Zambia through formal and informal channels. Under the formal channel, the production and marketing of rice seeds are subject to scrutiny by the SCCI. CAP 236 and National Agriculture Policy allow both the public and private sectors to breed, test and release rice varieties for cultivation through the formal channels. Under the informal channels, farmers use the grains saved from their harvest as seeds in the subsequent seasons. Such farmer-saved seeds are often shared amongst the members of the farming communities based on mutual trust. Unlike formal channels, the seeds produced and supplied through the informal channels do not involve any institutional engagement; and hence the data and quality of such seeds cannot be properly gauged.

Since rice is largely grown under rain fed lowland and upland environments, the rice varieties released for cultivation in Zambia are grown under these two production environments (Table 3). The rainfed lowland swamps in which rice is cultivated in Zambia is often referred to as ‘dambos’. Such dambos represent drainage depressions in low lying areas that are subject to variable levels of wetness or flooding. Production profiles of certified seeds for the released rainfed varieties during the past 3 years are shown in table 3. While Supa Mongu (Supa Mg) represents the most popular rainfed lowland variety, NERICA 4 is the most widely used variety by rice farmers in the rainfed upland ecosystem.

Table 3: Areas and amount of certified seed production for the released varieties in Zambia

Ecosystem	Name of Varieties	Cultivated Areas (Ha)			Amount produced (MT)		
		2015-16	2014-15	2013-14	2015-16	2014-15	2013-14

¹⁰ Center for Applied Legal Research (2012) The SADC Harmonized Seed Regulatory System: A Review of National Seed Policy Alignment Processes in HaSSP Project Countries

Irrigated Lowland	-	-	-	-	-	-	-	-
Rain-fed Lowland	Angola crystal	0.25	-	-	150 panicles	-	-	-
	Burma	0.25	-	-	150 panicles	-	-	-
	Kilombero	28.75	35	2.25	40	75	4	
	Supa Mg	295.5	50.25	50.25	300	95.5	105	
Rain-fed Upland	NERICA 1	0.5	1	3	150 panicles	2	7	
	NERICA 4	53.25	57.2	72.75	105	108	144	

In the absence of a strong interest from private seed companies in introducing and/or breeding rice varieties; the public research is the only entity engaged in research and release of rice varieties. Formal rice seed production in Zambia involves a sequential cascade of multiplication processes involving the breeder seed, pre-basic seed, basic seed and certified seed. The ZARI stations that released the rice varieties produce breeder seed and pre-basic seed and sell at cost recovery rates to licensed private seed producers for the formal production of downstream seed classes. Under the regulations, the certified seed (C-1) that is produced from the basic seed, shall be subject to a maximum of 2 further cycles (C-2 and C-3). In the recent years, Quality declared seed, which is also subject to inspection and certification processes by the SCCI (and hence considered as a certified seed), has emerged as a new class of formal seed. Table 4 shows the volumes of the various classes of rice seeds produced by the public and private actors between 2013-4 and 2015-16.

Table 4: Trends in volumes of rice seeds produced in Zambia¹¹

Seed Class	Name of production stations	Production amount per station (ton)			Cultivated area per station (Ha)			Total production (ton)		
		2015-16	2014-15	2013-14	2015-16	2014-15	2013-14	2015-16	2014-15	2013-14
Breeder Seed	ZARI, Misamfu	0.10	0.08	0.08	0.10	0.10	0.10	0.15	0.15	0.15
	ZARI, Mongu	0.10	0.07	0.07	0.08	0.08	0.08			
Pre-Basic Seed	Zamseed Co.	2.00	-	-	1.00	-	-	2.20	0.50	0.30
	ZARI-Mongu	0.20	0.35	0.20	0.25	0.30	0.12			
	ZARI-Misamfu	0.80	0.15	0.10	1.00	0.18	0.06			
Basic Seed	ZARI-Mongu	4.30	3.00	-	2.50	1.50	-	6.20	4.00	5.00
	ZARI-Misamfu	1.90	1.00	4.00	0.50	0.50	2.25			
	Zamseed Co.	-	-	1.00	-	-	0.50			
Certified Seed (includes QDS)	APPSA RSDP	163.0	-	-	124.0	-	-	599.1	291.5	232.6
	Caritas Chipata*	2.50	-	-	1.25	-	-			
	Kamano Seed Co.*	121.6	58.00	-	64.0	100	-			
	Mongu SGA	212.0	83.50	96.00	112.25	144.5	51.30			
	Zamseed Co.	100.0	150.0	150.0	50.0	50	60.00			
	ZARI-Misamfu	-	-	-	16.25	-	-			
	DACO/CCAP	-	-	6.65	-	-	3.50			
Eastern Corridors Consultants	-	-	10.00	-	-	4.00				

* produced exclusively QDS

¹¹ Data sourced from Seed Control and Certification Institute (SCCI) of Zambia

Most private seed companies in Zambia generally focus on export and/or high value cash crops and a few cross-pollinated food crops such as maize and soybean. Government nevertheless promotes participation of private seed producers by providing early generation seeds including breeder and pre-basic seed at a no-loss no-gain (cost recovery) basis. In the recent years, a few private seed companies have started producing certified seeds primarily to supply through the government’s flagship Farm Input Subsidy Program (FISP).

Cumulative data on production of QDS class of formal seeds in the recent years show that there is a significant increase in the recent years, suggesting that there is also a growing interest amongst private seed producers in supplying QDS seeds (Fig. 2). Surveys show that there are 50 registered seed enterprises in Zambia. Of these, 17 companies were actively engaged in production and/or marketing of seed crops in 2016. Of the 17 companies, 10 companies were engaged in the production of certified seed. The remaining seven produced QDS seed.¹²

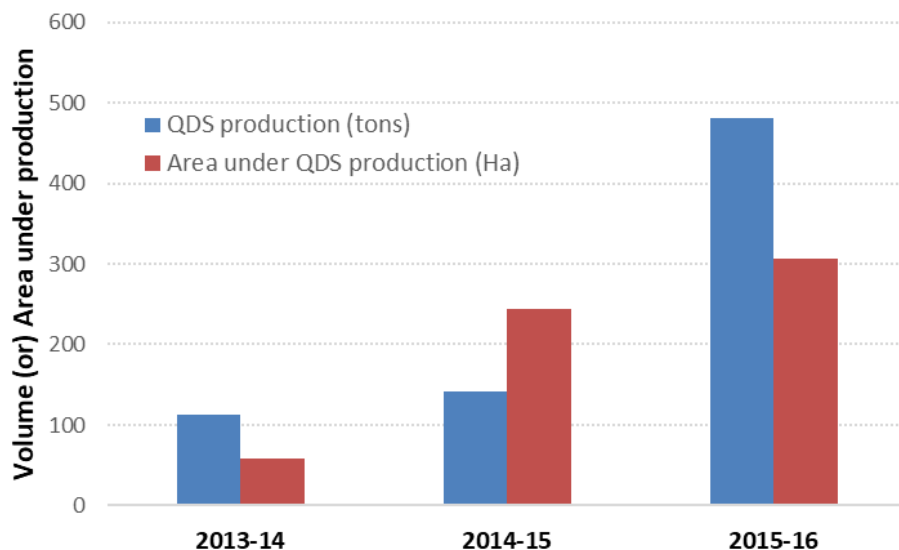


Fig. 2: Trends in production of Quality Declared Seeds (QDS) in Zambia

2.3. Seed Quality Control

The Seed Control and Certification Institute (SCCI) is the responsible government agency for ensuring the quality of seeds in Zambia. SCCI conducts inspections of seed fields, marketing and trade, and facilitates seed import and exports. To improve its functional coverage and efficiency, the SCCI engages public extension officers and skilled personnel from private seed companies to participate in seed quality control.

2.3.1. Methods

Rice seed growers are registered with SCCI through a seed company or a seed association. While the production of pre-basic, basic, certified seeds is subject to inspection and certification, the breeder seed production is generally not inspected by the SCCI. Field inspections are carried out for a minimum three times for rice seed crop four times viz., pre-planting, vegetative stage, flowering stage and pre-harvest stages. Field standards set forth by the SCCI include crop rotation, isolation distance and presence of off types. The methods and procedures of inspection of agronomic management practices during rice seed production are illustrated in table 5. Successful seed crops are harvested, processed and packed in seed lots of maximum size according to seed testing rules by the ISTA.

¹² Mbaya et al (2017) Zambia Brief 2017, published by The African Seed Access Index (TASAI)

Table 5: Procedure and methods of field inspection for quality control

Seed Class	Institutions in charge of inspection	Frequency and timing of Inspections	Items for Inspection	Inspection Methods	Quality Standard for Inspection
Breeder Seed	-	-	-	-	-
Pre-basic Seed	SCCI, seed company	Pre-planting, Vegetative stage, Flowering stage and Pre-harvest stages	Cultivar purity	Random counts	<5 off types/10 m ²
			Field isolation	Determine distance to other rice fields	10m
			Crop Rotation	Observe residues, ask the grower	2 years
			Field management	Observe crop husbandry	Crop fit for seed
Basic Seed	SCCI, seed company	Pre-planting, Vegetative stage, Flowering stage and Pre-harvest stages	Cultivar purity	Random counts	<5 off types/10 m ²
			Field isolation	Determine distance to other rice fields	10m
			Crop Rotation	Observe residues, ask the grower	2 years
			Field management	Observe crop husbandry	crop fit for seed
Certified Seed	SCCI, seed company	Pre-planting, Vegetative stage, Flowering stage and Pre-harvest stages	Cultivar purity	Random counts	<10 off types/10 m ²
			Field isolation	Determine distance to other rice fields	5m
			Crop Rotation	Observe residues, ask the grower	2 years
			Field management	Observe crop husbandry	Crop fit for seed
QDS	SCCI, seed company	Pre-planting, Vegetative stage, Flowering stage and Pre-harvest stages	Cultivar purity	Random counts	<10 off types/10 m ²
			Field isolation	Determine distance to other rice fields	5m
			Crop Rotation	Observe residues, ask the grower	2 years
			Field management	Observe crop husbandry	Crop fit for seed
			Pests and diseases	Observation	Inspections practicable, Crop fit for seed

Seed lots are sampled and submitted to one of the seed analytical laboratories located at Chilanga, Mazabuka, Choma, Mongu, Solwezi, Chipata, Mkushi, Kasama and Ndola for testing and certification. The quality control measures undertaken by the SCCI on the harvested rice seeds are illustrated in table 6. The SCCI main seed testing laboratory at Chilanga is accredited to International Seed Testing Association (ISTA) and implements the seed quality assurance system prescribed by the Organization for Economic Co-operation and Development (OECD) seed scheme.

Table 6: Procedure and methods of inspection of harvested rice seed samples

Seed Class	Institutions in charge of inspection	Items for Inspection	Inspection Methods	Quality Standard for Inspection
Breeder Seed	-	-	-	-
Pre-basic Seed	SCCI, Licensed seed company	Purity % by weight	Draw sample and test in Seed lab	100
		Germination %	Draw sample and test in Seed lab	>85.0
		Weed seeds by no.	Draw sample and test in Seed lab	1
		Moisture %	Draw sample and test in Seed lab	11
Basic Seed	SCCI, Licensed seed company	Purity % by weight	Draw sample and test in Seed lab	>99.0
		Germination %	Draw sample and test in Seed lab	>85.0
		Weed seeds by no.	Draw sample and test in Seed lab	1
		Moisture %	Draw sample and test in Seed lab	11
Certified Seed	SCCI, Licensed seed company	Purity % by weight	Draw sample and test in Seed lab	>99.0
		Germination %	Draw sample and test in Seed lab	>85.0
		Weed seeds by no.	Draw sample and test in Seed lab	2
		Moisture %	Draw sample and test in Seed lab	11
QDS	SCCI, Licensed seed company	Purity % by weight	Draw sample and test in Seed lab	>98.5
		Germination %	Draw sample and test in Seed lab	>85.0
		Weed seeds by no.	Draw sample and test in Seed lab	5
		Moisture %	Draw sample and test in Seed lab	11

Seeds sampled from the licensed producers' fields are sent to the nearby seed testing laboratories for verifications on purity, germination and hygiene. Presence of seeds from weeds and off-type varieties is tested both in terms of their numbers and weight. The prescribed minimal purity standards for the various classes of rice seed by the SCCI are shown in table 7.

Table 7: Purity Standard adopted by the SCCI on certified rice seeds

Seed Class	Purity Standards	
	Minimum number of off-type/10 square meter of field	Purity %age by weight
Breeder Seed	0	100
Pre-basic Seed	<5	>99.0
Basic Seed	<5	>99.0
Certified Seed (C1, C2, C3)	<7	>98.5
QDS	<50	>98.5

2.3.2. Human Resources

The breeder and pre-basic seed production of rice varieties are mainly done at the ZARI stations in Misamfu and Mongu. Adequate number of technical personnel are available at these stations for the production of the early generation seed classes, though the work load of these technical personnel engaged in production of these early generation seed classes also demands research activities in developing new varieties through breeding and selection. Production of basic and certified seeds are largely done by private seed companies. Most of the seed companies contract progressive farmers as seed producers and market the sourced seeds to farmers through agro-dealer networks and/or government sponsored programs such as FISP. A growing number of entrepreneurial farmers, farmers cooperatives, and farmer union are engaged in the production of QDS.

Through a licensing scheme, the SCCI appoints seed inspectors, samplers and analysts, and trains and examines candidate inspectors, samplers and analysts. SCCI monitors the licensed personnel perform seed quality control activities. Presently about three rice seed producing private companies namely, Zamseed, Kamano and Future Seed are engaged in such licensed inspection services. SCCI conducts training for the field inspectors and the producers of pre-basic, basic and certified seed on various agronomic management practices such as seed bed preparation, roguing of off-types, harvesting, post-harvest handling and storage. The SCCI sponsors such capacity building activities through its annual budget allocation and other agriculture and/or community development projects supported by development partners, non-government organizations and private seed companies.

2.4. Seed Supply

Supply channels for rice seed adopt paths of other seed propagated crops. The early generation seed classes (breeder and pre-basic seeds) are supplied by ZARIs to private seed producers. Private seed enterprises supply the certified seeds through registered agro-dealer retailers in production areas. The licensed QDS producers supply the QDS to community farmers through farmers cooperatives and/or unions. In cases where the QDS producers are engaged by private companies; the QDS is supplied through the registered agro-dealer networks. Private seed companies generally distribute the seeds through the open market and do not restrict the supply through their own selective agro-dealer networks (Table 8).

Table 8: Stakeholders in the rice seed supply chain in Zambia

Supply Chain Activity	Stakeholders	Roles played
Breeder seed	ZARI, Seed companies	Development, Production, Procurement
Pre-Basic seed	ZARI, Seed companies	Development, Production, Procurement
Basic seed	ZARI, Seed companies	Development, Production, Procurement
Certified seed production	Seed companies, Agro-dealers	Production, Procurement
Quality Declared Seeds	Seed companies, Agro-dealers, Farmer Association, Direct sales	Production, Procurement

Supply Chain Activity	Stakeholders	Roles played
Distribution of seeds	Seed companies, Agro-dealers, Farmer Association, Direct sales, Development Partners, Ministry of Community Development, NGOs	Marketing and distribution of certified seed (including QDS)
Financing	Private sector, Development projects, GRZ programs	Sponsor seed production, distribution and marketing

The government's major delivery vehicle for rice seed involves the FISP program through private participation. Under this program, the MoAL identifies eligible smallholder rice farmers in collaboration with the Ministry of community development, and distributes the vouchers to the eligible beneficiaries. Certified seeds (including QDS) of popular rice varieties are procured from private sector at market prices and supplied to the beneficiaries at subsidized prices through agro-dealers. Although the subsidy portion is variable across the years, the rice farmers paid about 20% of the market prices under the FISP in 2016 to the agro-dealers. An electronic voucher system was implemented in 2015-16 and 2016-17 to improve the efficiencies of targeting of beneficiaries and the redemption of vouchers by the participating private stakeholders. Outside the FISP, the rice farmers buy at market prices. Such open market prices for the various rice varieties are shown in table 9. Pricing is largely determined by the market forces; based on factors such as cost of production, marketing operations, logistics, and profit margin. Government generally does not influence nor intervene in the market pricing mechanisms.

Table 9: Purchase price from seed multipliers and sales price of certified seed

Ecosystem	Name of Varieties	Price ^a (in ZMW ^b)
Irrigated Lowland	-	-
Rain-fed Lowland	Kilombero	n/a
	Supa Mg	K 205 per 10kg
Rain-fed Upland	Nerica 1	K 145 per 10kg
	Nerica 4	K 145 per 10kg

^a Data on market prices from 2015/16 season, ^b Zambia Kwacha (ZMW) Exchange rate: 1USD = ZMW 9.5

Seed supply is often a function of the demand. Demand estimates for rice seed is not yet available in Zambia. Unlike in open- and cross-pollinated crops where the seeds display segregation of characteristic features in the immediate generation, prompting the farmers to renew the seeds; rice is a self-pollinated crop, in which the genetic integrity of the cultivars erodes only slowly over a few generations. Such a rather gradual disintegration of genetic purity over time often deter the farmers from renewing their seeds. Although the frequency of renewal of rice seeds by the rice farmers in Zambia is still not known, it is presumed that the farmers use their saved grains as seeds for about 4 years before considering renewal of their seed sources. Development partners engaged in advancing rice value chain promote the adoption of seeds amongst smallholder farmers. For instance, JICA distributes small packs of improved seeds to smallholder farmers so that they could see the difference in performance and multiply and/or renew the seeds. IFAD and FAO are engaged in creating awareness on the importance of using quality seeds in increasing the productivity amongst smallholder farmers through extension activities.

3. Challenges in rice seed value chain

3.1. Legislation, Institutions, Policy and Planning

The Seed Act (CAP 236) which came into effect in 1995 requires amendments in the light of a more globalized seed trade in the region. Although the regulations (No. 108 of 1997)⁸ were revised in 2006¹³, there is a need to modify the rules and procedures related to seed variety release; seed certification and quality assurance so as to allow the rice varieties registered in the COMESA and SADC regions shall be quickly released for cultivation in Zambia. This will help overcome the limitations in technical capacities in accelerating research on rice varietal improvement in Zambia. By leveraging the strengths of seed certification agency in Zambia, the harmonization shall remove technical barriers to seed trade from Zambia to the regional markets. Pronouncement of an exclusive national seed policy could also accommodate such external considerations.

Given the infancy stage of development of rice seed value chain, a national seed policy can help restructuring and reorganizing the rice seed sub-sector within the broader context of seed sector. This is important because the increasing trend towards the production and supply of QDS (Fig. 2) of rice varieties requires a completely different production, inspection and marketing policies from that of the typical certified seeds (C-1, C-2 and C-3). There may be a need for more decentralized inspection, wider distribution and more active contact between producers and farmers (end users) under the QDS system, all of which contrast with the traditional formal system involving the certified seeds (C-1 to C-3). Current agriculture policy however emphasizes that the regulations are applied in an equitable way without any discrimination between the typically certified seed and QDS. Since such a blanket approach increases the cost of QDS production, the market prices of QDS are also not differentiated from that of other classes of certified seeds. In the absence of policy clarifications; the undifferentiated prices might affect the sustainability of marketing of both the classes of seeds.

Planning for seed production is not done by the public agencies engaged in early generation seed production. This affects the planning by the downstream producers of basic seed, certified seed and QDS classes. Public institutions engaged in early generation rice seed production and inspection experience insufficient and inconsistent annual budget allocation. This affects the routine activities such as the early generation seed production by ZARIs and field inspection activities such as field visits, sampling and certification processes by the SCCI. Although a SADC Seed Center¹⁴ is established in Lusaka under the harmonization efforts, regional certification labels (COMESA and SADC) are not yet available for locally produced seeds, despite a robust demand from private seed producers in Zambia to locally produce and trade in regional markets.

¹³ Plant Variety and Seeds Regulations (2006) Subsidiary Legislation

¹⁴ Kuhlmann K (2015) Harmonizing Regional Seed Regulations in Sub-Saharan Africa: A Comparative Assessment. Syngenta Foundation

3.2. Seed Production

While the lack of annual planning for early generation seed production affects the upstream supply of seeds of the preferred rice varieties, unavailability of estimates of effective demand of certified seeds for rice varieties affects the planning of production of certified seed and QDS. In the absence of empirical evidence on demand for the certified rice seed and the average frequency with which the rice farmers in Zambia renew their seed, it is difficult to plan the supply of certified seeds by the market. Public research institutions and private seed companies presently rely on colloquial evidence on the purported quantities of seeds expressed by the stakeholders, including farmers and experts. Given the indecisive nature of colloquial evidences however, basing the planning processes on such non-effective demand estimates poses a challenge to both public and private stakeholders in the rice seed value chain.

Nevertheless, it is widely acknowledged that the effective demand for certified seeds by rice farmers is low and that farmers might renew their seeds from fresh sources roughly once in 4 years. Inadequate human resources in research and extension services related to seed technologies limit the technical back stopping and promotion of adoption of quality seed by the rice farmers. Infrastructure needs such as greenhouses, seed testing/analytical and cold storage facilities at ZARI stations have not been adequately addressed to encourage researchers routinely maintain and renew the nucleus seeds of released varieties from which the breeder seeds are produced. ZARI stations presently produce breeder and pre-basic seeds of the popular varieties solely on the basis of expectations that the certified seed and QDS producers might procure them. However, lack of a coordinated planning process ushers in uncertainties over the volumes, shelf life and re-stocking of the breeder and pre-basic seeds of the popular varieties.

Since most of the rice farmers use their own saved grains as seeds, the private sector does not find rice seed production as attractive. The few private seed companies that engage in the production of certified seeds become interested only when there is a pre-determined market such as through the government's FISP program. Due to the low rates of return and higher costs of involved in the research and development of hybrid rice seeds, the private seed companies also shy away from the challenges associated with the productivity enhancement. The recent increase in QDS production by the farmers cooperatives and unions face challenges in accessing sufficient quantities of basic seeds, technical and managerial knowledge, processing equipment, quality basic seeds, land, finance that are necessary for scaling up the production.

3.3. Seed Quality Control

Seed inspectors of the SCCI are hamstrung by the scarce availability of logistical means for transportation, sampling, recording and reporting. The inadequacy in transportation cripples the timeliness of their visits to seed producers' fields and the subsequent certification processes. The challenge becomes more acute in cases if the QDS is produced in areas with poor accessibility to roads and markets. Lack of digitization of data recording (such as geo-positioning of seed producers' fields, history of cropping, seed yields) and transmitting and pooling of the relevant field and laboratory data also delay the certification processes. The technical capacities of the licensed private stakeholders

engaged in field inspection and seed growers of the various classes require to be built further to improve the quality and the scale of economies.

Despite a rigorous inspection and certification process carried out by the SCCI however, admixtures of seeds and counterfeit seeds are reported in the market place. Presence of seed admixtures is generally attributable to the awareness amongst and the inability of the seed producers in distinguishing the subtle variations in roguing of non-specific rice plants and seeds. Certified seed producers generally do not use machineries for field operations such as weeding and harvesting. Impure seeds also rise in the seed lots due to poor post-harvest management practices during cleaning, storage and packaging. Sometimes, a seed grower is engaged in the production of more than one rice varieties by the seed companies and/or farmers' associations. In such cases, inefficient segregation of seeds of the different varieties during the planting, harvesting, cleaning and storing processes by the seed producer increases the risk of admixtures. Inadequate adoption of the recommended packaging protocols by the QDS producers and lack of low-cost materials for packaging the QDS also leads to the accumulation of admixtures.

3.4. Seed Supply

In the absence of a consultative planning process for rice seed production, the supply of breeder and pre-basic seeds of the various released rice varieties is inconsistent and largely dependent on the presumption of the breeders. Since ZARIs autonomously supply these early generation seeds directly to any interested licensed individual seed producers; the traceability of the seeds along the downstream production chain become a challenging issue for the SCCI. To avoid the expected royalty payment under the law of plant breeders' rights; the basic, the producers of the certified and QDS often do not report the full volume of the multiplied seeds to the SCCI. Such royalty-avoidance practices indirectly encourage the supply of rice seeds through informal channels. In cases where a farmers' association procures the pre-basic seeds from the ZARI station, there is a greater chance that the associations indiscriminately distributes to individual seed producers and/or farmers without any proper records; rendering the downstream seed supply chain becomes untraceable.

Most seed companies in Zambia concentrate on maize, resulting in a shortage of both the supply and demand for quality rice seed. Participation of the private seed companies in rice seed production and marketing is largely dependent on the procurement plans under the FISP. One of the major factors not attracting the private sector investments in rice seed production and marketing includes the lack of irrigation schemes where rice grain production can be vividly profitable to the farmers. Inadequate incentives for expanding agro-dealerships in remote areas is affecting the supply of rice seeds. Poor road networks and lack of electricity in rural areas also affect the transportation and hence the accessibility to seeds by farmers in remote areas. The weak presence of private sector also leads to the limited awareness and supply of the certified seeds of the improved varieties in areas under intensive rice cultivation. Public extension officers engaged in advocacies and demonstration of advantages of the use of quality seeds are unable to increase the frequency of their technical visits to farmers and potential seed producers in most of the rice producing areas due to inadequate transportation and logistical support.

The QDS producers are loosely organized, poorly structured and weakly integrated in the seed supply chain. The marketing channels for QDS is weakly structured and rely largely on informal arrangements. Inadequacy of entrepreneurial skills amongst the QDS producers affects the planning of their field operations, and arrangements for field inspection and certification processes, and marketing. The poor marketing linkages between the QDS producers and the potential buyers (private companies, farmers associations and individual farmers) limit the scale of production. Moreover, the market places of these potential buyers are also fragmented and scattered across the country. The protective mindsets of some farmer communities resist the procurement of QDS from neighboring farmers associations.

Lack of organization amongst the QDS producers also have led the markets to adopt arbitrary pricing mechanisms. Although the empirical cost of production of QDS is lower than that of other certified classes (C-1, C-2 and C-3), the sale price is the same for both the classes of seeds. The unbiased pricing of QDS could challenge the affordability of farmers and thereby undermine the adoption of QDS. Besides the weak entrepreneurial skills amongst the QDS producers, the financial capacities remain limited by the lack of credit support from the financial institutions. Scaling up and scaling out of the QDS production remain constrained by the inadequate technical capacity building opportunities for the existing QDS producers and potential QDS producers.

4. Strategies for the development of the rice seed sub-sector

Despite the various challenges in the production and supply of rice seed, there are several prospects for advancing the value chain of the rice seed sub-sector in Zambia. This section outlines a roadmap for a comprehensive development of the various segments of the rice seed industry in Zambia.

4.1. Vision and Scope

This roadmap envisions a vibrant and commercialized rice seed sub-sector in Zambia. The scope of the proposed interventions intends to cover all aspects of the rice seed value chain in Zambia. It is therefore envisaged that the various strategic elements drawn here will pave ways for a coordinated and complementary actions by all the relevant public- and private stakeholders along the rice seed value chain.

4.2. Goal and objectives

This roadmap aims to contribute to increased rice production by enhancing the productivity through the usage of certified seeds. While the general objective of the proposed strategic approaches is to increase the availability, accessibility and adoption of certified rice seed; the following specific objectives are intended: -

- i. To develop superior rice varieties with desirable traits that are adapted to various rice ecologies
- ii. To promote the use and production of certified seed
- iii. To improve the enforcement of seed quality control services
- iv. To spur entrepreneurships in rice seed sector and facilitate market linkages

4.3. Position of the roadmap

The roadmap proposed in this document aims to directly contribute to the implementation of the second National Rice Development Strategy (NRDS; 2016-2020) which aspires to increase the rice production and productivity. Since one of the major strategic interventions envisaged by the NRDS includes 'enhanced farmers' access to quality seed'; the abovementioned objectives of this roadmap augurs well with that of NRDS. The NRDS is embedded within the context of Zambia's agriculture sector strategy and captured in the framework of National Agriculture Investment Plan (NAIP). Thus, the proposed roadmap embeds itself into the overarching objectives of National Development Plan (NDP) and the Vision 2020.

4.4. Implementation Structure

Since this roadmap feeds into the execution of the second NRDS; its implementation shall be overseen by the Zambia Consortium for Accelerated Rice Development (ZCARD) which fosters the implementation of the NRDS. The ZCARD is comprised of representatives from public and private stakeholders along the rice value chain. The taskforce that drew this roadmap shall provide the necessary technical consultations to the ZCARD on the implementation of the roadmap. In corroboration with the participating public institutions and relevant private seed companies, the taskforce shall develop project concept notes the execution of which shall lead to concrete implementation of the proposed roadmap. Besides monitoring the overall implementation of this roadmap, the ZCARD shall be responsible for mobilizing the necessary funds for the execution of the roadmap from various sources such as the government, development partners and private seed companies. On the basis of need, the ZCARD shall review the strategic approaches proposed in this document and engage in the monitoring and evaluation of the roadmap by 2020.

4.5. Strategic Principles and Approaches

This roadmap sets forth 'guiding the transformation of rice farmers into adopting quality seeds that will enhance the productivity and profitability of rice production' as its key strategic principle. The recent increase in the production and supply of rice amongst QDS (Fig. 2) opens new vistas for enabling such a transformation. Such a strategic thrust however requires multi-pronged approaches that will engage the various rice seed value chain actors and supporters. In the absence of large irrigated ecosystems for rice production in Zambia, the roadmap shall focus on enabling the adoption of quality seeds through the following strategic interventions: -

1. **Development of improved market oriented rice varieties:** Farming communities tend to generally demand fresh seeds of newer varieties than traditional varieties. This creates niches for aggressively promoting the use of certified seeds through private and public partnerships. Traits such as early maturity, higher yields, resilience to climate, pests and diseases and aroma could potentially also increase the revenues of farmers, which in turn hold potential for driving the adoption of certified seeds of the varieties.

2. **Creation of demand for quality seeds:** Through a vicious cycle, the low demand prompts shallow participation by private stakeholders and a diminished supply of quality seeds, which in turn continually dampens the usage of quality seeds by potential early adopters. Creating the demand for quality seeds

through various extension methods that will demonstrate the advantages in rising productivity, quality of grain production and profitability hence represents an important strategic axis in advancing the rice seed sub-sector.

3. **Quality regulation:** Inspection and certification services of seed production and marketing represent key regulatory tools that could help enhance the value of the rice seed that the farmers acquire. Ensuring quality through rigorous implementation of the regulations in the market places will boost the trust amongst farmers and provide sustenance to the adoption practices.

4. **Promoting entrepreneurs along the rice seed value chain:** Empowering seed companies and individual entrepreneurs engaged in the production and marketing of certified seeds (C-1 through C-3) and QDS will help increase and sustain the adoption of quality seeds by farmers when the government exits subsidy support programs such as FISP. This roadmap intends to enable the environment for local seed enterprises by proposing evidence based policy- and structural reforms.

4.6. Target Setting and Gap Identification

In line with the NRDS targets for grain production, this roadmap has identified the targets for local production, inspection and supply of the various classes of rice seeds. Based on the available human resources and technical capacities of the existing stakeholders, gaps are identified in fulfilling the set targets. The second NRDS aims to increase the annual raw grain production to 66,788 by 2020 from a baseline of 44,512 tons in 2015. It is also envisaged that the targeted production will be achieved by a 20% increase in area under rice cultivation to a total of 46,244 Ha. It is expected that about 70% of the targeted grain production in 2020 will come from rainfed lowland production environment and the remaining will come from rainfed upland environment.

Seed distribution data from the private seed companies and FISP suggests that presently about 10% of the rice growing areas is covered by certified seeds (including QDS) in 2017. This roadmap aims to increase the adoption of certified seeds to a step wise increment of 20%, 30% and 40% of the area under cultivation in 2018, 2019 and 2020 respectively. Using an average seed rate of 40 kg/Ha by farmers, the estimated volumes of seeds of the various classes are shown in table 10.

Table 10: Required quantities of seeds and the required area for multiplication of different classes

Seed Class	Volumes of seed			Area required for multiplication		
	2018	2019	2020	2018	2019	2020
Breeder Seed (gram or Sq. m)	670.2	1071.1	1503.3	0.22	0.36	0.50
Pre-basic Seed (Kg or Sq.m)	50.3	80.3	112.7	16.76	26.78	37.58
Basic Seed (tons or Ha)	3.77	6.02	8.46	1.08	1.72	2.42
Certified Seed (tons or Ha)	329.9	527.2	739.9	164.9	263.6	370.0

Of the 70% of the area targeted under the rainfed lowland ecosystem, Supa Mg, Kilombero, and ITA 230 will be prioritized. In the rainfed upland ecosystem, NERICA 4 and other emerging/traditional varieties will be prioritized. Variety wise requirements of quantities of seeds and the area required for the

multiplication of the said quantities of certified (table 11), basic (table 12), pre-basic (table 13) and breeder (table 14) seeds are shown below:

Table 11: Estimated requirements of certified seed production of the different varieties

Name of variety	Varietal Share	Quantities of seeds (tons)			Area required (Ha)		
		2018	2019	2020	2018	2019	2020
Rain fed Lowland (70%)							
Supa MG	40%	92.4	147.6	207.2	46.2	73.8	103.6
Kilombero	40%	92.4	147.6	207.2	46.2	73.8	103.6
ITA 230	20%	46.2	73.8	103.6	23.1	36.9	51.8
Rain fed Upland (30%)							
NERICA 4	80%	79	126.5	177.6	39.6	63.3	88.8
Others	20%	20	31.6	44.4	9.9	15.8	22.2
	Total	329.9	527.2	739.9	164.9	263.6	370.0

Table 12: Estimated requirements of basic seed production of the different varieties

Name of Variety	Varietal Share	Quantities of seeds (tons)			Area required (Ha)		
		2016	2018	2020	2016	2018	2020
Rain fed Lowland (70%)							
Supa MG	40%	1.06	1.69	2.37	0.30	0.48	0.68
Kilombero	40%	1.06	1.69	2.37	0.30	0.48	0.68
ITA 230	20%	0.53	0.84	1.18	0.15	0.24	0.34
Rain fed Upland (30%)							
NERICA 4	80%	0.90	1.45	2.03	0.26	0.41	0.58
Others	20%	0.23	0.36	0.51	0.06	0.10	0.14
	Total	3.77	6.02	8.46	1.08	1.72	2.42

Table 13: Requirements of pre-basic seed production of the different varieties

Name of Variety	Varietal Share	Quantities of seed (Kg)			Area required (Sq. m)		
		2016	2018	2020	2016	2018	2020
Rain fed Lowland (70%)							
Supa MG	40%	14.07	22.49	31.57	4.69	7.50	10.52
Kilombero	40%	14.07	22.49	31.57	4.69	7.50	10.52
ITA 230	20%	7.04	11.25	15.78	2.35	3.75	5.26
Rain fed Upland (30%)							
NERICA 4	80%	12.06	19.28	27.06	4.02	6.43	9.02
Others	20%	3.02	4.82	6.76	1.01	1.61	2.25
	Total	50.27	80.33	112.75	16.76	26.78	37.58

Table 14: Estimated requirements of breeder seed production of the different varieties

Name of variety	Varietal Share	Volume of seeds (g)			Area required (Sq. m)		
		2016	2018	2020	2016	2018	2020
Rain fed Lowland (70%)							
Supa MG	40%	187.7	299.9	420.9	0.06	0.10	0.14
Kilombero	40%	187.7	299.9	420.9	0.06	0.10	0.14
ITA 230	20%	93.8	150.0	210.5	0.03	0.05	0.07
Rain fed Upland (30%)							
NERICA 4	80%	160.9	257.1	360.8	0.05	0.09	0.12
Others	20%	40.2	64.3	90.2	0.01	0.02	0.03
	Total	670.2	1071.1	1503.3	0.22	0.36	0.50

Given the capacity constraints in the public institutions, there is a need to assess the human resources required in production and inspection services. For the production of the above-mentioned volumes of breeder and pre-basic seeds, adequate land is available at the ZARI stations. There is however a need to increase the number of human resources (Table 15) so that the required volumes of seeds are produced without compromising on their other research and developmental duties. Gaps in number of human resources required for inspection of all the seed classes are also shown in table 15.

Table 15: Required human resources for breeder and pre-basic seed production

Regions	Researchers		Gap	Technicians		Gap	Inspectors		Gap
	Required	Available		Required	Available		Required	Available	
Western	2	1	-1	4	1	-3	6	1	-5
Northern	2	1	-1	4	2	-2	4	2	-2
Muchinga	0	0	0	0	0	0	5	0	-5
Luapula	1	0	-1	3	2	-1	5	2	-3
Total	5	2	-3	11	5	-6	20	5	-15

Besides the number of human resources, the technical capacities of both the existing staff and the new recruits need to be built. General requirements of technical training and the costs of training are shown in table 16.

Table 16: Capacity building requirements for breeder and pre-basic seed production and field inspection

Personnel	Number of technical personnel to be trained	Areas for training	Required Budget for training (USD)
Researchers	3	Seed production and Maintenance breeding	30,000
Technicians	20	Seed production	120,000
Inspectors	20	Seed production and certification	120,000
Total	23		270,000

4.7. Strategic Priorities and Actions

The proposed roadmap for rice seed value chain development proposes the following strategic intervention options as priority actions by the relevant stakeholders: -

4.7.1. Legislation, Policy and Institutions

- Draft and validate a national rice seed sector policy framework and implementation strategy
- Establish a forum for coordinating public and private stakeholders, and organize annual planning for seed production and inspection
- Identify and establish small and medium irrigation infrastructure/schemes for rice production in Kalabo, Kaoma, Mongu, Senanga, Sesheke, Mungwi, Kaputa, Isoka, Chinsali, Chama, Mwense, Mansa, Chiengi, Lundazi and Mambwe (as proposed in the second NRDS)
- Introduce 'One grower – one variety' policy' allowing individual seed producers (such as QDS producer, seed out-grower) to grow only a specific variety in a given season through licensing
- Include specific budget lines for rice seed production, inspection and certification for the relevant public institutions such as ZARI stations and SCCI on an annual basis
- Build capacity through fresh recruitments and training of existing and new staffs
- Provide specialized field and laboratory equipment for seed research and seed testing
- Provide transport means (motor bikes and cars) and hand-held devices/equipment for inspection of seed producing fields
- Provide financial access through special commercial windows for QDS producers and other entrepreneurs engaged in seed production and marketing to access inputs, machineries and seed processing and packaging equipment
- Press for quick establishment of regional certification facility in Zambia as agreed under the SADC and COMESA forums
- Gather evidences for the necessary policy reforms for structuring and supporting QDS production and pricing through stakeholder consultations
- Expand support for private investments along the rice value chain through Citizen Economic Empowerment Commission (CEEC); which supports commercial enterprises
- Promote subsidies for QDS producers in accessing 'early generation seeds' and inputs (fertilizers, machineries and packaging technologies)

4.7.2. Seed Production

- Develop and introduce new, superior, high yielding and early maturing varieties with market preferred grain characteristics
- Expand collaborations with regional and international research and development institutions on rice breeding, seed inspection and rice seed production and supply
- Maintain nucleus seeds of all the released rice varieties through periodic maintenance breeding and conserve all available rice germplasm through *in situ* and *ex situ* conservation methods
- Establish seasonal/annual estimates of the effective market demand for certified (including QDS) rice seed in different administrative regions by engaging the various public and private stakeholders

- Increase the supply of early generation seeds through institutionalization of annual planning for production
- Establish a database that is accessible through online and offline; and share the details of producers, production, storage, sales points, sales volumes, market prices and agro-dealer shops amongst all stakeholders
- Speed up the establishments of seed unit at ZARI and encourage seed unit to take up the responsibility of 'tracking the buyers' (registered seed producers) on the multiplication and marketing of the seeds from ZARI
- Encourage rural youth/women in QDS production (as they may be keener on the quality) and marketing of QDS by:
 - sensitizing entrepreneurial youth/women in rice producing areas, farmer associations and youth/women farmers on the market potential for QDS and the socio-economic benefits
 - providing training opportunities on QDS production exclusively (or) by specifying at least 50% opportunities for youth and women within the training program
 - facilitating linkages with seed users, extension agents and seed inspection agencies
- Promote the participation of private companies in the production of certified seeds and QDS of newly released varieties through incentives, technical backstopping and partnering in extension activities
- Improve the skills and knowledge of producers of certified seed and QDS through: -
 - provision of periodic hands-on training and follow-up on impacts
 - various extension approaches (field schools, trainer of trainees) and extension methods for sharing the information on seed production technologies through mass media, technical manuals and workshops
- Provide assistance to QDS producers in forming a cooperative/union so that the QDS production and marketing can be coherently organized, streamlined and shared amongst other stakeholders
- Provide training for QDS producers on skills related to the technical knowledge, financial planning, business and marketing
- Reduce the cost of certification for QDS through: -
 - decentralization of seed inspection services to block level
 - scaling out of the inspector licensing scheme to increase the reachability of inspectors to all rice QDS producing areas
 - encouraging the use of certified seed (rather than pre-basic or basic seed) as a source seed for QDS production
 - building technical capacity of QDS producers on efficiently increasing the seed yield levels
 - promoting the usage of appropriate small tools and machineries that can reduce the cost of field operations such as puddling, weeding, harvesting and packing

4.7.3. Quality Control

- Improve the enforcement of regulations and the accessibility of the seed producers to the field inspection and seed certification processes of the SCCI by: -
 - enhancing the number of seed inspectors deployed in rice seed growing areas

- improving the technical capacities of seed inspectors
- increasing the involvement of private seed companies in field inspection
- deployment of inspectors (using the same out-sourcing model employed by SCCI for field inspection) also for monitoring the seed markets/sales points
- rigorous post production testing and monitoring of the seed markets by SCCI
- Engage extension officers and license seed inspectors in the estimation of seed demand and annual planning of seed requirements
- Increase the number of licensed seed inspectors and the mobility of licensed field inspection officers in QDS production areas
- Establish seed testing laboratories in the headquarters of all rice growing provinces, where they are not presently available
- Increase the operational capacities of existing seed testing laboratories in the provinces by upgrading infrastructure and instrumentation

4.7.4. Seed Supply

- Create demand for certified rice seeds by: -
 - creating awareness amongst the rice growers through public- and private extension services
 - establishing public-private partnership on promotional activities on the demonstration of the linkages between purity of seeds and crop productivity, marketability and farm revenue
 - rehabilitating existing dambos across the rice growing regions and old irrigation schemes in Mongu, and resolve land issues
 - establishing newer irrigation schemes in potential areas
- Encourage locking/reserving subsidy credit exclusively for the purchase of certified rice seeds which could also ensure seed supply markets
- Incentivize' agro-dealers selling the QDS and the certified rice seeds in all rice growing areas, including the remote and less accessible rice growing areas by: -
 - increasing the usage of e-vouchers with offline options for recording the sales
 - building capacity (business and financial) of the agro-dealers
 - improving the logistical infrastructure (feeder roads, electricity) in rural areas
- Disseminate market prices for the various classes of rice seeds to farmers, farmer associations, agro-dealers and seed producers
- Create niche markets for QDS production and/or marketing by identifying areas where private seed companies selling certified rice seed are not prevalent
- Explore economically viable alternate packaging materials for QDS using locally available, cheaper and renewable resources
- Discourage loose selling of QDS (without packages)
- Provide financial access through special incentives (e.g. interest free loans) for agro-dealers located in remote and less accessible rice production areas