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STAPLES VALUE CHAIN NAFKA ACTIVITY

TASK ORDER NO. AID 621-TO-II-05000

**Rice Seed Value Chain at Morogoro:
Challenges and Recommendations**

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List of Acronyms

AS	Ammonium Sulphate
ARC	Africa Rice Centre
ARI	Agricultural Research Institutes
ASA	Agricultural Seed Agency
CAN	Calcium Ammonium Nitrate
CB	Cost Benefit ratio
CS	Certified Seed
DAP	Diammonium Phosphate
DUS	Durability Uniformity Stability
EGMS	Environment-sensitive Genetic Male Sterility
FTF	Feed The Future
FYM	Farm Yard Manure
HRD	Human Resource Development
IFDC	International Fertilizer Development Centre
IRRI	International Rice Research Institute
IWM	Integrated Weed Management
KATRIN	Kilombero Agricultural Training and Research Institute
KPL	Kilombero Plantation Limited
KPRL	Kapunga Rice Plantation Limited
LCC	Leaf Colour Chart
MKRSL	Mtenda Kyela Rice Supply Limited
MoU	Memorandum of Understanding
NERICA	New Rice for Africa
NGO	Non Governmental Organizations
NPT	National Performance Trials
NRDS	National Rice Development Strategy
OPV	Open Pollinated Variety
PGMS	Photoperiod sensitive genetic male sterility
PTGMS	Photo-thermo sensitive genetic male sterility
PPP	Public Private Partnership
PS	Private Seed company
QDS	Quality Declared Seed
RYMV	Rice Yellow Mottle Virus
SRI	System of Rice Intensification
SRR	Seed Replacement Rate
TASTA	Tanzania Seed Trade Association
TOSCI	Tanzania Official Seed Certification Institute
TSP	Triple Super Phosphate
USAID	United States Agency for International Development
UDP	Urea Deep Placement
VBAA	Village Based Agricultural Advisors

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Executive Summary:

Rice in Tanzania is next to maize as a staple food crop. Morogoro, Tabora and Shinyanga are the major rice growing regions in the country. Morogoro has maximum contribution compared to others. Around 905 rice is produced by small-scale farmers with productivity of 1 to 1.5t/ha. Tanzanian rice productivity is very less compared to other rice growing East African countries. The main reasons are lack of inputs availability and other infrastructure facilities.

Among the inputs, non availability of quality seeds is the major hurdle in attaining good yield/ha. The National Rice Development Strategy has already prioritised this problem as no one. The present investigation was undertaken to study the constraints faced by rice seed value chain in Morogoro region where NAFKAK is operating. Individual rice seed growers, seed companies, agro dealers, agricultural extension officials, certification officials, research institutes and rice growers were consulted and discussed to understand the present scenario and devise recommendations.

Rice Seed system in Tanzania is operating both in modern and conventional system, the later has more than 97% of seed transaction whereby farm saved seeds are recycled every year. The modern system of seed is shared by ASA and for some extent by recently entered seed companies. The pre basic seeds are supplied by KATRIN and basic and certified seeds are produced by ASA and also private seed companies on own and contract seed growers farm. Small farmers and contract growers are main source of human resource in rice seed production system. Apart from certified seeds QDS is another class of seeds which is being produced by small farmers and sold locally. The current rice seed production is not even 5% of the market demand at seed replacement rate of 20%. To achieve 1,963,000 MT of rice production as per NRDS by 2018, 39260 tones of certified seed is required. However, the ASA could only produce 816 tons in 2012. Even to have 20% of new seeds to achieve the targeted rice production, 7852 tons of certified / QD seed is required. This huge gap is mainly attributed due to challenges in rice seed value chain.

Non availability of improved varieties with drought tolerance, biotic stress tolerant and aromatic character was found major constraints in entire NAFKA operational area. Except Saro -5, which is semi aromatic, no other improved variety is available for adoption. Although many varieties are released during last one decade but are not much popular among the growers. Many local varieties are there in farmers' fields with high market demand and public acceptability, but their maintenance breeding and seed production is lacking. It is necessary to take up seed production of widely accepted local varieties with a separate system like Seed Unit. Breeders should also concentrate on characterization and documentation of local varieties, which could be used in breeding programmes.

The availability of certified rice seed in NAFKA operational are is limited to in and around city places and rest of the farmers use farm / self saved grain as seed. In absence of agro dealers farmers left with no option than using their grain as seed. Unless rice seed is made available locally at village level during the sowing season, the adoption level of new and improved varieties will never increase.

Demonstrations on use of new varieties will expose the farmers better and creates awareness about use of improved seeds among local rice growers. ASA and KATRIN should work on modality of continuous supply of seeds of pre basic and basic seeds for certified and quality declared seed production. NAFKA may assist in training more number of farmers to undertake certified seed production for ASA and private seed companies. With this arrangement more private companies will follow to grab the opportunities and a competitive healthy seed value chain will establish. Apart from CS, Quality Declared Seeds (QDS) shall play a crucial role in ensuring seed availability in remote areas and villages. The government should consider the QDS segment as on par with CS until the full fledge CS system gets established everywhere. VBAAAs selected by NAFKA shall be trained for QDS production and marketing locally.

Inadequate use and availability of fertilizers among the rice seed growers and their non availability in villages and remote areas limits their application for seed crop. Demonstrations on use of chemical fertilizers should reach interior places. Agro dealers should be trained on guiding farmers to use fertilizers for better yield. The seed companies can arrange to supply fertilizers to their seed growers on credit basis. Use of Leaf Colour Chart (LCC) for determining the nitrogen application will help many farmers to take the right decision on their farm itself. Introduction of mobile seed and fertilizer retail out lets is a novel approach in ensuring availability of both the essential inputs at village level.

Rice is a water loving crop, poor irrigation management yields low. The rain fed seed growers are facing shortage of moisture and irrigated seed growers submergence and poor drainage. In both the cases, seed production is being affected. Seed growers needs to be trained on good agronomic practices of soil and water conservation. Proper ploughing, harrowing and bunding before onset of rains help in in-situ conservation of water and soil.

For a healthy seed crop, good agronomic practices are very essential. But many rice seed growers are not following them. They are poorly equipped and don't have any knowledge about mechanization. This has been compromising the seed quality up to 40%. In order to strengthen seed production chain, introduction of mechanization is very essential. NAFKA may consider for procurement of small and low cost need based implements, equipments and machines essential for rice seed production.

New methods of seed sowing *viz.*, drum sowing, direct sowing, SRI method of transplanting would reduce the drudgery and cost of sowing. Introduction of tractor drawn / power tiller drawn or small equipments essential for seed production will strengthen the seed value chain. Demonstration on use of herbicides for weed management, timely sowing to escape the drought and abiotic stresses should be suggested.

Many rice seed growers are not aware about pests, diseases and their management. The local agro dealers are also not sound in this regard while prescribing chemicals. Training farmers on identification of pests, diseases and their management will help them in raising healthy seed crop. NAFKA may train seed growers by publishing a technical manual on the topic.

Seed certification has been entrusted to TOSCI. But, poor staffing, lack of training, limited mobility and resources are limiting certification services. Especially beyond Kilombero river, there are no seed certification are available. Fake or spurious seeds with poor quality are also entering market due to inadequate quality control. TOSCI should ensure staffing, with good capacity and infrastructure facilities. NAFKA may consider for supporting strengthening of a seed testing laboratory in Kilombero or Ifakara. It will help many QDS growers based in remote villages.

To achieve the target of NRDS and self sufficiency in seed requirement, training more farmers to undertake CS and QDS production is essential. There is huge demand for contract seed growers by seed companies as well as ASA. NAFKA may consider for training farmers for CS and QDS production along with publication of technical manuals for each class of seed production. QDS is recently taking some scope where ever certified seed is scarce. However, QDS growers should also be trained well to ensure quality seed production. Training VBAAAs for QDS production will strengthen the human resource and availability of quality seeds locally. These trainings will create an additional employment opportunities in seed production, processing and marketing activities.

Poor tillering and panicle formation are some constraints faced by seed growers. It usually happens due to drought, frost, weeds, poor variety, low nitrogen application, improper spacing and poor management practices. This can be avoided by use of quality basic seed, proper spacing, weed management, application of recommended dosage of fertilizer, pest and disease management, early sowing and following good agronomic practices.

Harvesting and threshing are the quality determining factors in rice seed production. Tanzanian farmers don't have any kind of mechanised harvesting in rice cultivation and similar is the situation with rice seed producers. Manual harvesting is routine practice. Matured plants are cut with sickle half feet above ground and threshed by beating with wooden log or smashing on wooden plank. The house hold winnower is used for separating seeds from dust and debris. This unscientific method of seed crop threshing is the main source for quality deterioration.

Processing is hardly practiced in rice seed production by any seed company or entrepreneur. This is a clear indication of compromising the quality of seeds due to lack of processing facilities. Ultimately the poor buyers are being cheated in the name of quality seeds. This also leads to deviation from ethics and science of seed production.

Replacement of traditional harvesting and threshing by mechanization is a must for seed growers. The NAFKA should consider introduction of paddy threshers or multi crop threshers or combine harvesters or mini combine harvesters for rice seed growers. Introduction of mini combine harvesters for seed purpose would solve their problem of contamination. Multi crop thresher or mini combine harvester or paddy thresher in Kilombero and Ifakara would help many seed growers to thresh their crop easily without compromising the quality.

NAFKA may consider for partial supporting for establishment of rice seed processing facility both at Mvomero and Ifakara. In order to help the seed growers of Kilombero and Ifakara, establishment of a processing facility at Ifakara would be a good decision. Alternatively mobile

rice seed processing plants are also available. One unit of this at Ifakara will help maximum QDS growers to process their seeds nearby and do a comfortable seed transaction locally. For a competitive rice seed market, pricing should not exceed 2 to 3 times the grain price unless the variety is very scarce and expensive to produce. For cross pollinated crops like maize it should be 4 to 5 times that of its grains. This kind of pricing mechanism will enable the rice seed value chain sustainable.

Various extension activities like demonstrations, field days, agricultural fairs, campaigns, distribution of leaf lets, posters, banners, hoardings, radio talks, demonstrations on use of fertilizers, safe use of plant protection chemicals will strengthen the seed growers.

There is a need to establish a proper information generation system on seed supply analysis and demand estimation. NAFAKA may convene a meeting of print, electronic media representatives with a request for dedicating their space and time for broad casting / publishing agricultural technologies across the country.

Seed production requires some capital for hiring machines procurement of inputs and for other operations. The small and poor farmers who cannot afford to buy all these. Hence, there is a need to introduce rural micro financing facility among the rice seed growers. Establishment of rural banks with micro credit facilities and crop insurance will not only bring money flow in market but also improves living standards and purchasing power of small farmers. NAFAKA may consider for brining in micro finance institutions in to Ifakara.

Rice seed system of Tanzania is suffering from lack of irrigation, power, roads, transportation and marketing facilities. These facilities have limited the movement and use of quality seeds, fertilizers and plant protection chemicals. This has been one of the major reasons for detracting seed entrepreneurs in entering the rice seed value chain. The government seed policy should be pro private and public partnership. Unless it ensures the basic road, transportation, power, irrigation and infra structure facilities, rice seed system does not perform well. NAFAKA should coordinate all the potential stake holders in rice value chain for supporting execution of essential services required for sustainable rice industry. At present government is providing 80% subsidy for procurement of agricultural implements and machineries for group of farmers and farmers associations. NAFAKA may encourage its affiliated farmers associations to procure essential implements and machineries required for rice seed production under this scheme.

Objectives of the study

The current study was undertaken with an objective of

- Identification of potential scope for increasing rice seed production in Morogoro
- Identification of constraints faced by rice seed growers, processors and other stake holders of rice seed value chain.
- Assess the status of seed availability, production, processing, marketing and scope for increasing the volume of rice seed trade.
- Explore the feasibility for establishment of collaborations between native and international research organizations for germplasm exchange and breeding opportunities concerned to local need.
- Identification of gaps in agronomic practices followed by seed growers to improve quality of seeds.
- Understand the farmer's ability and knowledge about pest, disease, nutrients and weed management in rice seed production.
- Identify the opportunities for farmer's associations and groups for seed production in paddy.
- Understanding the strengths and abilities of seed companies and agro-dealers in meeting the seeds demands of paddy growers at village level.
- Identify the status of rice seed business and scope for private players to participate in seed multiplication and marketing.
- Identify the areas of mechanisation, improvement and technology transfer for upgrading the seed production level and quality.
- Assess the scope for increasing quality declared seed growers and their role in ensuring the rice seed in remote villages and interior places.
- Study the avenues for strengthening certified seed production, seed certification and seed distribution to support the rice value chain.

Methodologies followed:

- Visits were conducted at all the three rice ecosystems of both rain-fed and irrigated rice areas of NAFAKA operational districts, seed production plots were visited and analysed for challenges faced on farm.
- Informal interactions were held with rice seed growers, rice growers and extension field workers to know their experience, knowledge about quality improved seeds, constraints in their availability, and means to solve them.
- Attending field days at demonstration plots with improved high yielding seeds and fertiliser use were undertaken, interaction with farmers and their associations about use of quality seeds by farmers, their production and marketing by associations were held.
- Seed growers were interacted to know their challenges faced in different stages of rice seed production and marketing.
- Visits and interactions were held with agricultural seed agency and local seed traders to discuss on various factors associated with rice seed value chain viz., production, harvesting, processing, quality management, certification, storage, transportation and marketing.
- Agro dealers were visited and interacted to know their knowledge, service, inputs available and trend of rice seed business in serving the paddy growers. Assessment was made on availability of different chemical inputs required for rice seed cultivation.
- Meetings were done with research scientists and technical staff from ASA, TOSCI, department of agriculture to know the present status and plans for improvement of rice seed value chain.
- Discussions were held with seed company staff and seed growers to know their present practices followed and future plan to expand rice seed venture.

Introduction: Tanzania has one of the fastest growing urban populations in East Africa, rising 4.7% per year; the growing middle class prefer rice over other staples: local rice production cannot keep up with demand, driving imports. Rice is the second most important food and cash crop in Tanzania after maize; and it's among the major sources of employment, and income for many farming households.

Three major regions in central corridor of Tanzania growing rice are Morogoro, Tabora and Shinyanga. They together have 48.4 % of the total area under rice cultivation in Tanzania. All are favored by agro-climatic conditions offering enough rains for growing paddy. Morgoro region contributes the highest rice production (22 %) from an area of more than 350,000 ha.

Around 90% Rice is mainly produced by small-scale farmers, on an average farm size of 1.3 ha. However, rice productivity in Tanzania (1-1.5 t/ha) is lower than in most neighboring countries and is one of the lowest in the world. Paddy rice production in Tanzania has been increasing since 2000. Increases have mainly been driven by expansion in total land planted with rice rather than increases in yield. The current level of production is not sufficient to meet the domestic demand hence; rice is being imported from many countries annually.

Tanzania produces around one million tons of rice annually, and imports around 100,000 tons of rice to meet its domestic requirement. Prices of rice often surge in the country due to the reliance on rice imports

Table 1. Rice area production and productivity in Tanzania

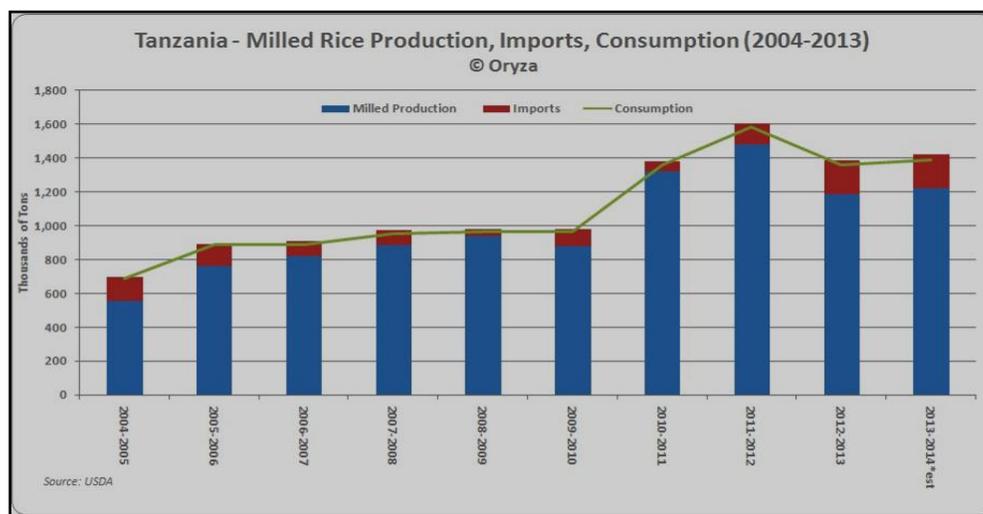
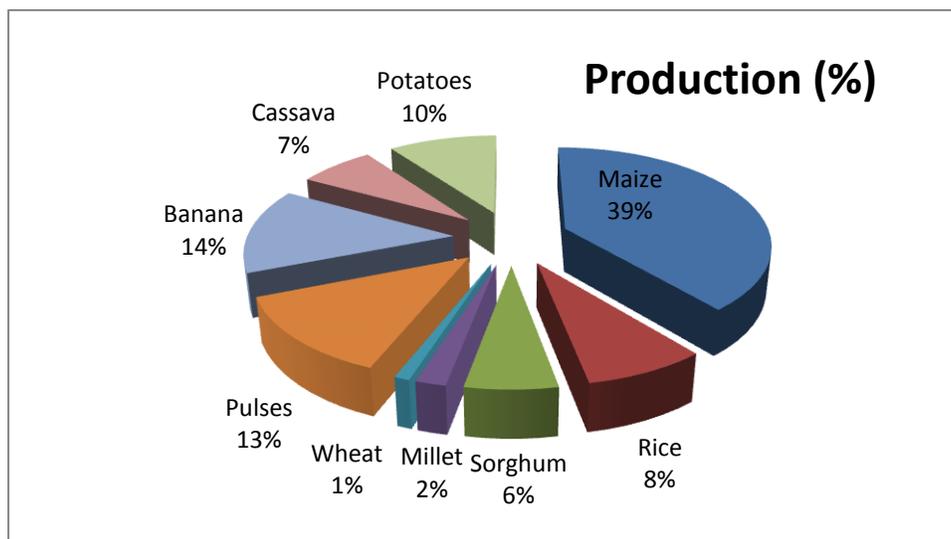
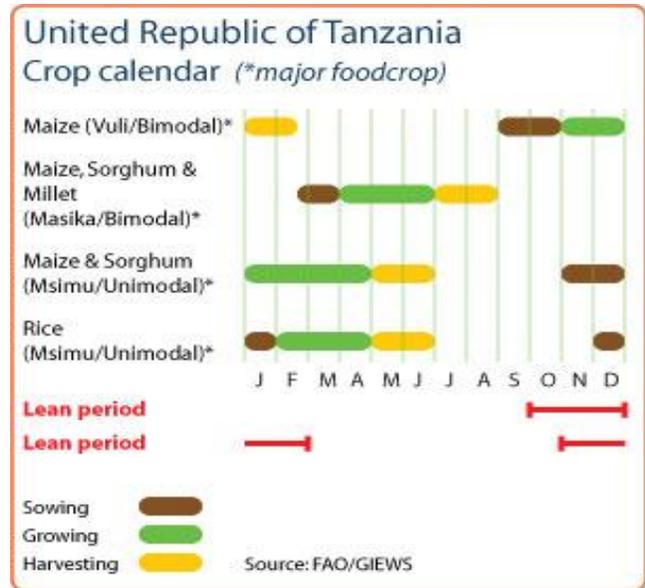


Table 2. Production of cereals in Tanzania				
Commodity	2009-13 (Average)	2013	2014 Forecast	Change 2014/2013
	000 tonnes			Percentage
Maize	4441	4700	4700	0
Rice	1983	1880	1900	1
Sorghum	801	850	850	0
Others	7655	7894	7914	0

(Source: FAO)

The average consumption of rice from 2002 to 2007 was 200 Kcal/capita/day compared to 553 Kcal/capita/day of maize and 208 Kcal/capita/day of cassava. In addition to being a staple food for medium and high income consumers, rice is also the preferred dish for many households during festival season or social functions. Furthermore, it is often preferred by urban households because it is convenient to prepare. Thus, shifting consumer preferences from conventional foods to rice, increasing per capita incomes and rapid urbanization in recent years has resulted in a substantial increase in annual per capita rice consumption by nearly 20 percent to about 25-30 kg/year.



To meet the domestic demands of rice, Tanzanian government has setup a special strategy called as National Rice Development Strategy (NRDS) with the aims of attaining self sufficiency in rice production and productivity by 2018. The vision of NRDS is to transform the existing subsistence-dominated rice sub-sector into a commercially viable production system. The strategy underscores the existing potentials for rice production in Tanzania and focuses on i) development and availability of improved seeds resistant or tolerant to major biotic and abiotic stresses, ii) development and availability of improved post harvest processing technologies and value addition (grading and packaging) processes, iii) low use of labour saving technologies and inadequate technology transfer, and iv) construction of more irrigation infrastructure.

It has tied up with many international doners including USAID. The Feed the Future programme of USAID is contributing all kinds of support to fulfill the aims of NRDS. To meet the targets, many challenges in rice value chain needs to be addressed effectively and ensuring availability of

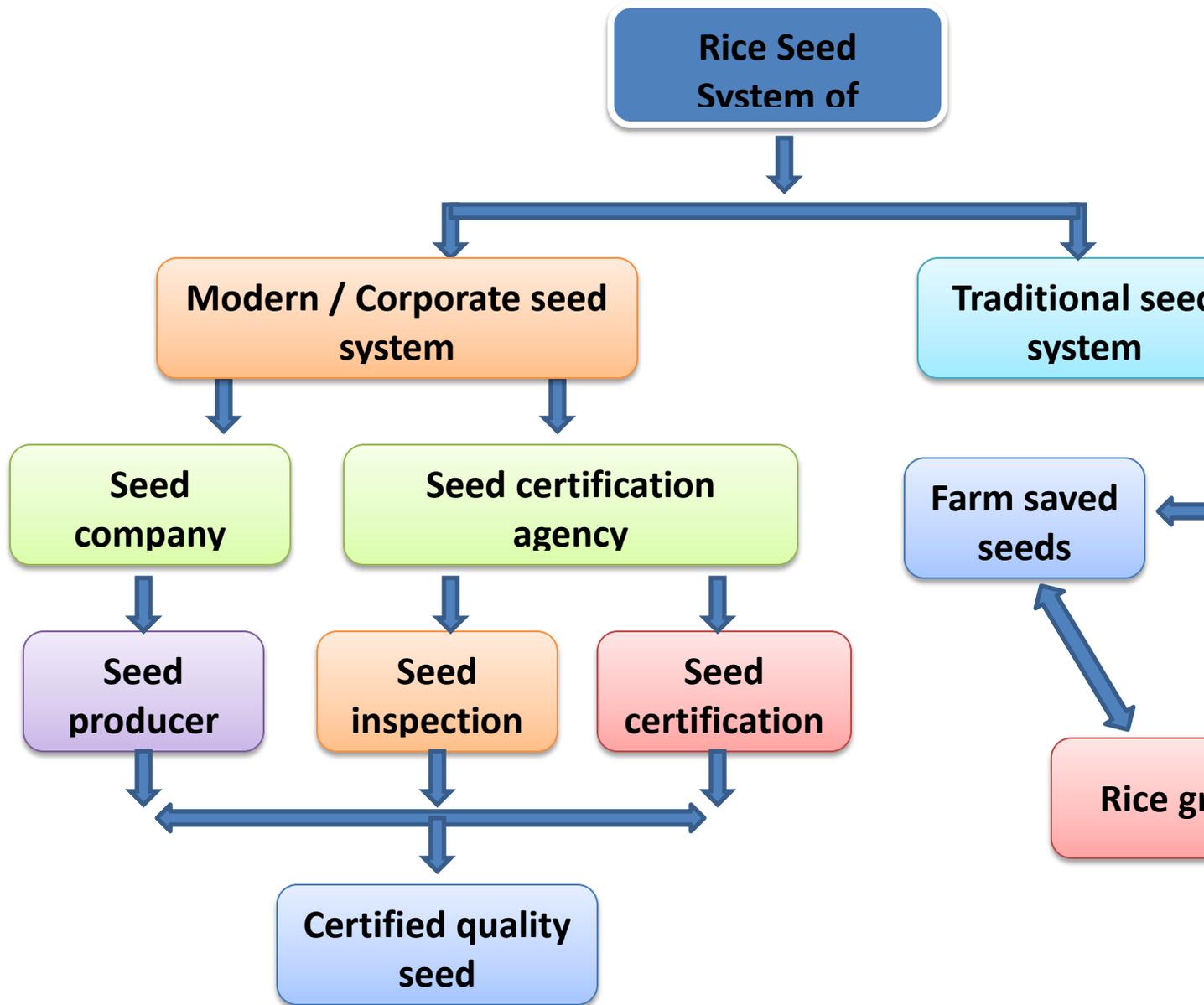
quality rice seeds is one among the most prioritized sector of NRDS. In order to strengthen the rice seed production and seed value chain of NAFAKA operational area, current investigation was undertaken to study the challenges faced by rice seed value chain and formulate the strategies to overcome.

Table3. Current challenges the rice value chain

Challenges	Eco-system		
	Rain-fed	Up-land	Low-land
Availability of drought resistant varieties	Red	Yellow	Green
Lack of high yielding and aromatic variety seeds	Red	Yellow	Red
Availability of high yielding quality seeds	Red	Red	Red
Use & availability of fertilizers	Red	Yellow	Red
Local availability of inputs	Red	Red	Red
Improper water management practices	Red	Red	Yellow
Timely availability of inputs	Red	Yellow	Red
Poor agronomic practices	Red	Red	Red
No knowledge about plant protection practices	Red	Yellow	Red
Poor mechanization	Red	Red	Red
Poor harvesting and post harvesting practices	Red	Yellow	Red
Proper processing facilities	Red	Red	Red
Very few market opportunities	Red	Green	Red
Poor returns / cost benefit ratio	Red	Yellow	Red
Poor extension services	Red	Red	Red
Poor transportation	Red	Red	Red
Lack of government support for private entrepreneurs	Red	Red	Red
Indicators	Accute	Very high	High

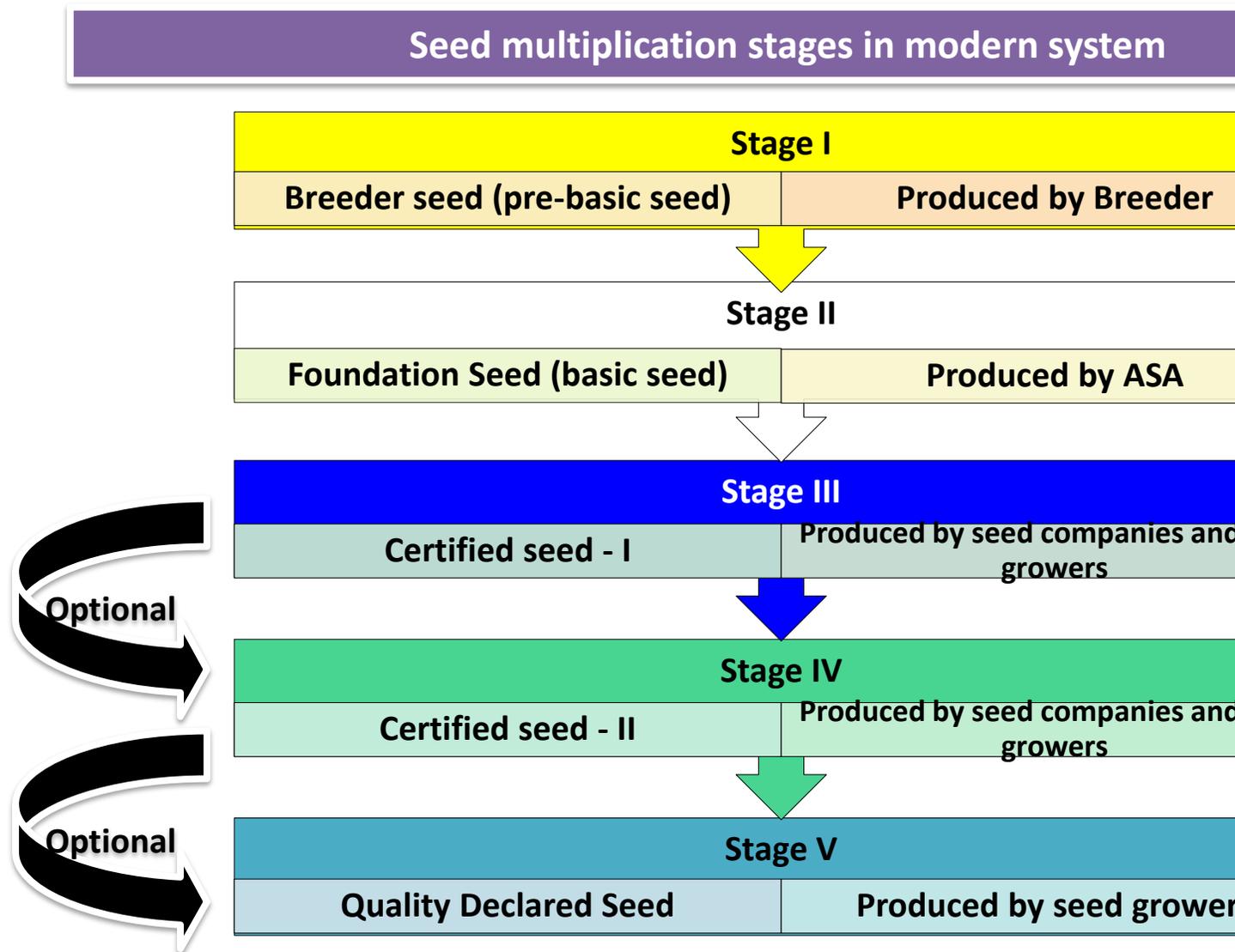
Rice Seed system in Tanzania: Seed has been a vital and important basic input of agriculture. The rice seed value chain of Tanzania has two types of seed transaction. In traditional system, farmers use their own farm saved seeds annually. Every year farmers collect the good performing ears / panicles and use them as a source of seed for next generation of crop, likewise the seed selection continues. Barter or exchange of seed material among the farmers is another very old traditional practice of seed exchange system. In modern seed system, which is also called as corporate seed system, the seed is produced by an organisation under the supervision of a trained official or seed producer, the seed quality is ensured by certification and marketed through agro dealers and retail outlets. Currently around 97% of the rice seed in Tanzania is circulating under traditional seed system and only 3% is under modern system.

Schematic view of present rice seed value chain in Tanzania



Under the modern system, breeder (pre-basic) seed is produced by research institutes, foundation seed is produced by (basic) Agricultural Seed Agency (ASA) and certified seed is by seed companies. There is one more stage of seed multiplication called as Quality Declared Seeds (QDS) but less than 0.01% farmers are involved in this category of seed production. This system is mainly operating in rural areas. Since the intervention of NAFAKA, QDS growers are formed in Morogoro region, trained to undertake quality declared seeds and market locally among the rice growers. On certain cases, the certified seed is produced (recycled twice) as stage I and stage II. The source for certified seed is basic seed and for QDS it is certified seed stage I or stage II. The QDS growers can maintain the source at his farm with quality standards of certified seed.

The demand for quality rice seed in Tanzania is increasing annually. The quantity of seed produced by ASA is not even 5% of the seed required to achieve 20% of Seed Replacement Rate (SRR). The network of ASA for seed production, processing, and marketing are also not well established in rain-fed ecosystem like in Kilemboro. Due to lack of infrastructure, on many occasions, the quality of seed is also compromised. In addition to this, lack of extension services in creating awareness about use of quality rice seeds among the rice growers left them totally unaware about the importance of seed.



There are few private rice entrepreneurs in Tanzania who grow rice and produce seeds. They are mainly involved in a small proportion of rice supply chain in domestic market and exporting to neighboring countries.

1. Mtenda Kyela Rice Supply Limited, in Mbeya Region
2. Kapunga Rice Plantation Limited (KRPL), Mbeya Region
3. Kilombero Plantation Limited (KPL), in Kilombero region
4. Mbarali Rice Farm, Mbeya Region

These companies have many tenant and contract rice growers apart from own farms. Their rice seed production is limited for own farms, contract growers and never sell to outsiders. Ultimately the small and poor farmers are deprived of quality seeds. The non availability of quality seed material is hampering the entire rice value chain. It affects all the stages of rice cultivation starting from planting in soil to serving on plate.

Demand and Supply of rice seed: Tanzanian government has formed the Agricultural Seed Agency (ASA) in 2006 with key function is to produce, process and market both basic and certified seeds. According to National Rice Development Strategy (NRDS) the target production of rice by 2018 is 1,963,000 MT by 2018. If rice cultivation is to be done with an average yield 2.5 t/ha, seed requirement of 50 kg/ha and seed – grain ratio of 1:50, it would require 39260 tonnes of certified seeds. But, seed produced by ASA in 2012 was 816 tons of certified seed which is below the 5% of seed requirements and remaining 95% is grown by small scale farmers To achieve 20% of 39260 tonnes of seed demand as per NRDS target, **7852 tons of certified / QD seed** is required. It is near 10 times more than the seeds produced in 2012. The government has many challenges to meet the target figure. ASA has been also lacking in infrastructure, man power and financial assistance in meeting the seed demand. Many donor agencies and NGOs have joined hands to strengthen the rice seed system to meet the target of NRDS. But, the practical progress since 2012 has no sign of growth towards achieving the targeted amount of seed and grain production.

Table4. Different class of seeds produced during past five years in Tanzania (mt)

Seed class	2007-08	2008-09	2009-10	2010-11	2011-12
Pre basic	3.2	NA	8.9	5.8	26.7
Basic	17.3	23	55.8	90	37.5
Certified	149.5	784.9	951	950	816
QDS	20.1	9.2	21	107	83.5

(Source: ASA, 2014)

Major varieties include: TXD 306 (Saro-5), TXD 88, TXD 85, SUPA, NERICA 1, NERICA 2 NERICA 4, NERICA 7, WAB 450-12-2,-BL1-, Mwangaza, Supa India

Quality control / Seed certification: Tanzania Official Seed Certification Institute (TOSCI) is the official agency responsible for field inspection, seed inspection, sampling, seed testing, variety evaluation and verification through NPT, Distinctness, Uniformity and Stability tests (DUS), control plot testing and National Performance Trials (NPT) which are necessary tests for variety release and registration. TOSCI also carries out quality assurance of certified seeds

through both field inspection (for isolation and characteristics) and sampling (for purity and germination). However, the institutes is not fully equipped with all the facilities required to ensure the quality of seeds, lack of human resource, technical skill, and infrastructure has limited the services to in and around Morogoro in NAKAFA operational area.

Table5. Different agencies involved in rice seed production

Activity	Name of institutions	Roles/Responsibility
Production	Agricultural Seed Agency (ASA), Universities, National Agricultural Research Institutions: KATRIN and Dakawa, Private Sector (local seed companies), QD-Seed producers	Universities (Sokoine Univ.) & Research Institutes: Production of pre-basic seed ASA: Basic, Certified (I &II) seed Private Companies: Certified (I & II) QDS: QDS-I, QDS-II
Inspection	Tanzania Official Seed Certification Institute (TOSCI)	Seed and Field Inspection to determine quality standards
Supply/ distribution	Public (ASA), QDS producers and private seed companies	Supply and distribution of certified and QDS seeds to farmers

Private seed companies in rice seed value chain: Number of private companies are doing seed business in Tanzania. There were less than 16 seed companies in 2005, today there are more than 55 companies both international and national are doing seed business under the umbrella of Tanzania Seed Trade Association (TASTA), formed in 2002. Many private Seed Companies of foreign and domestic origin mainly focus on hybrid seeds of maize and vegetable and their importation leaving the crops of seed security importance (e.g. rice, open pollinated variety (OPV) maize and legumes). These are currently produced and distributed by local seed companies, which are not as competent as the private foreign companies. Tanseed international Ltd. is a local seed company doing a small quantity of rice seed business and closely associated with NAKAFA in Morogoro.

Public research institutes in rice value chain: The National Rice Research Program is coordinated by Agricultural Research Institute (ARI) KATRIN (Kilombero Agricultural Research and Training Institute) Ifakara and focuses on breeding rice varieties suitable for different rice agro-ecosystems of Tanzania and to resistance/tolerance to biotic and abiotic stress factors such as diseases, drought, salinity etc. ARI Cholimba, ARI Mikocheni and Sokoine University of Agriculture are other local institutes directly involved in rice research. International institutes such as International Rice Research Institute (IRRI) and Africa Rice Centre (ARC) are also operating in rice seed value chain in close collaboration with KATRIN and Dakawa. The rice research in Tanzania is facing acute shortage of human resources. At present out of 147 staff required, only 29 are filled with mere 12 scientific officials who are not in a position to meet the increasing demand. The breeders entrusted with production of pre-basic seeds are also facing infrastructure, human resource and financial shortage in ensuring the demand for pre-basic seeds.

Table 6. Human resource at KATRIN

Category	Requirement	Available	Vacant
Ph.D.	16	2	14
M.Sc.	25	5	20
B.Sc.	26	5	21
Others	80	17	63
Total	147	29	118

(Source: KATRIN)

During the last three years Seed production of Pre-Basic seed from ARI KATRIN amounted to 8.9, 7.8 and 26.7 tons respectively for the years 2010, 2011 and 2012. This quantity itself shows that there is an urgent need of boosting the production of pre-basic seeds to meet the demand and achieving the targets of NRDS.

Challenges faced by Rice Seed Value Chain:

Development and availability of improved varieties: Tanzanians prefer aromatic rice than non aromatic. During importation of rice also the domestic aromatic rice prices remain steady. Hence, there is a need for developing more number of aromatic rice varieties with drought, biotic and abiotic resistance. Resistant to RYMV is in high demand. Among the rice varieties released in Tanzania, TXD 306 also known as Saro-5 is the only variety cultivated in some areas of Mvomero (DAKAWA) and Morogoro. In Kilembero NAFKA is undertaking demonstration of Saro-5. Tanseed International Ltd. Seed Company is the only private seed company involved in certified seed production of this variety with limited distribution in and around Mvomero and Morogoro. But there is no seed company operating in Ifakara where maximum rice area is under rain-fed and low land ecosystem.

Table7. Different rice varieties released in Tanzania and recommended for Morogoro region

Variety	Recommended Ecologies	Yield (t/ha)
Supa (1950)	Timely sown low land rain-fed and irrigated areas	2.0 - 3.5
TXD 85 (2001)	Timely sown in lowland irrigated areas	5.5 – 6.0
TXD 88 (2001)	Timely sown in lowland irrigated areas	6.0 – 8.0
TXD 306 (2002) (Saro-5)	Timely sown in lowland irrigated areas	6.0 – 7.0
Mwangaza (2006)	Timely sown low land rain-fed and irrigated areas	2.0 – 3.0
Kalalu (2006)	Timely sown low land rain-fed and irrigated areas	2.0 – 3.0
Komboka*(2012)	Timely sown in lowland irrigated areas	5.0 – 6.2

Tai * (2012)	Timely sown low land rain-fed and irrigated areas	5.0 – 6.8
Nerica 1 (2009)	Timely sown in upland areas	3.0 – 4.5
Nerica 2 (2009)	Timely sown in upland areas	3.0 – 4.5
Nerica 4 (2009)	Timely sown in upland areas	4.0 – 5.5
Nerica 7(2009)	Timely sown in upland areas	5.0 – 6.0
WAB 450 – 12 (2009)	Timely sown in upland areas	6.0 – 7.0
BL-1 – DV4	Timely sown in upland areas	5.0 – 6.0

* Released by IRRI for Tanzania

In spite of more than 12 varieties released by KATRIN, they have failed to reach the farmers field due to poor acceptance by the farmers and domestic consumers. Many native varieties with aromatic character and special features are more popular among the rice growers across the country. They are well adapted to local environment, yields during drought and calamities, resistant to pests, diseases and survived natural selection over the decades through various biotic and abiotic pressures. Unfortunately, no institute is doing any maintenance breeding or seed multiplication of these varieties. They have become orphan varieties. Ultimately farmers are deprived of improved seeds of their local varieties and depend upon their own farm saved seeds and compromise with yield.

Local rice varieties (farmer varieties)

- Kalimata
- Super India
- India
- Zambia
- Tulenabwana
- Kalimawango
- Mwanz

Recommendations: There is a need for collection, characterisation and documentation of native local varieties from all rice growing regions. Currently no institute is working on this aspect due to financial and manpower crises. These native varieties have novel characters like aromatic, resistant to biotic and abiotic stresses (resistant to Rice Yellow Mottle Virus (RYMV)), gall midge, blight, bacterial leaf blight, drought, salinity, lodging and cold weather). They can be used as a source for breeding high yielding varieties with locally acceptable features.

Outsourcing varieties / hybrids with drought tolerant, aromatic and high yielding could be undertaken by mutual collaboration between Tanzania (KATRIN) and other world leading rice growing countries such as India, China and Philippines and also with IRRI and ARC. NAFKAKA may consider building such collaboration for improvement of native rice value chain

The NAFKAKA may consider supporting research institutes like KATRIN or ARI, Cholima under grants for research institutes. The documentation of locally adopted varieties, their evaluation against DUS (Durability, Uniformity and Stability), characterisation and official registration of widely accepted varieties could be undertaken with grant in aid. Entrust research institutes for

pre-basic seed production of widely accepted local varieties with a separate system like Seed Unit. This seed unit will have designated staff for regular seed multiplication of pre-basic seeds and remain sustainable in long run with the revenue generated from marketing of pre-basic seeds.

Availability of high yielding quality seeds: The availability of certified rice seed in NAFKA operational area is limited to in and around city places. Many agro dealers are mainly located in city places and their business with rice seed is very nominal. In Morogoro region (Mvomero and Cholima (Dakawa)), availability of quality certified rice seed is up to 8% only and rest of the seed is from farm / self saved grain material. The worst case is of Kilombero and Ifakara, the availability of quality rice seed is less than 0.1%. Many rice farmers beyond Kilombero River had never heard about quality certified rice seeds. It is only after the intervention of NAFKA, that farmers are exposed to new quality seeds of high yielding through demonstrations. There are a limited number of agro-dealers in Ifakara, but they sell very little quantity of rice seeds annually. No agro dealers are based in villages and interior places, hence farmers left with no option than using their grain as seed. There is no proper system on ground to ensure timely availability of rice seeds.

Most of the certified rice seed production is concentrated in and around Mvomero and Cholima (Dakawa) area due to assured irrigation and other infrastructure facilities. This provides much scope for production and marketing of rice seeds locally. Private companies and ASA are also having their contract seed growers in this area. The NAFKA partner Tanseed is also having its certified seed growers in this rice belt. However, there is no private seed company is engaged actively in certified seed production at Kilombero and Ifakara. It is only since last two years; Tanseed is engaging few farmers around Ifakarka for certified seed production with the support of NAFKA.

Recommendations: There is a need to encourage agro dealers to operate in villages and remote places of rural areas. Unless rice seed is made available locally at village level during sowing, the adoption level of new and improved varieties will never increase. Popularisation of new rice varieties should be undertaken by establishing one demonstration between every four villages. Educating farmers to undertake seed production, where no seed is available would be best way to increase the area under seed production and seed availability. This creates awareness about use of improved seeds among local rice growers.

ASA should be convinced to undertake basic and certified seed multiplication at Kilombero or Ifakara. Since already KATRIN is doing pre-basic seed production and the arrangement of entire seed multiplication at one location will improve the quality and reduces the cost of production. It will create opportunities for a viable rice seed market in this valley. Enrolling small farmers as contract seed growers will help to maintain purity and high standards in seed production. NAFKA can assist in training more number of farmers to undertake certified seed production for ASA and private seed companies. Connect these trained seed growers with both ASA and private seed companies as contract seed growers. With this arrangement more private companies will follow to grab the opportunities and a competitive healthy seed value chain will establish. Already more than 50 certified and QD seed growers are formed by NAFKA and the proportionate ratio of 5 for every 100ha rice area will help to attain sustainability in rice seed production and availability.

In order to ensure the quality rice seeds in every village of NAFKA operational area in place of non availability of certified seeds, Quality Declared Seeds (QDS) shall play a crucial role in ensuring seed availability. Train one farmer in each village for undertaking QDS production, support him for registration and he will become a major supplier of quality seeds in and around his village. At present the government should consider the QDS segment as on par with CS until the full fledged CS system gets established everywhere.



Already NAFKA has selected Village Based Agricultural Advisors (VBAs) for transfer of technology and information related to agriculture among the villagers. These VBAs shall be trained for QDS production and marketing. In addition to them, farmers associations may also undertake the QDS production and sell among the members. It will be easier to market the seeds if production is done by group of farmers or associations. Already the NRDS has accepted QDS as a major key component of rice seed availability to achieve the targeted amount of rice production by 2018. The QDS concept not only ensures availability of quality seeds locally but creates employment opportunities and remains more sustainable. The interested CS and QD seed growers should get regular supply of parent seed material (basic seeds and certified seed respectively). Building trust among the players by NAFKA would enable more active partners to participate in rice seed value chain.

Inadequate use and availability of fertilizers: Rice is basically a water loving crop, in addition to water, application of chemical fertilizers *viz.*, N, P and K are essential components of its nutritional requirement. Many rice growers and seed producers in Tanzania are not fully aware about the role and use of fertilizers. Common fertilizers used particularly in rice fields range from organic to inorganic. Organic fertilizers are farm yard manure and compost which are found locally and not very widely used. Inorganic fertilizers such as Urea, Triple Super Phosphate (TSP), Di-Ammonium Phosphate (DAP), Ammonium Sulphate (S.A) and Calcium Ammonium Nitrate (CAN) are used. Seed growers in Dakawa use 50kg urea or DAP (Diammonium Phosphate) /acre at the time of sowing or two months after planting, hitherto both 50kg/acre are used in entire rice season. The seedling nurseries are raised without use of any fertilizers. Some progressive farmers, who practice partial mechanized seed production apply 50kg/acre DAP at the time of sowing/transplanting and 50kg/acre urea after one month interval. Very few trained farmers undertaking seed production for ASA and private seed companies are using 50Kg DAP at the time of planting and 100kg urea in two split applications.

Most of the farmers in rain fed area (Kilombero and Ifakara) don't use fertilizers, they are not much aware about its existence and benefits also. Many think their soils are virgin and need not use fertilizers, otherwise soils will be polluted. Only those farmers who had some formal training by developmental agencies are aware about benefits use of fertilizers. The use of Farm Yard Manure (FYM) or compost is not at all practiced by any of the rice growers.



A tractor carrying fertilizer is jammed in poor

Apart from knowledge on use of fertilizers, availability at village level is another major constraint. On many occasions interested farmers won't get them in their villages. They had to travel 30 to 40km, poor roads and transportation also adds to the cost of fertilizers, ultimately farmers' gets discouraged from use of fertilizers in seed crop. Proper nutrition is a must for seed crop; chemical fertilizers have to be applied for a good and healthy seed crop. Agro dealers also lack interest in stocking fertilizers due to poor transportation, space required, heavy investment, non availability of credit facility and poor knowledge on use of fertilizers among the farmers.

Recommendations: Currently the NAFKA is undertaking number of demonstrations to showcase the yield advantages on using fertilizers in various places. Yara Fertilizer Company is collaborated with NAFKA for demonstrations. Yara cereal is a rice specific fertilizer available in market. More number of demonstrations on benefits of using chemical fertilizers should be planned for next season. Farm schools, field visits, and more field days can be organized on use and benefits of using fertilizers. Farmers' behavioral change is also needed on use and adoption of chemical fertilizers especially among those who enroll for QDS production. Agro dealers should be trained on guiding farmers to use fertilizers for higher yield.

The fertilizer companies like Yara should be encouraged to open their sub distribution and stock depot in Ifakara with more numbers of retail outlets; this will ensure the availability at all major places and also farmers will buy them whenever they visit Ifakara. It will reduce the transportation burden of farmers to some extent. Year round availability enables more farmers to adopt this technology. The seed companies can arrange to supply fertilizers to their seed growers on credit basis or can tie up with fertilizer companies and payments can be adjusted with the income generated from sale of seeds.

For a healthy rice seed crop, use of 4 to 5kg urea/acre of nursery bed should be followed. After transplantation one bag of DAP/acre and urea 50kg each at the time of tillering and panicle emergence respectively yields more than 1.5 to 2.0 tons of seed/acre. Soil testing before application of nutrients is best recommended where ever facilities are there. Urea Deep Placement (UDP) granules may suite well for irrigated and assured rainfall rice areas. Diseases and pests incidence is directly related to application of nitrogen level. Use of nitrogen fertilizer

(urea) alone will build up susceptibility for pests and diseases. The best time to apply nitrogen fertilizers is at transplanting and panicle initiation stages, any application after flowering leads to spikelet sterility and cause late tillers production.

Use of Leaf Colour Chart (LCC) for determining the nitrogen application will help many farmers to take the right decision on their farm itself without any destructive/analytical method. The matching of colours in LCC will guide on nitrogen application. These charts are cheap (USD2) easy to use and decision making and NAFKA may distribute one chart to each of its trained seed grower. If facilities available site specific nutrient application can be popularized to address the needs of individual seed farms

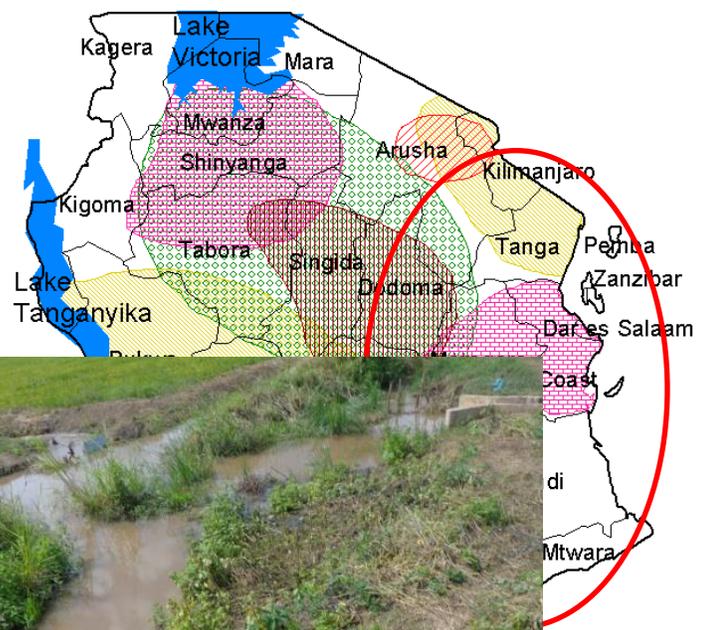


Introduction of mobile seed and fertilizer retail outlets is a novel approach in ensuring availability of both the essential inputs at village level. These mobile retail outlets are already popular in banking and other essential commodity sectors. The mobile units can open the retail outlets of seeds and fertilizers once in a week during the village market day or on any day where maximum villagers from nearby places gather at a common place. The concept will add value to the seed entrepreneurship and creates employment opportunities. Efforts should be made to create awareness on use of FYM and crop residue as source of nutrients. The rich organic matter will add all essential nutrients to soil and help in raising good healthy seed crop.

Inadequate soil and water management practices: The four districts of NAFKA operational area have all the three types of rice cultivation Kilombero: Rain-fed & low land, Kongwa: Upland, Rain-fed, Kiteto: Upland, Rain-fed and Mvomero: Upland & low land. Among all, the highest rice area is under rain fed ecosystem followed by irrigated.

In case of irrigated ecosystem, farmers don't follow proper soil and water management practices. Poor ploughing, harrowing and puddling were found in many seed producers plots. Fields without proper bunds were found with heavy water stagnation and over flowing of water. The improper water management leads to loss of nutrients and

Tanzania Crop Zones



pest & disease incidences, finally poor seed yield. Salinity will increase due to poor water management. This has been becoming one of the main challenges at national level rice research.

In rain fed ecosystem, farmers rarely take up ploughing or harrowing. Bunds are not well formed, which is must for conservation of rain water. The moisture stress, coupled with poor soil conservation makes it difficult to undertake seed production. Sufficient moisture level has to be ensured for successful seed crop cultivation.

Recommendations: Deep ploughing during summer, land levelling, harrowing and puddling are best practices for rice seed production in irrigated conditions. Proper bunding should be ensured to avoid heavy water stagnation. Irrigation canals should be properly laid out before beginning of the season. NAFKA may consider for training seed growers about good irrigation management practices for both rain fed and irrigated rice seed growers. Arresting flow of water from one plot to another will avoid loss of nutrients, spread of diseases and pests in seed plot.

In rain fed rice seed production plots, ploughing, harrowing and bunding before onset of rains help in in-situ conservation of rain water. This will avoid loss of water, nutrients, top soil through runoff. Unwanted things in seed plots such as mounds, shrubs, tree trunks and structures should be removed to ensure uniform distribution of water across the length and breadth of the plot. In the event of poor rainfall, seed plots could be irrigated if bunds are made.



Good irrigation canal and subways for irrigated paddy area

Poor agronomic practices: In Tanzania rice production is mainly confined with poor small and marginal farmers. They contribute more than 90% of the rice produced in the country. They are not exposed to modern scientific methods of rice cultivation. Hence, rice seed production practices are also not well developed. Seed production in rice involves a number of good agronomic practices starting from land preparation to harvesting viz., ploughing, harrowing, puddling, nursery raising, transplanting, weeding, plant protection measures and harvesting. All these require one or the other equipments and machinery to undertake. However, many rice seed growers follow these practices without any equipment or advanced tool. Their current agronomical practices makes seed production very difficult.



Hand held hoe



Sickle for weeding



sickle for harvesting



Stick for threshing



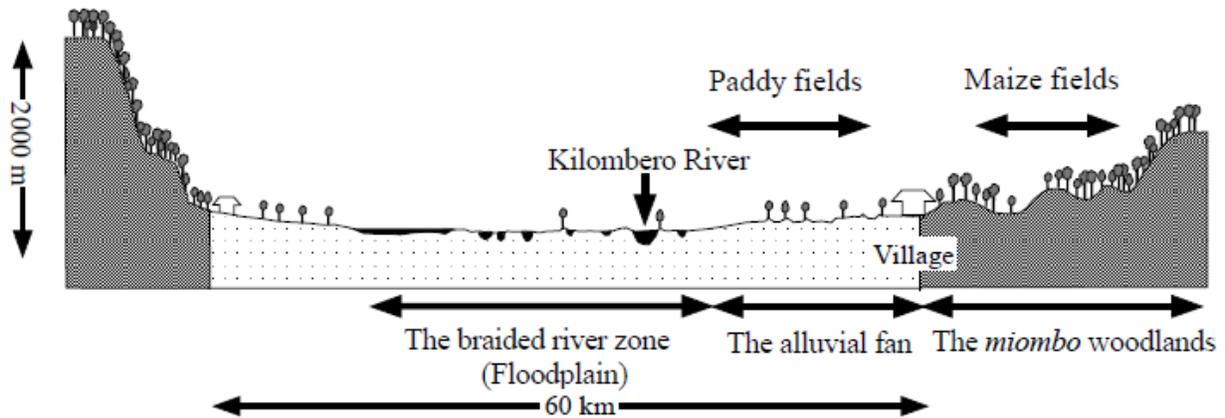
Winnowing with wide a bamboo house hold winnower



Threshing rice seed by mowing tractor

Weeds are another nuisance in seed production, many rice growers and seed producers struggle to keep their plots weed free. Weeds in rain fed areas compete with seed crop for moisture, nutrients and space. They are more vigorous than seed crop. Most of the non cultivated lands are covered by these noxious weeds. Their minute, light weight seeds spread on most of the rice seed plots leaving no option to eradicate them completely. These also act as source of inoculums for many disease and pests affecting rice seed crop. They are also contaminates in seeds harvested.

The rain fed and low land areas of Kilombero River vally is mainly covered with tall grasses such as elephant grass (*Penisetum purpureum*), guinea grass (*Panicum maximum*), *Hyparrhenia* spp. and reed (*Phragmites mauritianus*), but no trees occur due to the long-term flooding. These grasses are very aggressive in competing with seed crop.



Typical profile of the Kilombero Valley

Most of the farmers don't have any equipments or instruments for land preparation and other agronomic practices. They just use a long handled hoe for all the field operations starting from land preparation to harvesting. For weeding and harvesting a sickle is handy, for harvesting a wooden stick, these are the only equipments the rice seed growers are using since decades. The winnowing is done by traditional bamboo winnower, on certain occasions those who can afford to hire tractor, they run (mow) tractor over the cut straw to separate the grains. Sowing and transplanting are done manually.

After maturity of seed crop, the plants are cut above ground level and left in field for more than 10 to 15 days. This leads to over drying of seeds. While threshing, beating will lead to broken seeds and reduces germination per cent of rice seeds. Many rice seed growers waste their effective labour and time with these unproductive equipments and tools. In order to ensure the quality rice seed production, introduction of minimal equipments and mechanisation is must.

Use of high seed rate was found with many rice growers as well as seed producers. This will add more cost to the seed production and also waste the quality parent seed material. Proper spacing, sowing and transplanting methods are not known by many farmers.

Recommendations: For a quality certified rice seed production the crop should meet all the parameters prescribed below. Hitherto farmers ensure them in seed production. With their present practices of seed production none of the parameters match with quality of seed produced.

Quality standards for certified rice seed

Off types= 0.010%

Test weight = 25-30gm (1000seeds)

Purity= 98%

Other seeds 10/kg

Germination=85% and above

Validity= Six months

Diseases on panicles= 0.05%

Isolation distance= 3mt

Inert matter= 2%

Weed seeds = 10/kg

Moisture=13%

Two different ecosystems needs separate kind of mechanisation in rice seed production. In case of areas like in Mvomero and DAKAWA, introduction of specific equipments for irrigated system will enable quality seed production. The farmers in this region are capable of affording to buy or hire them. Some of them are already hiring tractors for ploughing and harrowing, but many seed growers lack proper equipments and instruments. Few local rice growers, who are also involved in seed production are having iron ploughs of bullock drawn. Introduction of this simple equipment alone helps many farmers to plough their seed plots effectively.



The NAFKA can consider supporting seed growers in procuring following equipments required at different stages of rice seed production.

1. Tractor mounted iron plough (for ploughing)
2. Tractor mounted disc plough (for puddling & ploughing)
3. Tractor mounted harrower (for harrowing)
4. Tractor mounted renovator (for recycling crop residue in to soil)
5. Tractor mounted land leveller (for levelling)
6. Tractor mounted seed drill (for sowing)
7. Power tiller (for field operations instead of tractor)
8. Paddy transplanter (power tiller operated or self operated)



Rotovator



Disc plough



Power tiller



Power tiller drawn seed drill



Tractor operated seed drill

Tractor operated seed drill



Bullock drawn seed drill



GROUNDNUT SEED DRILL
(Double Row) Manually Operated

PREMIER

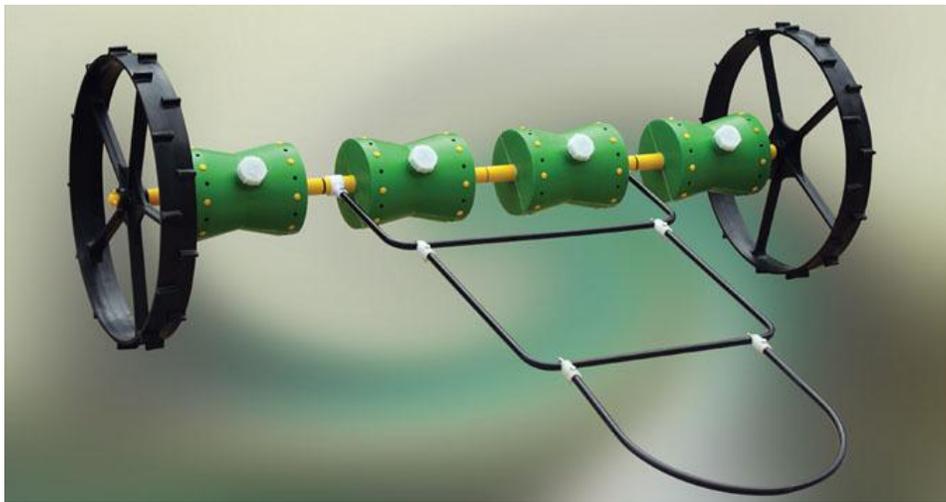
Hand drawn seed drill



Bullock drawn single row seed drill



Hand pulled single row seed drill



Direct sowing seed drum for paddy for irrigated and rain-fed areas



Filling pre-germinated seeds in drums



Sowing on puddled field

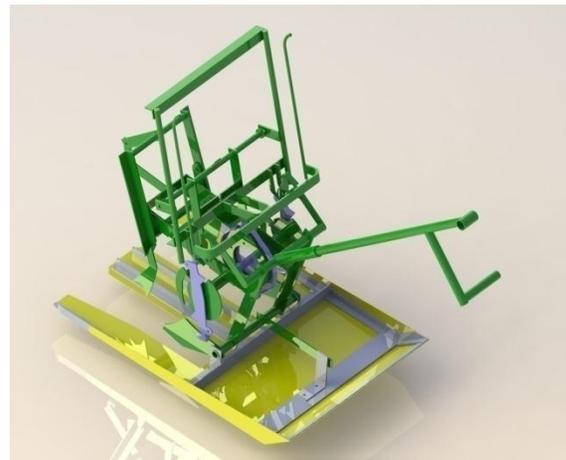


Paddy grown by seed drum method

All the prescribed equipments are very useful for rice seed growers in irrigated area. These all are tractor drawn and they should be popularised among the seed growers.

For transplanting introduction of paddy transplanters will reduce labour requirement, drudgery, seed requirement and also time. Planting seed crop with machines will enable proper spacing, inspection and pest and disease management if any. Those who are not able to afford for machine transplanting, direct seeding on puddled plots by drum seeder is the best alternative. It saves the seed, time, cost of seedling production, labour and provides enough scope for use of herbicides for weed management and plant protection practices due to line sowing.

In recent times some farmers are trained on System of Rice Intensification (SRI) method of rice cultivation. This method suites well for seed production in rain fed areas. For proper planting, spacing, and efficient use of soil moisture SRI method can be trained to more number of seed growers. NAFKA may consider for designing SRI markers and demonstrate among the interested seed growers to make planting easy. For rain fed areas SRI is very suitable. In SRI method each acre can be sown using only 8 to 10kg seeds by planting single seedling/hill

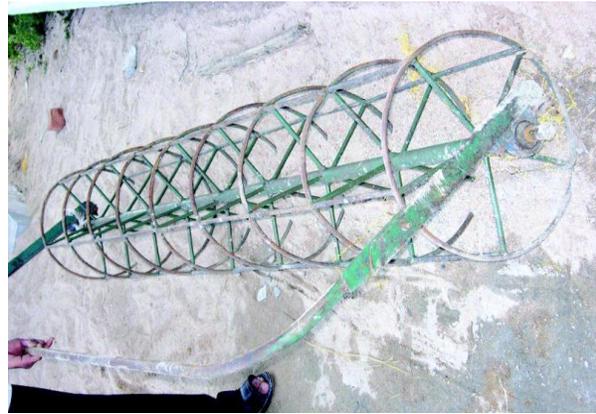


Rice transplanter motorized & hand operated



Hand operated rice transplanter

Raising nursery fir machine transplanting of rice



Close up view of SRI marker easy to fabricate locally



SRI method paddy planting under puddled conditions and direct planting under rain-fed conditions

Sowing rice in total dry soil is a new practice called as Direct Seeded Rice and is widely growing in India. This elite method has many advantages over any of the existing methods of rice cultivation.

- Suitable for both rain fed and irrigated areas.
- No need of raising seedling nursery.
- No transplanting is required.
- Saving of seeds by 50%.
- Scope of weed management by engaging herbicides.
- Time saving, low cost and less labour intensive.

Direct seed drill method helps in reducing basic seed requirement and enables sowing large area in short time. Application of pre emergence and post emergence herbicides at first and 30th days after sowing will check the weeds completely. There are seed drills of tractor drawn, power tiller drawn and bullock drawn. Small scale seed growers can adopt single row or double row hand drawn seed drill. These drills are very economical and easy to operate without any special skills.

Many rice seed and grain growers in rain fed area use sickle and hoe for manual weeding, but they does not check the weeds completely. Educating farmers to keep seed plots, bunds and surrounding areas weed free helps in reducing the problem by 50%. The use of herbicides has to be popularised for chemical weed management. Proper irrigation also checks their emergence. Introduction of cycle weeders, and cono weeders for SRI rice in rain fed areas will reduce drudgery and labour requirement.

For effective weed management Integrated Weed Management (IWM) practices should be followed. They include summer ploughing; regular cleaning of bunds by manual weeding or herbicide sprays, clean crop cultivation, regular weeding till grain filling, removal of weeds before their flowering, use of appropriate herbicides, regular inter-cultivation practices all together helps to check the weed population and also helps in reducing the insect and diseases. A weed free plot helps in increasing the seed yield by 5% and quality by 10%. New molecules of herbicides should be introduced by following required procedures. NAFKA may consider for contacting and encouraging multinational companies to register their new products of this segment.



Conoweeder (manual operated)



Conoweeder in paddy plot



power operated paddy weeder



Cycle weeder for rain fed rice seed growers

List of herbicides used in rice seed production

1. 2,4-D
2. Atrazine
3. Paraquat

4. Phosphonomethylglycine
5. Glyphosate
6. Diuron
7. Pendimethalin

Rain fed rice area is more prone to poor seed yield. For assured seed production in rain fed areas a proper planning of seed production events is must. Considering the rainfall pattern at Ifakara land preparations in the month of October – November is good so that sowing can be initiated in the month of December, where rains will coincide. The entire five months from December to April are having assured rainfall suitable for rice seed production. Hence, timely sowing is must. Any delay will coincide with drought which will compromise the seed yield.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept.	Oct	Nov	Dec	Total
1961	154	143	47.0	311	124	55	75	7	37	187	253	475	1868
1971	135	93	239	282	131	26	40	0	3	18	25	100	1092
1981	209.9	145.2	222.7	366	129.1	54.5	-	3	2	47.7	15.1	157.1	1352.3
1991	177.6	23.3	265.9	520.5	152.1	10.3	29.8	0.1	16.6	6.7	55.4	185.1	1443.4
Rain fall patter during the last decade at Ifakara (Kilombero district)													
2001	265.5	110.8	193.2	416.3	219.6	29	9	1.6	-	1.7	0	243.3	1490
2002	296	171.1	514.9	395.3	31.1	13.7	25.6	7.8	31.9	65.7	46.8	220.9	1820.8
2003	149.6	312.6	257.9	237.3	74.2	11.9	24	0	15.8	8.5	6.3	109.5	1207.6
2004	226.6	436.6	215.8	343.2	9.4	17.4	0	0.7	7.4	90.2	110.4	239.6	1697.3
2005	176.1	34.1	254	288.1	169.6	51.7	0	1.9	1.8	2.2	52.9	2.5	1034.9
2006	71.8	253.8	124.8	526.1	97.6	87.4	18.4	58.8	28.4	64.9	126.5	499.8	1958.3
2007	102.8	114	361.3	200.5	90.1	31.2	2.5	67.9	23.4	36.6	78.3	98.9	1207.5
2008	86.9	282	371.2	413	23.3	8.9	1.2	3.1	3.6	31.9	133.5	71.4	1430.0
2009	101.2	215.5	183.7	183.9	101	9.1	0	0.5	0	1.4	16.9	140.3	953.5
2010	211.6	59	239.6	234.8	53.4	31.2	0.4	4.9	1.6	0	16.9	134.9	988.3
2011	66.7	367.3	351.7	236.5	153.8	17.3	0.4	1.3	51.6	53.5	42.9	-	1343.0
	Rice growing period (RGP)												RGP

Use of proper seed rate, sowing method and time of sowing should be trained to seed growers. The broadcasting method of sowing is more popular in Kilombero and Ifakara, instead direct sowing with seed drill or seed placement by dibbling is the best practice where in 10 to 12kg/acre seeds are enough to maintain the ideal plant population. The seeds sown in dry soil will also remain viable and germinate once the rains are received or moisture is ensured.

Table9. Suitable rice seed production calendar for rain fed ecosystem

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept.	Oct	Nov	Dec	
Operations	Rice cultivation calendar												
	Monthly operations to be carried out												
	Sowing	Weeding			Harvesting						Land preparation	Sowing	
Fertilizer Application Pest and disease				A relay crop (short duration) can be introduced to grow on left over soil moisture to get additional benefit									

	management	(Preferably legumes) during May end to August				
Crucial stages	Tillering, flowering & Seed setting (Assured yield)	Planting/ sowing must be done during December or before first week of January. Delayed sowing lead to water stress during flowering and seed filling, hence yield may get reduced by 10 to 15%.				Germination and seedling establishment

With the introduction of all the above technologies, mechanisation and instrumentation for agronomical practices, there will be rapid change in behavior of rice seed growers. Their confidence in quality seed production will increase. More farmers will come forward to enroll for seed production.

Poor plant protection practices: Rice growing farmers in Tanzania are not much aware about disease and pests infecting rice. Similar is the condition of seed producers. During the survey, disease such as blast, bacterial leaf blight (BLB), sheath blight, loose smut, RYMV, grain discoloration, neck blast, brown leaf spot and sheath rot were noticed. Many of them are causing yield losses from 5 to 65%. The blast, BLB and RYMV have become major concern for breeders.

Among the pests stem borer, Spotted Stem Borer, African Pink Borer, Stalked-eyed Borer, The African rice gall midge, hispid beetles, African rice hispa, *Dactylispa lenta* Weise, rice flea beetles, small rice grasshopper, Rice Stink Bug, Army Worm, leaf hoppers, green leaf hoppers and leaf folders were noticed.

Farmers and seed growers are not fully aware about these diseases and pests. Unfortunately many extension workers and agro dealers also don't have proper knowledge about identification of pests and diseases of rice crop. The raising pest & disease free seed crop only can ensure production of quality seeds.



Sooty mold & hoppers

Neck blast

False smut



Grain discolouration



Chaffy panicle by neck blast



Leaf blast



Bacterial leaf blight



Sheath rot



Stem borer infested panicle



Brown leaf spot

Some of the diseases and pests observed during the field visits

In addition to above availability of plant protection chemicals is major hurdle for many rice growers and seed producers. Most of the villages and interior places don't have agro dealers, like fertilizers, farmers have to travel long distances to fetch the plant protection chemicals. Sometimes they don't get the right chemicals they needed.

Recommendations: Educating farmers on identification of pests and diseases would be more appropriate. A well trained and educated seed grower can ensure disease free seed crop by following appropriate preventive and protective measures whenever they are noticed. Maintaining weed free seed plots will reduce pest & disease inoculums. NAFKA should consider for training seed growers on identification of pests and disease problems and their management in rice seed crop. Publication of a hand book / catalogues for identification of pests and diseases and their management in local language with colour pictures would be more impressive.

A separate training or workshop may also be organised for agro dealers and extension workers on identification of pests and diseases of rice, and on use of various agro chemicals for their management in rice seed production. This will enable the agro dealers to advise the rice growers and seed producers to take up correct control measures.

Like chemical fertilisers, plant protection chemicals may also be sold in mobile units. Government should plan to ensure availability of all essential inputs for rice seed growers in achieving the goals of NRDS. NAFKA may consider for supporting establishment of mobile agro dealers one in each district of its operational areas in collaboration with interested new entrepreneurs or already operating entrepreneurs.

There are many new, environmentally safe and effective new molecules are available across other rice growing countries. The multinational companies operating in Tanzania should be involved in the project to learn them their business opportunities in rice value chain. NAFKA may help these companies by coordinating to register their chemical molecules essential for rice cultivation.

Seed certification and quality assurance: In Tanzania, the services of seed certification and quality assurance are entrusted with Tanzania Official Seed Certifying Institute (TOSCI). Currently it has three seed testing laboratories with head quarters at Morogoro. However, the services of rice seed certification are not available everywhere due to understaffed manpower. Most of the newly recruited TOSCI staff are graduates in general agriculture studies and are yet to undergo job training.

Limited mobility and resources are another reason for non availability of certification services in remote areas. Especially beyond Kilombero River, there are no services of seed certification available from TOSCI. Presently the seed certification facilities are available in and around Mvomero and Dakawa, but many farmers who are interested to undertake QDS at Ifakara and in remote villages are deprived of certification services.

Higher chaffy seeds are also hindering the quality of seeds. The disease and pest incidences at grain maturity lead to more chaffy seeds, ultimately these seeds lead to poor crop stand. During the interaction with farmers, movement of fake or spurious seeds in market is learnt. Many farmers complained that seeds purchased from agro dealers did not germinate well. More than 50% of seeds were chaffy and dead. This kind of unethical practice of selling poor quality seeds will lose the faith of farmers on quality improved seeds from market.

Recommendations: In order to ensure high quality seed certification facilities, well trained technical staff is essential. Technical capacity in inspecting, testing and regulating packaging & labelling practices should be improved. Upgrading of existing seed testing laboratories is needed to meet prescribed standards. NAFKA may consider for supporting strengthening of a seed testing laboratory in Kilombero or Ifakara. Convene a meeting of stake holders of seed value chain and formulate a proper system for regular certification services during the season in all rice seed production areas. Organize a special training for seed certification staff to strengthen their capacity, knowledge and skills in rice seed inspection, testing and certification.

Transportation and movement facilities make major impact on availability of certification services. Supporting for procurement of small vehicles by NAFKA for seed inspectors at Ifakara would benefit all trained QDS growers to undertake QD seed production and ensure their local availability. Minimum two field inspections for certified seed production and 10% of the seed crop area in case of QDS plot are must.

Seed growers and farmers shall be trained about simple seed germination

test method and removal of chaffy seed method by demonstrations. Sometimes the poor quality seeds and self saved seeds adds to the higher seed rate used for sowing. To remove the chaffy seeds use brine (salt) solution (follow egg flotation method to prepare the solution). In brine solution after mixing the seeds chaffy will float and can be separated. The sunken seeds are washed and used for sowing. It is good to treat seeds with Carbendazim 1gm/kg before sowing to avoid seed borne diseases and possible incidence in nursery stage.



Insufficient trained manpower (seed producers): Adoption of improved quality seeds is possible by regular supply of seeds in market. There should be also regular production by trained seed growers. In Tanzania availability of quality rice seed is less than 10% of the actual demand at a seed replacement rate of 20%. Shortage of sufficient trained seed growers is a major hurdle in rice seed value chain. Only at Mvomero and Dakawa, a good number of seed growers are doing seed production for ASA and private seed companies. However, they too are not well trained to ensure all the standards of certified seed production. QDS is recently taking some scope where ever certified seed availability is a scarce. However, they too needs to be trained well to ensure quality seed production.

Many seed companies lack infrastructure and own seed production facilities, including ASA, they are dependent on contract seed growers. But, their number is not sufficient to meet the increasing demand for quality seeds.

Recommendations: Production of quality certified seeds can be achieved by well trained seed producers only. There periodical knowledge up gradation and skill development will increase their confidence in sustainable seed production. At present more than 50 NAFKA trained farmers are doing seed production of CS and QDS at different places of NAFKA project area. Their number should be increased by training additional 100 farmers each at Mvomero and Kilombero location for two years to undertake certified or quality declared seed production. This will add to additional 1200mt of certified seed by every 200 trained seed producers if they take up seed production of minimum 2ha each.

Training new and interested farmers including VBAs for QDS production will strengthen the human resource for seed production and availability of quality seeds locally. These trainings will create an additional employment opportunities in seed production, processing and marketing activities. A technical manual with all detailed instructions to be followed in certified and quality declared seed production would be more helpful. NAFKA should consider for publication of manuals for CS and QD seed production. A proper linkage building mechanism should be established between QDS producers and buyers. Wider marketing opportunities for QDS growers with timely delivery will make it equally competitive with CS class of seeds.

Poor tillering and panicle formation: Tillering in rice is directly related to variety, spacing, season and nitrogen application. During the interaction, many farmers complained about poor tillering and panicle emergence. In broad cast method average tillers with productive panicles ranged from 4 to 6 and maximum was 8/hill. It was less than 10 in all the plots visited. In case of dibbling it ranged from 16 to 18 and maximum was 20. In case of transplanting it ranged from 25 to 26 and maximum was 28. Although some plants had up to 40 but most of them were non-productive formed after flowering. Based on the number of productive tillers panicles will form. Poor panicle emergence was also noticed due to frost.

Recommendations: Usually tillering is affected due to drought, weeds, poor variety, low nitrogen application, improper spacing and poor management practices. For one square meter 300 to 340 productive panicles are expected for an ideal paddy seed crop. This can be achieved by use of high yielding variety, use of quality basic seed, proper spacing, weed management, application of recommended dosage of fertilizer, pest and disease management and following good agronomic practices. Avoid frost period during panicle emergence. Temperature below 16°C restricts the panicle emergence.

Poor harvesting and processing: Harvesting and threshing are the quality determining factors in rice seed production. Tanzanian farmers don't have any kind of mechanised harvesting in rice cultivation and similar is the situation with rice seed producers. Only large scale rice growing private estates / companies like KPL have combine harvesters for their rice crop harvesting. Other than them, few farmers in Mvomero are hiring combine harvesters since two years. But, most of the rice seed crop plots in entire NAFKA project area are harvested by manually. In rain fed areas harvesting is done very late even after crop has attained maturity. In spite of physiological maturity, farmers leave the crop in field for further drying believing that, it

helps in separating the grains while threshing. This is very detrimental practice for seed production.

Matured plants are cut with sickle half feet above ground and left in the field for drying. After 10 to 12 days the stalks are heaped and threshed using wooden stick / log or smashing on a wooden plank is also followed. Mowing tractor over the stalks to separate the grains is also followed. The traditional house hold bamboo winnower is used for separating the seeds from dust and debris. Seeds harvested by this method will be very poor in quality and germination ability.



Harvested paddy left for drying



Heaped rice seed crop for threshing

This unscientific method of seed crop harvesting is the main source for quality deterioration. Many farmers harvest the crop and leave in the field scattered. The prolonged exposure of seed crop to sunlight reduces the moisture content of the seeds. In addition to this dew and fog also damages seed quality in piled stalks.

Harvested and threshed seeds should undergo processing before marketing. Including ASA and private seed companies, none of the rice seed producers are following proper seed processing. The Tansed seed company working in close collaboration with NAFKA, doing rice seed business since three years also don't have processing facilities. This is a clear indication of compromising the quality of seeds due to lack of processing facilities. Ultimately the poor buyers are being cheated in the name of quality seeds. This also leads to deviation from ethics and science of seed production.

Recommendations: Rice seed crop harvesting should be done when it reaches moisture level of 20 to 18% but No farmers is practicing this in the entire rice belt of Tanzania. The safe moisture level for threshing is 15% and for storage 13 – 12%. Below this limit, the grains will become brittle and gets broken while threshing. Almost 20 to 30% seeds get damaged by this kind of threshing. Even higher moisture content will also damage the seed by harbouring pathogenic fungi leading to seed quality deterioration.

For seed production, drying should be done carefully after threshing; threshed seeds should be dried immediately by spreading evenly on a clean surface. Otherwise, quality deterioration due to

high respiration rate may occur if kept heaped. Optimum time for drying the seeds under sun is 8.00 am to 12.00 noon and 3.00p.m. to 5.00p.m. Drying of seeds during 12.00 noon to 3.00pm should be avoided.

In order to ensure high purity and quality seed production, extra care is must for harvesting and threshing of seed crop. To mainta purity, separate harvesting, threshing and drying is must. Avoiding contamination or cross contamination of seed with grains and other variety seeds has to be ensured throughout the harvest and post harvest processes. Replacement of traditional harvesting and threshing by mechanization is a must for seed growers. The NAFKA should consider introduction of paddy threshers or multi crop threshers or combine harvesters or mini combine harvesters for rice seed growers. During the interviews with seed growers it is learnt that some of them are ready to buy paddy threshers which are affordable by to them.



Combine harvester



Pedal operated thresher



Mini combine harvester



Motorized rice seed thresher



Mini combine harvester used in seed crop



Multi crop thresher



Simple multicrop thresher



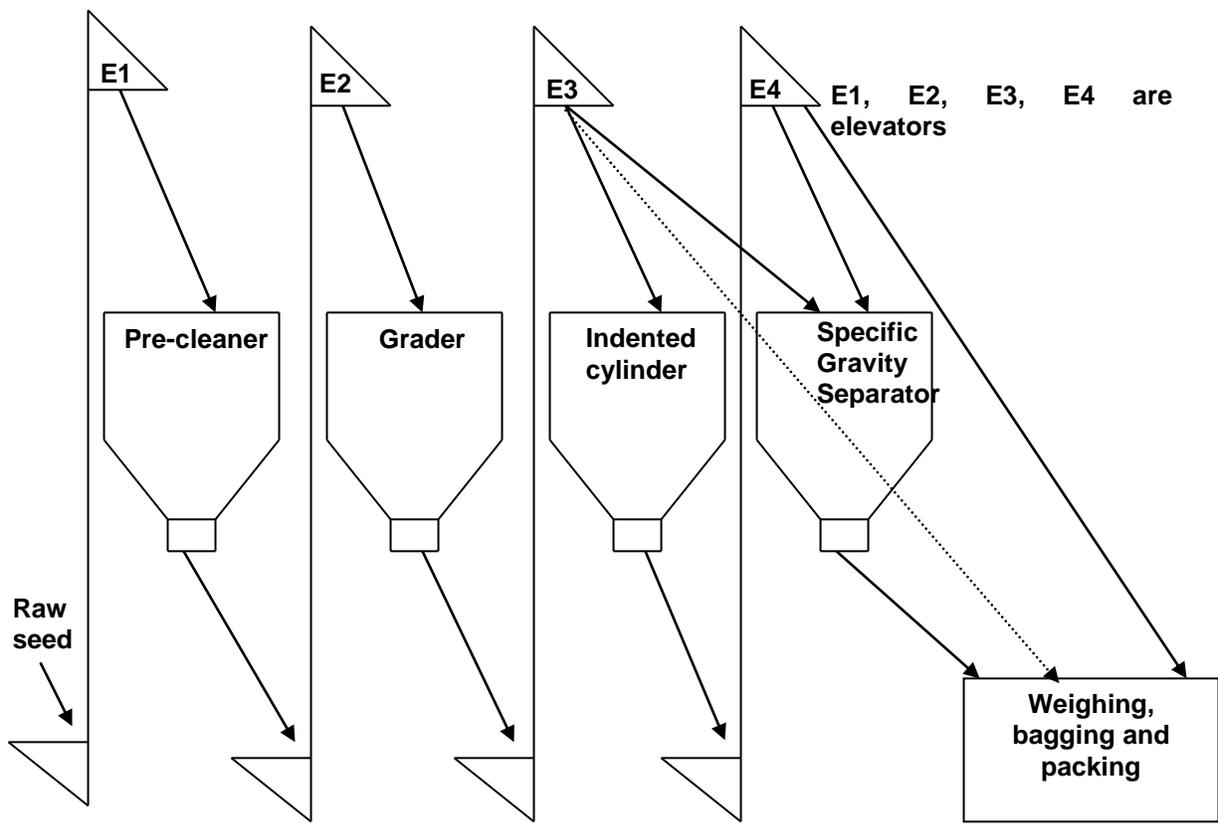
Diesel engine powered multi crop thresher

Farmers in irrigated areas of Mvomero are aware about combine harvesters. But their use for specifically seed crop is not followed. Introduction of mini combine harvesters for seed purpose would solve their problem of contamination, since most of them are doing certified seed production in this area. Those who are having tractors they can be advised to go for tractor operated multi crop thresher which can be used for all the crops grown there.

Introduction of multi crop thresher or mini combine harvester or paddy thresher in Kilombero and Ifakara would help many seed growers to thresh their crop easily without compromising the quality. These are mounted on movable carts and can reach where ever required. NAFKA may consider for procurement of movable paddy thresher or mini combine harvester for QDS growers in Kilombero region. This will help them in ensuring the quality prescribed for QDS. The machine can be kept with a group of farmers or with an association of farmers and can be used on hired basis. This will ensure its proper utilisation and maintenance among the community members.

Processing rice seed remains a major challenge in the present situation across NAFKA operational area. The project may consider for partial supporting to any of the private seed company like Tanseed to establish the processing facility at Morogoro or Mvomero. In order to help the seed growers of Kilombero and Ifakara, establishment of a processing facility at Ifakara would be a good decision. Otherwise the poor seed grower will never enjoy the facility. NAFKA should consider on priority for supporting any seed company to establish a processing facility at Ifakara. Alternatively mobile rice seed processing plants are also available. One unit of this at Ifakara will help maximum QDS growers to process their seeds nearby and do a comfortable seed transaction locally. Supporting to acquire seed bag stitching machines, weighing scale will add quality to the seeds produced by project beneficiaries.

Pictorial description of seed processing activities





Stationary seed processor



Mobile seed processor

Seed pricing and marketing: Presently the certified rice seed is sold in the market by agro dealers at 2000Tsh/kg. The certified seed grower is getting 1000Tsh/kg and similarly the QDS grower is selling his seed at 1200Tsh. The grain price is 350 to 400Tsh in rural areas and 500 to 600Tsh in urban areas. The current pricing is good for growers but equally not attractive for seed buyers. The entire pricing mechanism should be competitive and keep the interest of buyers.

Recommendations: Generally as a thumb rule for self pollinated crops such rice, sorghum, cowpea and other legumes; the seed price should not exceed 2 to 3 times the grain price unless the variety is very scarce and expensive to produce. For cross pollinated crops like maize it should be 4 to 5 times that of its grains. This kind of pricing mechanism will enable the rice seed value chain sustainable.

Poor extension services: The agriculture extension system is very poor among the rice farmers & seed producers. Technology transfer about the quality seeds and their production is lagging behind. Government functionary is also poorly performing in this regard. During the interactions and meetings with extension officials, under staffing was found a major drawback of poor technology transfer. Many districts are lagging proper transportation for extension officials. Poor roads and infrastructure limits their services only to city and surrounding areas.

In some of the villages they hardly see the extension officials in the entire year. NAFKA has been reaching farmers of interior and remote villages. Interestingly many of these villages are not yet known by government extension staff.

Recommendations: In order to meet the targets of NRDS, proper technology transfer about the use of quality and improved rice seeds is must. Farmers has to be educated about benefits of improved seeds. Various extension activities on use of quality seeds and seed production like demonstrations, field days, agricultural fairs, campaigns, distribution of leaf lets, posters, banners, hoardings, radio talks, demonstrations on use of fertilizers, safe use of plant protection chemicals and organizing competitions for best growers etc, will create more awareness among the rice growers. NAFKA is already organizing most of these activities. Involving local governments for demonstrations and other stake holders like fertilizer companies, seed companies and plant protection chemicals companies will make them more effective. The

collective effort by involvement of all the stake holders will bring drastic change in use of quality seeds.

Involve local and regional political representatives along with government officials for better awareness creation. This will bring in more participants in each event and involvement of regional and national media could also help in popularising quality seeds. There is a need to establish a proper information generation system on seed supply analysis and demand estimation. This will help in planning for seed production and distribution. NAFKA may convene a meeting of print, electronic media representatives with a request for dedicating their space and time for broad casting / publishing agricultural technologies across the country. This idea will increase their listeners / viewer / readers. Any effort in popularising the quality seeds will increase the seed demand and quality assurance will increase the returns in seed production.

Lack of credit and finance: Seed production requires some capital for hiring machines procuring fertilisers, plant protection chemicals and for other operations. The small and poor farmers who cannot afford to buy all these will never dare to take up seed production; even if they do it, they fail to ensure prescribed quality without these inputs. Seed growers in irrigated areas are looking forward for mechanization and improvement of their fields and irrigation canals. In rain fed areas of Kilombero and Ifakara, very few farmers are involved in seed production. There is a need to encourage and form more number of seed growers both in CS and QDS class of seed production. To help these small farmers in procuring equipments and basic inputs, short term loans are required which is presently not available. Non availability of any financial institutes in these areas will restrict the growth and development of rice seed vale chain.

Recommendations: Rice being the major cash crop for most of the small holders, there is a need for establishment of rural banks with micro credit facilities and crop insurance. This will not only bring money flow in market but also improves living standards and purchasing power of small farmers. NAFKA may consider for brining in micro finance institutions in to Ifakara. Discussions may be held with national and regional rural banks to start commodity based money lending facility for paddy seed growers.

Farmers associations could be supported by nationalized banks to undertake microfinance facilities at village levels. This arrangement will help the seed growers to meet their requirements and do quality seed production. This will provide a good platform for strengthening the rural cooperative movement. It also generates employment opportunities and financial transactions. Financing for procurement of small machineries and equipments will strengthen seed growers. Bankers should consider rice seed growers and processors for establishment of permanent facilities of processing.

Some national banks are offering mobile banking facilities like CRDB bank. It is essential to extend such facilities to more interior areas where rice and rice seed are traded. It will bring in a kind of commercialization of rice seed value chain.

Poor infrastructure and government support: Sound agricultural development is only possible where basic infrastructure facilities like irrigation, power, roads, transportation and marketing facilities are adequate. In Tanzania more than 90% of the farmers are living without

any of these facilities. Poor roads and transportation have widely affected agricultural growth in the country. Similar is the situation of rice seed sector.

Transportation becomes worst in rain fed Kilombero and Ifakara area. During rainy days, many villages and remote hamlets remain disconnected with rest of the world due to floods and breach of roads. In case of irrigated areas, poor maintenance of canals and sub distributor channels have led to wastage of water and increase in soil salinity. The roads also are not much good here. This situation has distanced away rice seed production in many places. Poor transportation has restricted movement of seeds, fertilisers and other inputs. This has been one of the major reasons for detaching seed entrepreneurs in entering the rice seed value chain. The poor roads and lack of transportation facilities are discouraging the certification facilities also.

Recommendations: Good roads and transportation facilities will solve 25% of the problems faced by rice seed sector. The government should be urged to take up appropriate measures to ensure good roads and transportation for healthy growth of agriculture and rice seed sector in particular. For sustainable seed industry, the government seed policy should be pro active. Incentives for space and support of finance for entrants in rice seed value chain is the way of attracting investors. NAFKA should coordinate all the potential stake holders in rice value chain for supporting seed value chain. Unless good quality seed availability is ensured, movement of quality rice cannot be expected. Upraising government for better roads and irrigation facilities will boost the morale of seed producers.

In order to introduce mechanization in rice seed production, NAFKA may help in coordinating farmers with government scheme for procurement of machineries and instruments under subsidy scheme. At present government is providing 80% subsidy for procurement of agricultural implements and machineries for group of farmers and farmers associations. On certain cases individual farmers are also considered for supporting. The existing farmers associations under NAFKA can buy the machineries / instruments required for rice seed production and individual seed grower can avail the services of them on nominal charge basis.

Ensuring storage / ware houses by government for seed producers will enable their availability locally. Seeds produced could be stored locally and transported where ever required during the season. For QDS growers in remote areas storage facility would help to keep their seeds safe from moisture heat and storage pests which can deteriorate the quality.

Summary of recommendations:

- Introduction of drought resistant, aromatic and stress tolerant rice varieties should be encouraged in partnership with KATRIN, IRRI and ARC. If required foreign varieties may be imported and tested for adoption under the supervision of KATRIN and ARI, Cholima
- Documentation of local and native rice varieties and registration of best performing one would enable to undertake its seed production as highly demanded by consumers
- Introduction of mechanization in land preparation, sowing, weeding, harvesting and other agronomical practices will ensure high quality seed production at low cost.
- Introduce small equipments and tools for farm operations which can reduce the labour requirement and drudgery.
- Ensure regular availability of inputs like fertilizers and plant protection chemicals across all the rice growing areas during the season. It will assure high quality seed production by seed growers.
- Training farmers on irrigation management, good agronomic practices, soil and water conservation practices and proper rain water harvesting will enable them to raise good seed crop.
- Educate farmers on use of improved new varieties and fertilisers by maximum number of demonstrations on different places; this will increase seed demand as well as awareness about the benefits of using fertilisers.
- To bridge the gap between demand and supply of seeds, train more number of farmers to undertake CS and QDS production in both rain fed and irrigated ecosystems.
- In place of non availability of certified seeds, QDS production should be encouraged, this arrangement will ensure local availability of quality seeds regularly at low cost.

- Consider for training TOSCI staff and extension officials for effective execution of their services to seed growers especially in Kiolombero valley area.
- Support TOSCI for need based infrastructure or facility to ensure seed certification in all the places at Kilombero valley.
- Consider farmers associations and groups for seed production activity train them and link them with ASA and seed companies for regular supply of seeds.
- Educating farmers on identification of pests, diseases and nutritional deficiencies will ensure high quality disease free seed production and reduce the losses.
- Creating awareness about clean crop cultivation, timely sowing, weed management and other critical operations will reduce the cost of seed production and increase the seed yield.
- The government should be upraised about the poor roads, transportation and irrigation facilities to address the problems at the earliest.
- Convene a joint workshop on higher level with USAID and other partners for up gradation of roads, transportation and basic infrastructure facilities essential for rice seed sector.
- Support for establishment of rice processing plant by a seed company shall be considered on condition of establishing the facility permanently at Ifakara.
- For small scale farmers of rain fed area introduction of multi-crop threshers or mini combine harvesters will take care of seed quality deterioration during harvest and post harvest situations.
- Ensuring credit facilities at rural areas or supply of minimum inputs for seed production by seed companies will attract more number of farmers to enrol for seed production.
- Healthy seed pricing mechanism should be placed to ensure sustainability of seed value chain.
- Connect farmers and farmers associations with government facilities in acquiring necessary equipments and machineries under subsidised prices.
- Government should be convinced on building active seed policy and permission to sell QDS seeds beyond their area of production also.

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