



THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF AGRICULTURE FOOD SECURITY AND  
COOPERATIVES

SYSTEM OF RICE INTENSIFICATION

TRAINING MANUAL FOR  
EXTENSION STAFF AND FARMERS



JUNE 2015





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## ACRONYMS

<b>EAAPP</b>	Eastern Africa Agricultural Productivity Programme
<b>FYM</b>	Farm Yard Manure
<b>IO</b>	Irrigators' Organization
<b>O&amp;M</b>	Operation and Maintenance
<b>PHRD</b>	Policy and Human Resource Development
<b>SRI</b>	System of Rice Intensification
<b>SWMRG</b>	Soil-Water Management Research Group
<b>URT</b>	United Republic of Tanzania
<b>FAOSTAT</b>	Food and Agriculture Organization Statistics



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## BACKGROUND

Rice (*Oryza sativa*) is an important cereal grown by small scale and large scale farmers as a food and cash crop in almost all regions of Tanzania. It is second to maize in terms of consumers' preferences. According to FAOSTAT (2008), Tanzania was reported to be the second largest producer of rice in Eastern, Central, and Southern Africa after Madagascar. In Tanzania, major rice production systems are lowland rainfed, irrigated and upland rainfed. Current average yield is estimated at 1.5-2.1 tons/ha, but yields as high as 5 tons/ha have been obtained in irrigated rice projects

Tanzania has a total irrigation development potential of 29.4 million hectares, of which 2.3 million hectares are classified as high potential, 4.8 million hectares as medium potential and 22.3 million hectares as low potential. Production and productivity in most irrigation schemes is generally low. For smallholder traditional rice cultivation, yields of 4.0 - 5.0 t/ha are realized in improved irrigation schemes (URT, 2009). The challenge is on how to raise crop production with restricted resources of land and water, finance, agricultural inputs and support services (URT, 2009).

It is a common cry in the world that water shortage is increasingly being recognized as a major constraint to improving the lives of the rural poor and is an important component of rural livelihood programs to be established in Southern Africa (SWMRG, 2005). Extensive irrigation during dry season dries up the rivers, thus disturbing ecosystems and wildlife. Rice being the crop having high water requirement, there is a need to search for alternative methods of reducing water requirement of rice without compromising with the yield. The System of Rice Intensification (SRI) is an emerging water saving technology, with many fold increase in crop yields (Laulanie, 1993). The practice is used as a coping strategy to climate change and variability and it has shown to save about 30%-50% of water (Tusekelege *et. al.*, 2014).

The System of Rice Intensification (SRI) is a package of practices especially developed to improve the production of rice with less water. In Tanzania, the yield levels from SRI ranges from 7.0 to 11.0 tons per ha. (Tusekelege et. al., 2014; Kahimba et al., 2014; Zacharia et al., 2013). The fact that SRI has been introduced recently probably around 2010, its spread has just started.

## INTRODUCTION

Rice yield is declining in Tanzania due to climate change and variability, abiotic and biotic stresses. This has caused food shortage to the increasing population at shrinkage land. Strategies to revert the situation are highly required. The use of SRI is one of the best farming approaches that aim at increasing rice productivity. The SRI uses young seedlings of 8-12 days old that leads to double yield per unit area due to nutrient use efficiency and increased number of effective tillers. The system also uses low seed rates and reduces conflicts over water use among irrigators. Adoption of SRI enhances rice productivity, but this will only be possible if there is clear understanding of conditions for successful SRI introduction, approaches and laid down principles. This is assured by following required steps for conducting SRI, sound scheme organization, minimizing pre-harvest, harvest and post harvest losses and adherence to storage and effective marketing channels.

In order to disseminate SRI practices and methodologies, training materials are required. Therefore, this training manual is aimed at providing an opportunity for extension staff and farmers who are working in irrigation schemes to learn and practice SRI principles and methodologies in order to increase rice production.

This manual is divided into five chapters. Chapter one provides the basic facts and principles of SRI including its characteristics. The advantages and disadvantages of SRI are also highlighted in this chapter. In Chapter two, the steps in implementing SRI are outlined while the management of SRI is given in chapter three. In Chapter four the conditions for successful implementation of SRI is presented while Chapter five discusses issues related to post-harvest management. Although this manual is intended for use by extension staff and farmers, however, it can also be used by training institutions.

# CHAPTER 1:

## UNDERSTANDING THE SYSTEM OF RICE INTENSIFICATION

This chapter explains the approach, concepts, principles, characteristics, advantages and disadvantages of SRI, so as to equip the trainees with the required knowledge for better implementation of this technology.

### 1.1 Approach

The SRI is an agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. The approach is based on the cropping principles of significantly reducing plant population, improving soil conditions and irrigation methods for root and plant development, and improving plant establishment methods.

### 1.2 Concepts and Principles

The concepts of SRI may also be considered as principles which are covered under this chapter. They include the very young seedlings at two leaf-stage, usually between 8 and 14 days old, handling carefully and quickly protecting the seedlings' roots and minimizing the transplanting shock (within 30 minutes), single plant per hill instead of 3-4 plants to avoid root competition, widely spaced to encourage greater root and canopy growth in a square grid pattern of 25cm x 25 cm and use of organic and/or inorganic fertilizers.

The SRI is guided by a set of principles which makes it unique from the conventional system of rice production. The following are the principles which have to be followed in order to obtain high benefits from SRI:

**Principle 1: Use of young seedlings between 8-14 days old (2 leaf stage)**

Seedlings with 2 leaves stage have great potential for profuse tillering and root development to achieve maximum yield potential of varieties.

**Principle 2: Adoption of wider spacing at 25 cm x 25 cm in a square grid pattern**

The field should be well puddled and leveled. After leveling the field, a wooden or steel marker can be used to make grids of 25 cm x 25 cm.

**Principle 3: Transplanting single seedling**

Single seedling has to be handled careful during transplanting. With wide spacing, single seedling can not suffer from competition of water, nutrient and light.

**Principle 4: Use of fertilizers**

Use of organic and/or inorganic fertilizers is recommended in SRI cultivation as they give better response and improve soil health. Application of FYM / compost before ploughing and incorporation into the soil is recommended. In case of short supply of organic fertilizers, supplementation by inorganic fertilizers may be adopted for better yields depending on soil test values at the time of preparation of the field.

**Principle 5: Alternating wetting and drying**

The SRI method does not require continuous flooding. Alternate wetting and drying method is recommended. The unsaturated soil encourages root development which enhances absorption of nutrients. Irrigate at a depth of 3-5 cm for 3 days to maintain soil moisture near saturation then dry the field for 6-10 days until soil cracks where next irrigation is applied. The irrigation intervals, however, vary with soil texture. Soils having low water holding capacity require frequent irrigation.

## **Principle 6: Weed Management**

Weeds can be controlled manually, application of herbicides, proper land preparation and use of mechanical weeders. The use of mechanical weeders such as push and rotary weeders in weed control is recommended. For better results, weeding is done by pushing and pulling the weeder when the field is temporarily flooded. In this way, weeds are incorporated into the soil which adds nutrients through decomposition. It also adds organic matter which improves soil condition (aeration, infiltration and enhanced microbial activities). The first weeding is done at 8-12 days after transplanting. Further weeding may be undertaken depending on the necessity at 10-12 days interval until crop produce panicles.

### **1.3 Characteristics of System of Rice Intensification**

The SRI as one of the current recommended technology in rice production has some important characteristics as mentioned below:

#### **High yield**

Rice yield in Tanzania under smallholder irrigation system averages from 4-5ton/ha. Improved rice varieties under conventional practice have shown yield potential ranging from 7-8ton/ha. However, the yield under SRI averages from 7-11ton/ha. The high yield is attributed to high tillering and more productive tillers.

#### **Water saving**

Wetting and drying method saves about 40% of water used under conventional method. Under the current climate change scenarios, water scarcity is projected to be a major challenge in irrigated agriculture. In this case, SRI technology becomes an adaptation option. Water crisis in irrigation schemes will also be reduced while putting more land under irrigation.

### **Quality of grain**

Young single seedling transplanted in a wide spacing benefits from growth factors like light, nutrients and water which results in optimal plant growth and big well filled grains.

### **Frequent weeding**

Rice production under continuous flooding system suppresses the growth of weeds. Therefore farmers use this technique opportunistically to reduce the frequency of weeding. In SRI on the other hand water is applied under alternate wetting and drying. This technique results in excessive weed growth which if not timely controlled may cause immense loss in yield. Frequent weeding is required preferably 3-4 times. To reduce high infestation of weeds the mechanical weeders or herbicides can be used. Although extra costs will be required, these are compensated by the high yield obtained.

## **1.4 Advantages and Disadvantages of SRI**

### ***1.4.1 Advantages of SRI***

Experience has shown that SRI has many advantages to the farmer and the environment. The advantages include:

- a) Low seed rate is used (about 5- 7 kg per ha) as compared to 30-45 kg per ha in conventional method. Also, cost of seed is reduced because small amount of seeds is used. This is because in SRI only single plant is used per hill while in conventional system 2-3 plants are used. Wide spacing also contributes to use of less seeds
- c) Plant and root growth is enhanced because soil is allowed to dry so as to enable many roots to emerge. This is because under SRI there is high nutrient use efficiency and enough roots aeration.
- d) Amount of water used is reduced by 40% -50%. Due to alternating drying and wetting, little water is used. Therefore



the saved water can be used for other purposes, such as water for livestock, domestic use and production of hydro-electric power.

- e) Reduced conflicts over water use among irrigators within the scheme as well as other water users.
- f) More tillers are produced; one seedling produces from 50-90 tillers per plant compared to 6-13 tillers for conventional method.
- g) High yielding ranges from 7-11 tons per ha compared to 4-5 tons per ha of conventional method (under potential irrigation schemes)
- h) SRI is an adaptation measure to climate change. This is due to the fact that future climate projection indicates that rainfall and runoff will reduce in some parts of the country leading to water scarcity. SRI is a practice that uses less water for production.
- i) SRI leads to early maturity due improvement of physical, chemical and biological soil conditions.
- j) SRI results into large grain size due to wider spacing which allows the plant to take more nutrients as compared to close spacing in conventional method.
- k) It increases biomass which can be used as livestock feed and/or ploughed under to increase soil nutrients.

#### ***1.4.2 Disadvantages of SRI***

The only disadvantage is that SRI requires frequent weeding (3-4 times). However, this is compensated with high yield and seed saving.

## CHAPTER 2:

# STEPS IN CONDUCTING SYSTEM OF RICE INTENSIFICATION

Rice production under SRI technology involves a number of steps which should be followed in order to be able to realize high production and productivity advocated in the use of the technology. This chapter highlights chronological steps that are involved in the implementation of SRI. The steps include proper seed selection and preparation, nursery preparation, land preparation, transplanting, weeding, fertilizer application and timely harvesting. Each of these steps contributes to the final goal of the SRI. The steps that are necessary for conducting SRI are included in this chapter so that the extension staff and farmers can understand and disseminate the technology.

The important steps to be undertaken are detailed below:

### **Step 1: Selection and preparation of quality viable seeds**

As far as SRI is concern seed should carefully be selected and prepared to obtain pure and quality seed for high germination percentage. The following issues need to be considered:

Obtained seeds from reliable source or farmers own seed

Put clean water in a bucket, half full;

Put a good fresh egg (chicken) in the water to check if it sinks then remove it;

Add table salt into the bucket and stir. Insert an egg to the solution and check whether it floats, if not remove an egg add more salt and stir more until you get a solution in which the egg floats. Stop adding the salt.

Put the rice in the solution, stir and leave it to settle;

Good seeds will sink to the bottom and the bad ones will float;

Remove the floating seeds and put them away (Plate 1);

The seeds that sink to the bottom are good and should be used for establishing the nursery;

Wash the good seeds by fresh water 3-5 times to remove salt;

Put the seeds in a bag that can pass air easily (e.g. gunny bag);

Soak the seeds in a container with water for 24 hours;

Remove the seeds from the water container and incubate them for 36-48 hrs depending on temperatures;

Sprouted seeds are taken to the nursery for sowing (Plate 2)



*Plate 1: Seed selection by egg and salt solution method*



*Plate 2: Sprouted seed ready for sowing in the nursery*

## **Step 2: Nursery plot preparation and management**

In nursery preparation the following issues need to be considered

Nursery should be prepared 2 weeks before sowing date using a hand hoe and a rake in an area free from shade and with well drained soil;

Three (3) raised beds of 3 m<sup>2</sup> (1m x 3m) can provide enough seedlings for 1,000 sq meters (quarter of an acre);

About 3-4 kg seeds are enough for establishing a nursery to cater for one (1) acre; (1kg/ 0.25 acre; 1.5-2 kg/0.5 acre; 6-8 kg/2 acres .... 15 -20 kg/ 5 acres)

Pre-germinated seeds are sown by broadcasting and followed by gently pressing in well puddled soils to ensure they will not be moved easily by water or subjected to birds' infestations;



Cover the bed with straw to prevent it from direct sun light and birds' infestations;

Apply water twice a day depending on soil moisture availability;

Remove the straw once the seeds have germinated.

The process of seedling preparation should be started while land for transplanting is being prepared;

On top of a plastic sheet, make a 2-3 cm thick seedbed of a mixture of soil and organic fertilizer or well dried fine manure, at a ratio of 1:1. The sheet prevents seedling roots from running too deep into the soil at the time of transplanting;

Sow the treated and pre-germinated seeds not too densely on the seed bed;

Spread organic fertilizer on the seed bed 2 days after sowing;

Spray organic pesticides if needed;

Wet the nursery as necessary. Do not flood, but just keep the soil moisture saturated;

Seedlings can be grown on plates, or banana leaves.

wet the nursery before uprooting the seedlings

### **Step 3: Land preparation**

It is important to prepare the land in a well leveled form for easy infield water management. The following points need to be considered.

Wet the field for easy ploughing and puddling

Level the field properly so that water can reach all areas

Spread appropriate amount of organic fertilizers (manure) or chemical fertilizers equivalent for the size of your field plot before the last harrowing;

For easy management of water, create ditches in the field to help drainage;





***Plate 3: Land leveling by using wooden board***

Divide the field using grids. This is achieved by raking the field using a specially fabricated rake to mark grids on the muddy surface;

Simple tools can be fabricated to suit the spacing that will be used and can consist of rakes (made from wooden, bamboo or metal frames) or ropes;

A wooden or metal frame is easier to use and gives better results in terms of straight lines;

Use 25cm x 25cm spacing. With wider spacing and a single plant per hill, plants get increased exposure to sunlight, air and nutrients, allowing profuse growth of roots and canopies. These in turn produce stronger stalks and more tillers than conventional paddy practice.

During grid making, the field should not have much standing water.

If the field does not hold the marking, it is a clear sign the soil is too wet and not ready for transplanting;

The soil water must be drained to make the soil appropriate for transplanting the seedlings.



***Plate 4:*** *Marking 25cm x 25cm transplanting grids in the field*

#### **Step 4: Transplanting**

Before transplanting, disassemble the seedbed and remove the seedlings;

Transplant at the age of 8 -14 days when the seedlings have two leaves;

Be careful not to damage the young roots;

Put the seedlings (with some soil still attached to the roots) on a plate or tray to make it easier to transport them to the field;

Plant one seedling per hill on the grid intersections marked on the field;

Plant seedlings at shallow depth, just 1 – 2 cm deep;

Slip the seedlings into the soil sideways so that the roots stay horizontally into the soil. Do not push the seedlings in from above as this may cause the root tips to point upwards from the soil, slowing down their growth.

Allow no more than 30 minutes between the uprooting of seedlings and their transplanting. It reduces mortality and stress on the young seedlings, and they will grow faster.



***Plate 5:*** A two-leaf seedling appropriate for transplanting



***Plate 6:*** Seedling transplanting



### **Step 5: Wetting and drying of the field**

Wetting and drying the fields use less water and improve soil aeration and promote roots elongation that allow more tillering and rapid growth of paddy plants. The following points need to be considered

As a start try a 6 to 10 day cycle. i.e., irrigate field and let it dry out for 6-10 days. This cycle can be modified based on soils and plant conditions; when the cracks are observed on the soils it is time to irrigate. You can determine visually when to irrigate depending on the size of the cracks that appear on the soil surface. The idea is to keep the soil moist and not saturated to allow air to get into the soil for the benefit of the roots and soil organisms;

Irrigation should be stopped 1-2 weeks before harvest for the field to dry and the plant to transfer maximum nutrients into the grains.

### **Step 6: Weeding**

In SRI the minimum use of water increases weed infestation that compete with rice for water, air, nutrients and light and hence timely weeding is needed. Field wetting and drying requires more weeding, especially at initial growth stages before full canopy development, than the common practice, as weeds tend to grow more rapidly under aerated soil conditions. The following issues need to be adhered.

Start weeding 10-12 days after transplanting;

Depending on how best the land was prepared, the intensity of weeds and type of weeds, weeding may be repeated 2 times every 10 days;

Spike-teethed rotary tools are recommended to manual weeding because this way, weeds are mixed into the soil as green manure. It also enhances the tith. For better performance, there should be sufficient moisture in the field to facilitate easy pushing while avoiding sticking of the soils on the weeder. Chemical spraying can also be used to control weeds.



**Plate 7:** *Cone weeder and Spike weeder*



**Plate 8:** *A rotary weeder*

### **Step 7: Fertilizer application**

The use of fertilizer is very important for attaining good and sustainable paddy yield. Both basal and top dressing fertilizers should be applied at recommended rates depending on soil fertility status. Generally, the most important nutrients for rice production are nitrogen and phosphorus applied at rates of 80 kg N/ha and 30-40 kg  $P_2O_5$ /ha respectively.

- Nitrogen fertilizers should be applied in two equal splits: at maximum tillering and at panicle initiation stages;
- Depending on availability, farmers can make use of as much organic fertilizers as possible as these tend to improve soil conditions for better crop growth ;
- However, farmers can use both organic fertilizers together with the chemical fertilizers if it is profitable;



*Plate 9: Fertilizer application*

## CHAPTER 3:

# SCHEME ORGANISATION UNDER SRI

In practicing the System of Rice Intensification farmers need to be organized into groups. The groups should consist of at least 20-30 farmers, selected among themselves under the guidance of Extension Officers in collaboration with village and Irrigators' Organization (IO) leaders. After formation of groups, some demonstration plots are laid in the fields of selected members and these serve as learning grounds for other farmers. These demonstrations are fora where farmers and trainers debate observations, share experiences and present new information from outside the community.

The IO is the overseer of all irrigation activities within the scheme. Sustainability of irrigation scheme depends on effectiveness of the IO leadership. The roles of IO under SRI include ensuring selection of suitable participants for demonstrations, making regular operation and maintenance of the irrigation infrastructure, collection of water use fees and ensuring equitable distribution of water to the selected demonstration sites. The IO is also responsible for liaising with individuals and institutions interested in developing irrigation.

### **3.1 Selection of group members**

Criteria for selection of group members are established and the respective extension officers lead the process of identifying group members. These criteria include activeness in paddy production, willingness to participate in group work, good relationship with others, willingness to learn and share experience. In establishing the groups it is important to ensure that both men and women are involved. However, deliberate efforts are needed to encourage women participation. Such efforts include:

Identification of women categories within the target group (for example married women, heads of households, widows and girls);

Scheduling and timing of meetings to match with women activities;

Where there is likelihood of men domination in electing group members in favour of men, the two gender groups should discuss separately so as to express their opinions freely.

### **3.2 Site selection**

Group members need to agree on a place where the SRI demonstrations are going to be established within the scheme. The criteria for site selection include: easy access to the scheme, assurance of water supply and drainage, soils with no salt problems and should be acceptable by all members.

### **3.3 Rules governing the group activities**

The participants should be members of IO and should abide to the rules and by-laws that established their organization. These rules include: payment of membership fees, participation in group activities and adherence to developed cropping calendar which makes water management easier. The rules and by-laws should be discussed thoroughly among the group members and failure to abide to them may lead to penalties.

### **3.4 Meetings**

There should be regular self organized group meetings. The frequency will be decided upon by members, to discuss various issues including:

- Planning meetings in collaboration with researchers and extension staff at the start of the crop season to discuss on resources needed and agree on activities to be conducted along the season;
- Progress of specific activities and exchange of experiences gained;

- Problems and possible solutions experienced in execution of the activities;
- Planning strategies for sharing new technologies with other farmers.

### **3.5 Dissemination and promotion of SRI**

As a strategy to up-scale the SRI technology, every group member is required to train at least five non participating farmers. In addition, there is a need for the group to link with other organizations, agencies and individuals in the immediate community who practice SRI for greater impact.

Information and knowledge sharing on SRI can be through the following path ways:

- Field visits among irrigators;
- Farmer field days;
- Participation in agricultural shows/exhibitions;
- Demonstration plots;
- Village meetings;
- Farmer to farmer training
- Media-print and electronic media

### **3.6 Monitoring and Evaluation**

The criteria for periodical monitoring and evaluation of group activities should be established. Groups have to decide what they want to monitor, how to do it and the results should be discussed among themselves. Monitoring should be related to the set objectives and its importance should be made clear to the group members.

One of the approaches to monitor group activities is through meetings. Activities can also be monitored through farmer field visits whereby group members get chance to learn how different operations were carried about and share experiences.

### **3.7 Operation and Maintenance of irrigation infrastructure**

The performance and sustainability of irrigation scheme depends to a great extent on the level of operation and maintenance of supportive infrastructure which include the weir, conveyance system and distribution system. The objective of regular operation and maintenance (O&M) include:

- Ensuring good working conditions of the irrigation infrastructure thus supplying required water for sustainable crop production;
- Increased production and productivity due to assured supply of adequate water to the crops;
- To minimize costs of maintenance / rehabilitation of irrigation infrastructure if otherwise left unattended for long time;
- To increase water use efficiency by avoiding water losses through seepage.

Proper and regular maintenance of irrigation infrastructure will avoid the risks of sabotage on infrastructures and ensure adequate supply of water to the fields.



**Plate 10:** *A well maintained irrigation infrastructure*



**Plate 11:** *A traditional unlined irrigation canal*



## CHAPTER 4:

# CONDITIONS FOR SUCCESSFUL SYSTEM OF RICE INTENSIFICATION

For successful implementation of the System of Rice Intensification, there are basic conditions that must be met. These include among others: reliable water supply for irrigation, irrigation infrastructure, functional irrigation institutions, training on SRI, labour availability, cooperation among farmers, and timely availability and use of farm inputs. These are discussed in details in the following sections

### **4.1 Reliable water source for irrigation**

The system of rice intensification (SRI) requires reliable water source throughout the season for growing paddy covering period from nursery preparation, sowing, transplanting, field management and finally harvesting. Water should be available and applied to the farm when the soil has formed cracks, a condition for appropriate time for supplying water to the crop. Reliable water source may be permanent river or water reserved in a dam to be used for successful crop production.

### **4.2 Functional irrigation infrastructure**

Irrigation infrastructure should be working properly to ensure the availability of water during SRI implementation. Important structures include headworks, main canal, secondary canals, tertiary canals and farm roads. Lining of main, secondary and tertiary canals including provision of water distribution structure is an important undertaking for increasing irrigation water productivity. A drainage system should also be included for draining excess water and salts from the field appropriately. Designing and construction of irrigation schemes should include farm roads for easy transportation of inputs and produce.



### **4.3 Functional Institutions**

In irrigation schemes farmers are organized into informal or formal IOs. The formal organization must have its own constitution and be registered under specific country law to attain legal entity. The constitution contains roles and responsibilities of organization members and leaders of which most important include operation and maintenance of the scheme. Rules and penalties are part of the constitution for proper running the organization. Agreed plans of action during annual general meeting should be followed by all members and those not abiding are penalized.

The informal IO form a majority of irrigations schemes sometimes known as irrigation water committees. These organizations are well recognized at particular community level although they have no formal written documents or constitution. Rules and regulations are made by members through meetings and should be followed by all members. Penalties are imposed to defaulters of agreed plans of action. These organizations are well established in many places in country including Kilimanjaro where they are known as “mfongo system” by the Chagga and “ndiva system” by the Pare. Therefore functional IO is necessary for successful SRI practices that require close cooperation among farmers. Through such organization cropping calendar advocates practicing SRI principles can easily be planned and adopted by all famers.

### **4.4 Training**

Since SRI is a new approach in rice production countrywide, there is a need to conduct training to all key actors in irrigated rice production especially extension staff and farmers to ensure that all principles and practices of SRI are understood and followed by practitioners.

### **4.5 Labour**

There is relatively higher labour demand under SRI compared to conventional rice production systems. This is because the drying and

wetting practice under SRI encourages the growth of weeds. However, this challenge of labour demand can be minimized by use of mechanical push or rotary weeders, herbicides and good land preparation.

#### **4.6 Cooperation of farmers in field operations**

The SRI requires wetting and drying of the field unlike conventional rice cultivation where majority of farmers maintain flood water in their paddy plots. Success in maintaining SRI growing environment of wetting and drying period will require joint cooperation in timing water supply among adjacent farmers in the scheme sharing same field canal. This system also needs shared plan and commitment by farmers for smooth operation of various farm operations like land preparation, nursery preparation, and transplanting. Moreover, adoption of the practice is influenced by external factors like availability of inputs such as fertilizers in timely manner. Ordering of inputs through farmers' groups or having an input supply stockist stationed within the scheme area ensures timely supply of inputs.

## CHAPTER 5:

# PRE AND POST-HARVEST HANDLING AND STORAGE

Grains may be lost in the pre-harvest, harvest and post-harvest stages. Pre-harvest losses occur before the process of harvesting begins, and may be due to insects, birds, weeds and rusts. Harvest losses occur between the beginning and completion of harvesting, and are primarily caused by losses due to shattering.

Post-harvest losses do occur between harvest and the moment of human consumption. They include on-farm losses, during threshing, winnowing and drying, as well as losses along the chain at transportation, storage and processing. Important in many developing countries, particularly in Africa, are on-farm losses during storage, when the grain is being stored for consumption or while the farmer awaits a selling opportunity or a rise in prices.

### 5.1 Pre and Post-harvest Management

In Tanzania the issue of pre and post-harvest management is critical due to associated inadequate technologies leading to high crop losses. The losses are still high despite the various efforts to reduce them.

The postharvest loss for rice is estimated to be 30-40% each year (NAS. 1978). Losses occur during harvesting, threshing, pre-drying/drying, pre-processing/processing, transportation and storage. Major factors causing losses include temperature, moisture, pests, spillage during handling, transportation and in storage. To reduce pre and postharvest losses the following measures are recommended:

- At maturity of rice proper water management is required not to allow wetting the paddy as it will rot

- Timely harvesting
- Use improved technologies such as combine harvesters, threshers, winnowers and milling machines that are properly adjusted to avoid wastage.
- Drying paddy as soon as possible after harvesting (possibly within 24hrs)
- Avoid over drying of paddy before milling
- Ensure uniformity in drying of paddy grain
- In every stages of processing adhere to cleanliness as dirty paddy may not fetch good price or rejected
- Use of quality packaging materials
- In transporting paddy consider using appropriate transport that do not allow losses.
- Storage in improved storage structures like metallic silos

## **5.2 Steps in Postharvest management system**

The following are the steps in post-harvest management:

### **Harvesting**

Proper harvesting include preparation of the following: Harvesting tool/machines, threshing and drying space, packaging materials and means of transport.

Ensure the crop has reached the required maturity (80-85%) of grains in the panicle have turned brown.

Harvesting can be done manually or by use of combine harvester which can cut paddy panicles, threshing and bagging.



**Plate 12:** *Manual harvesting*



**Plate 13:** *Harvesting using a combine harvester*

### **Threshing**

Remove paddy grains from the panicles.

### **Cleaning**

Make sure the paddy grains are free from any impurities like sand, dust and paddy leaves.

### **Drying**

Dry paddy to the recommended moisture content (13 - 14%)

### **Packaging/Bagging**

It is recommended to pack paddy in 80kg sack.

### **Transportation**

Transportation from the farm should be done as soon as possible to avoid damage from pest's invasion, rotting due to moisture, theft and rain.

### **Storage**

Storage facility should consist of structure which is well ventilated. It should be free from moisture and pest while maintaining capacity to store paddy with easy means of inspection. Common improved storage facilities include reed granaries (*Vihenge*), silo and sacks.

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