CROP PROTECTION PROGRAMME

ON-FARM VERIFICATION AND PROMOTION OF GREEN MANURE FOR ENHANCING UPLAND RICE PRODUCTIVITY ON STRIGA INFESTED FIELDS IN TANZANIA

WORKSHOPS FOR TRAINING OF TRAINERS (TOT)

Matombo and Kyela 9 – 19 July, 2005

Project No. R8436

Working paper No. 10

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WORKSHOPS FOR TRAINING OF TRAINERS HELD IN MATOMBO AND KYELA

TRAINING OF TRAINERS - MATOMBO

1.0 Background:
The project titled "On-farm verification and promotion of green manure for enhancing upland rice productivity on *Striga* infested fields in Tanzania" has been operating in two Districts, Morogoro rural and Kyela. The objective of the project was to verify and promote the use of green manure to improve soil fertility and control *Striga* in low fertile *Striga* infested soils. Thirteen villages are covered by the project in these two Districts, 8 villages in Kyela and 5 villages in Morogoro rural. Primary schools were also involved with the purpose of out-scaling the technology these included 15 schools in Kyela and 6 in Morogoro rural district. In order to ensure sustainability of the technology a training of trainer's workshop was conducted in both Districts where Researchers, farmers, Extension officers, Teachers, Ward Secretaries and Ward executive officers participated

The training of trainers for Matombo Division was carried out at Mtamba from 9-12 July 2005. The purpose of the workshop was to train various stakeholders on the topics of improving crop productivity in general and Striga control in particular. The participants included farmers, extension workers, teachers and some division heads. These stakeholders were actively involved in the research to control Striga in Matombo division. The workshop was facilitated by A.M. Mbwaga (the team leader of the project), A. Moshi, J.P. Hella. G.J. Ley and Patrick Lameck. The list of participants is as presented in Appendix 1 while the programme is shown in Appendix 2.

2. Opening speech
The Division Secretary, Ms Grace S. Timothy, opened the workshop. She thanked the team leader for organizing this workshop. She also thanked the participants for attending the workshop. She urged them to actively participate in the workshop by being attentive and involved in the discussions so that they will be able to impart the knowledge to other stakeholders in Matombo.

3. Methodology for the training
The training was conducted in two parts. First the facilitators presented the various topics as shown in Appendix 2. The participants were then divided into four groups and each group was assigned one topic for preparation and presentation during the plenary session. This simulated what they will be doing when they return to their respective areas.

3.1 Facilitators' presentations

3.1.1 The Economic importance of Striga in Tanzania (A.M. Mbwaga)

Introduction: Striga is one of the more important constraint to cereal production in Tanzania and the whole of Africa below the Sahara
Economic important Striga species in Tanzania:
Striga hermonthica
Striga asiatica
Striga forbesii
Biology of Striga: most of the damage occurs underground, produces numerous seeds, remain viable in the soil for 15 – 20 years.

Spread: Ecology
Striga hermonthica occurs from Igunga towards the Lake Victoria i.e. Shinyanga, Mwanza, Mara.
Striga asiatica: from Tanga down to Mtwara, the most spread species.
Striga forbesii: occurs in Morogoro, Coast and Kyela.

Crops affected: Maize, sorghum upland rice, finger millet and sugarcane.
Effect on the crop:
Stunted growth,
Plant yellowing of the leaves
yield loss 40 – 90% and severely infested field up to 100%.

Local names for Striga
Sani - Luguru - sani
Kyumika - Nyakyusa

Spread
Through wind, seed, materials, implements
Control measures undertaken by farmers:
uproot, local medicine (witchcraft)
leave land fallow
shifting cultivation
grow crops like cassava

Control measures
Hand weeding/uprooting and burn
intercrop with legumes
harvest Striga free seeds
use resistant varieties
use of fertilizer – organic/inorganic
use of herbicide 2 – 40
crop rotation with legumes

3.1.2 **Soil fertility improvement (G.J. Ley)**

A number of soil fertility aspects were taught during the training of trainers at Matombo. These include:

- Reasons for soil fertility decline
- Effects of soil fertility decline
- Components of soil fertility
- Plant nutrients that control soil fertility
- Sources of plant nutrients
- Importance soil analysis

The major reasons identified for the decline of soil fertility included:

- Increased frequency of cultivation of annual crops (land scarcity due to increasing population)
- Limited use of fertilizers of all types

The effects of decline in soil fertility were listed as follows:

- Low maize yields of 1 to 5 bags per acre now, as compared to over 30 bags in living memory
- Increase in Striga infestation

Components of soil fertility were listed as follows:

- Soil depth
- Soil structure
- Soil pH
- Nutrient content
- Storage capacity
- Organic matter content
- Presence of fauna and flora
- Content of toxic substances

Plant nutrients that control soil fertility were explained in three parts:

- Carbon, hydrogen, oxygen from the air and water
- Macronutrients from the soil: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg).
- Micronutrients from the soil: Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Molybdenum (Mo), Boron (Bo), Chlorine (Cl), and Cobalt (Co).

The following sources of plant nutrients were explained:

- Inorganic fertilizers: solid, liquid. A number of nitrogen, phosphorus, potassium and combinations of these fertilizers were presented to the participants. The common fertilizers found in Tanzania include Urea, Triple Super-phosphate (TSP), Di-ammonium Phosphate (DAP), Muriate of Potash and some multinutrient fertilizers (NP, NK, PK, NPK)
- Organic fertilizers: farmyard manure, compost, mulch, green manures and legumes

What do farmers do about soil fertility?

- Inter-crop maize with legumes e.g. cowpeas
- Crop rotation maize followed by legumes (e.g. cowpea)
- Fallowing -only short fallow period possible because of limited land;
- Use of manure or compost - less than 5% farmers use on limited areas only
- Chemical fertilizers - extremely rare due to cost and unavailability at village level

Restoring soil fertility by planting green manure legumes
Participants were informed that growing legumes that produce large yields of biomass (foliage and roots) containing nitrogen in rotation with maize or rice can increase soil fertility and following maize or rice yields;
Options shown to grow well at Matombo:
Pigeon pea
Mucuna
Crotalaria (marejea)

3.1.3 Economic benefits of using Crotalaria and pigeon pea in crop rotation
(J.P. Hella-SUA)

The participants were taught to identify the resources they use for crop production. These included land, human, inputs and leadership. They were reminded that generally resources are limited in all production systems. Many examples were given to demonstrate the use of scarce resources in order to derive maximum benefits. In a participatory manner the trainers then undertook the cost analysis of producing rice/maize using two production systems:

- Crotalaria-rice/maize
- Rice/maize-rice/maize

1The analysis showed the system.; this legume in rotation with cereals was the most profitable in the long run. This was a surprise to many participants because of a loss of an edible crop in the season of planting Crotalaria.

3.1.4 Improved Maize Varieties for Lowland and Mid-altitude Areas
(A. Moshi-ARI Ilonga)

Definition of seed: Part of a plant with particular genetic qualities which is saved and planted in subsequent seasons in order to propagate the plant.

Qualities of improved seed:

- plants of improved seed are not easily attacked by insects or diseases, do not lodge easily,
- are drought resistant/tolerant, are early maturing, or have qualities liked by consumers e.g.
- improved seed results in high yield, and is easy to produce.

Improved Maize Varieties for the Matombo Area:
Areas of maize production are divided into;
Mid-altitude areas: (900 – 1500 m above sea level)
Kilima ST

- Matures in 135 – 140 days from germination
- tolerates maize streak virus disease (msvd)
- has good standability
- has white grain which are a mixture of dent and flint types
- has a hard endosperm
- can produce 5.0 – 5.5 t/ha (20 – 22 bags/acre) under good management.

Lowland Areas (0 – 900 m above sea-level)
Full season varieties:
STAHA

- flowers 62 days after germination
- matures in 120 days
- its grain is white and is a mixture of flint and dent types
- Tolerates maize streak virus disease
- its cobs have good husk cover
- has good standability
- can yield 4.5 – 5.0 t/ha (18 – 20 bags/acre) in a well managed field.

TUXPENO

- reaches 50% flowering 52 days after emergency

- matures in 120 days
- has very good standability
- its grain is dent
- can yield 16 – 18 bags/acre (4.0 – 4.5 t/ha) under good management

CH1 - is a single cross hybrid

- matures in 120 days
- is tolerant to msvd
- its grain is white and
- dent in type
- can yield 5.0 – 5.5 t/ha (20 – 22 bags/acre) under good management.

Medium maturing varieties

TMV-1

- reaches 50% flowering in 55 days
- matures in 110 days
- its grain is white and flint
- is resistant to msvd
- its grain is good for roasting
- is suitable for planting during the short rainy season, and in the long rainy season by farmers who are late in planting the full season varieties
- is suitable for planting in valleys on residual moistures after harvesting rice
- can yield 4.5 – 5.0 tons/ha (20 bags of shelled grain per ha).

STUKA-M1

- reaches 50% flowering in 52 days
- matures in 105 days
- its grain is white
- is moderately resistant to leaf rust, msvd and leaf blight
- is tolerant to drought and low soil fertility
- It can produce 3 – 4 tons/ha (12 – 16 bags)

Early maturing varieties

Kito ST

- reaches 50% flowering in 46 days
- matures in 90 days
- has shiny white flinty grain
- can be planted in the vuli season
- can produce 3.5 – 4.5 tons/ha (14 – 18 bags/acre).

Katumani ST

- reaches 50% flowering in 48 days and
- matures in 90 days
- its grain is white
- is suitable for planting during the vuli season or in the masika season when a farmer is late in planting his full season variety.
- Can yield 3.0 – 4.0 t/ha (12 – 16 bags/a) in a well managed field.

Reasons why a farmer decides to use improved seed
Use of improved seed for the first time
Many farmers have been using unimproved low yielding varieties. A farmer decides to start using improved seed after he/she is convinced that the improved variety has better qualities compared to his local variety.

A farmer who has already started to use an improved variety may switch to using another improved variety if he/she is convinced that the new variety is superior to the variety he/she adopted earlier.

When a farmer is convinced that the variety he/she has used for several seasons is adulterated, he/she seeks a fresh lot of the improved variety from seed stockiest.

Sources of improved seed
Purchasing certified seed from seed stockiest
Selecting seed of open-pollinated varieties from his/her own field (seed recycling).

How to select seed from one's field
A farmer may select seed from his field for planting in the subsequent season. This applies to open pollinated varieties (not hybrid varieties). The farmer should select cobs for seed from plants which are not lodged and diseased. Such cobs should be stored in a place different from where milling maize is stored. Maize cobs for seed should be chosen from the centre of the field to minimize the chances of saving seed from plants which may have been contaminated with pollen from maize varieties planted by his/her neighbours. It is recommended that after 2 – 3 seasons, a farmer should buy fresh certified seed of his variety and start a fresh to save seed from his/her own field.

3.1.5 Rain Water Harvesting
(P. Lameck – INADES Dodoma)

Concepts and Principles
Concept and Rationale
RWH is the process of collecting rainfall run off for its productive use
It is a system by which rainfall runoff is induced, collected, stored and used for its productive purposes

Due to continued drought resulting from environmental destruction, rainfall amount reaching the root zone of crops grown does not meet the crop water requirements (ETcrop).

ETcrop is the amount of rainfall required by a disease free crop from germination to crop maturity. Each crop has its own ETcrop. For instance maize (to dry grains) requires an average of 750 mm of rainfall to grow well to maturity. Most of the water is required at the booting stage as it is the time for grain filling on the cobs. For sorghum and millet the ETcrop is about 400 to 500 mm on average.

This calls for coming up with mitigation strategy of ensuring required amount of rainwater which reaches the root zone for better growth of crops. Among the many techniques RWH is one of them.

The principle:

Harvested Rain Water (RWHted)	=	Crop Water Requirements (ETcrop)	-	Annual Rainfall Ran.

There fore in short it can be written thus

$$\mathbf{RWHted = ETcrop - Ran}$$

From the principle it can easily be determined how much water Dodoma farmers need to harvest if they are to grow maize thus

Data input

- ETcrop for maize is 750 mm
- Ran for Dodoma is 500 mm

Therefore RWHted = 750 – 500 mm
= 250 mm.

This means that if Dodoma farmer don't harvest water he/she will harvest poor crop of even not harvesting at all.

Components of a RWH system for crop production

The RWH system has three main parts;

i. Catchment Area (Ca)

This is an area where runoff is induced and collected. Can be of a natural characteristics or artificial one (sketch no 1).

ii. Storage area

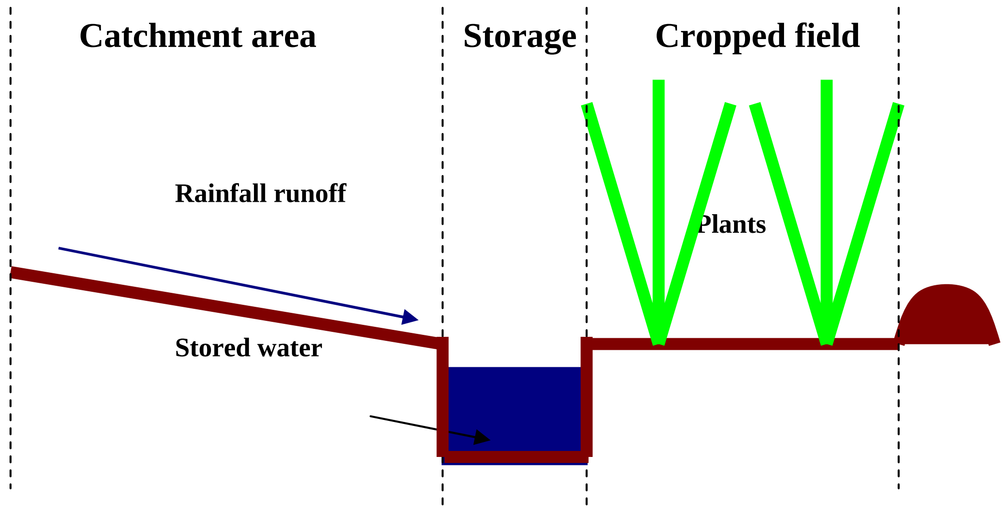
This is an area or place where rainfall runoff is stored before use. This can be a tank of any type and design or simply a soil onto which crop is grown

iii. Cropped field (Cf)

This is an area where harvested rain water is being used for crop production.

From the principle above, for Matombo farmers it was learned that the Average rainfall amount per annual is about 1500 mm. If you divide this

Sketch no 1
Components of RWH System



into the two seasons, the short one having about 700mm and the long one having about 800 mm it was realized that it is just enough rainfall to harvest maize. Instead farmer in the area think that rainfall is not enough.

After reflection it was realized that. The problem was not the rainfall amount but it was poor management of the available rainfall where greater amount of rain water is lost as runoff from farmer plots

Sharing of RWH experiences

Farmers wanted to understand why they are mismanaging their land. The following drawing was presented and discussed by comparing two farmers; one from Dodoma region (sketch no 2) where average rainfall is 500 mm and one from Matombo (sketch no 3) with average rainfall of 800 mm.
From the sketches, one can trace course of events from the moment rain drop touches the ground. Where there are RWH system water is cached for productive use where as where no RWH system all the water is lost as runoff causing floods and other destructions such as eroding the land, creating gullies and some time claim human life.

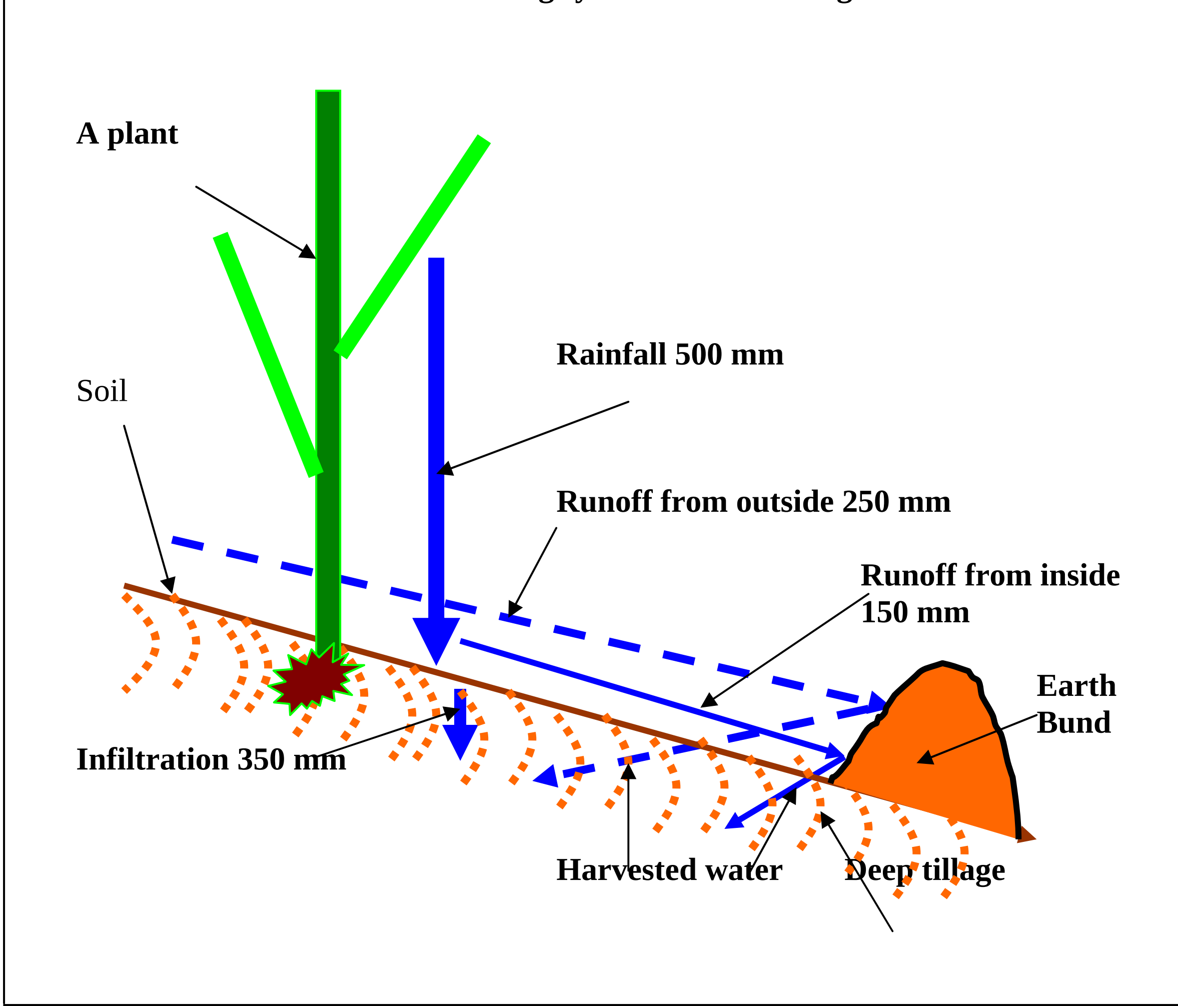
Example of a Dodoma farmer who harvest rainwater

If you trace rain fall here you will see it falls on the catchment's area amounting 500 mm. (for the whole season). In touching the ground it finds it deep tilled hence large amount about 350 mm of rains infiltrates into the soil root zone. The remaining 150 is converted into runoff and start flowing from the cropped field, but down stream it encounters a constructed earth-bund as a result it is directed back again into the cropped field. There is also another runoff coming from external catchment that is again directed back to the cropped field by the downstream earth bunds. So although Dodoma gets average rainfall of 500mm, the cropped field ends up with;

- Infiltration 350 mm
- Harvested from the plot 150 mm
- Harvested outside the plot 250.mm

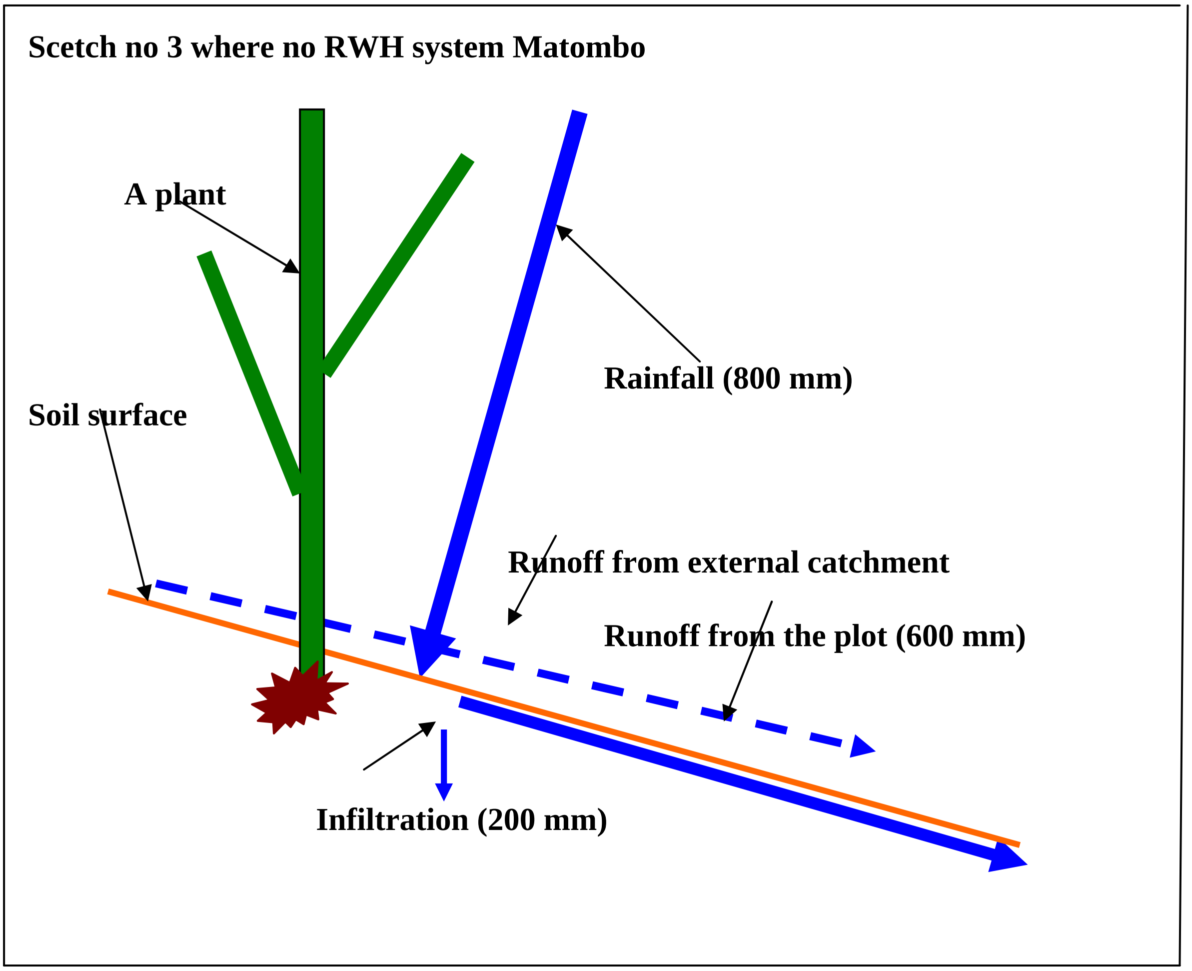
Total 750 mm which is ETcrop for maize

Sketch no 2. Rain water harvesting systems Dodoma Region.



What has helped this 750 mm crop water requirement for maize to be achieved is simply **deep tillage** and **contour bund** constructed down stream of cropped field. Many farmers in maize growing area consider deep tillage and contour bund construction as a punishment.

An example of a Matombo farmer who is not harvesting rainwater



From the sketch no.3 it can easily be observed that the falling rainfall of 800 mm finds a non deep tillage ground, only small amount of rainfall 200 mm infiltrates leaving the rest 600 mm to flow out of the cropped field. On top of this there is no even a contour bun hence all the water is lost down stream to rivers and ultimately to the ocean.

Sharing of various RWH systems

These include:

Deep tillage

As seen from sketch no 2 deep tillage, loosen the soil thus increasing pore spaces to increase amount of water retained in the soil root zone. By deep tillage farmers have been able to increase yield two times (from average of 3 bags to 6 bags of grain maize per acre).

However it was explained that when using tractor, the layer bellow the ploughed depth is compacted thus creates a hard pan. This hard pan obstructs roots development and caused ponding effect resulting into poor crop performance. Thus at least after three years areas under tractor ploughing need to be sub-soiled. Where no tractor, magole riper is an alternative.

Contour terracing
Involves use of bench terraces. In such an area there will be no slope hence no runoff. This ensures all the falling rain to remain and infiltrate into the soil root zone for crop production.

Use of green manure
Green manure loosed soil particles increasing soil pore spaces to harvest/retain more water for improved crop production. The leguminous green manure also increases soil fertility and reduce Striga infestation.

Making contour bunds/ridges
The contour bunds or ridges help to stop runoff water to have more **opportunity time** to infiltrate into the soil root zone for increased crop production.

Making of tie ridges
Tie ridges ensure rainwater not to escape from cropped field hence remain into the soil root zone for crop water requirements.

Constructing Dams
This has been a practice in many dry areas where a large dam is constructed across a narrow depression/catchment to stop and store flowing water and runoffs for longer period. This water can be used for many other productive uses.

Planting (Chololo pits)
This involves making a small pit of 9 inches (23 cm) deep and 9 inches diameter during dry season. During on set seed are sown into the pit and cover only by one inch (2.54 cm) layer of soil. The remaining 8 inches are for harvesting rainwater. This technique was innovated by a farmer called Keneth Sangura living in Chololo village - Dodoma.

Trench cultivation
In this system, trenches of 60 cm deep by 60 cm bottom wide are dug across a slope in the fields. The trenches are spaced 60 cm from each other. The trenches are then filled with crop remains and any organic matter one can reach. Then part of the excavated soil is used to cover these chaffs. Seeds are then sown into the soil covering the chaffs. When rain falls produced run off is trapped into these trenches and stays there for long time for production. A good crop and some times a relay crop is harvested when rains are not very poor. This system was innovated by Albert Mhembano of Ilolo Village Dodoma rural district.

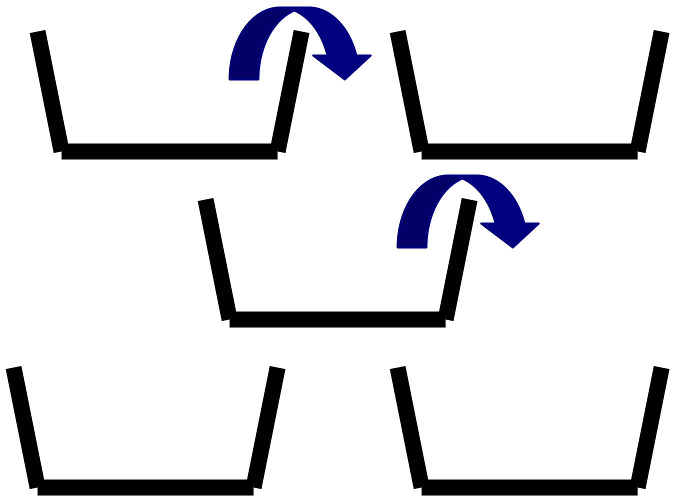
Caag of Somalia
This involves making trapezoidal bunds such that when water fills up the upstream basin, flows into next downstream basin. This continues until the bottom most basin and the excess water is allowed to flow harmlessly down the slop. In this system water is allowed to flow gently along the field thus attain more opportunity time to infiltrate into the root zone for crop water requirements. This works well in Somalia where annual rainfall can be as low as 127 mm. In Kisangara, where Sokoine University of Agriculture was conducting RWH research, the adjacent gully to this system disappeared after 3 years as most of runoff was checked by this caag system.

Make and use compost

Compost from locally available organic matter, improves soil structure by loosening most compact soils or reducing the meso-pores of sandy soils for increased water retention capacity of the soils to improve crop production.

Trapezoidal bunds
This is simply constructing contour buds down stream of the plot and wings on either side. When rain falls and resulting runoff flows it will be prevented by this bund not to go outside the plots until it overflows upstream the wings and goes down to the bottom trapezoidal bund.

See diagram



Findings from the workshop

After reflecting from the concept, it was realized most of the techniques were familiar to the farmers only that the concept of water harvesting was lacking among them. They thought on cannot add moisture from rainfall.
The participants admitted that training of contour buds as well as deep tillage has been offered since colonial times but none adopted. Some thought that may be they were introduced in a top down manner.

Participants also identified that, the soil it self is a storage of rainfall runoff.

Participants also realized that, there are so many ways of harvesting rain water and that each can come up with his/her own way. What is important is to stop water to have time to be stored into soil root zone.

3.2 Group work

The participants were divided into four groups. Each group was assigned to discuss and present one topic as follows:

- Teachers (Hussein Lugazo, Gabriel Mkumbo, Amos Fabian): **the management, biology and ecology of striga**
- Farmers (Twaibu Abdul Niga, V. Msawanga, Prisca Dimoso, Osward Tadei, Valaleia Lui, Paulo Mathew, Josephine Amos, Kunambi Moris): **use of fertilizers and the benefits of green manures in crop rotation**

- Extension agents (Sudi Msonjwa, H. Malila, H kisumo): **use of improved maize seed**
- Administrators (Grace S. Timothy, Jotham Sanga, Evelyne A.B. Msangya, Emiliana Kishinda, Bulilo Masatu): **rain water harvesting**

Each group then presented their topic in the plenary. Each presentation was judged by all participants for its clarity, effective use of teaching materials and content. The groups were advised accordingly on areas they can improve in their presentations.

4. Way forward

Table 1 shows how the participants planned to extend and share knowledge at Matombo. They also agreed to monitor and evaluate progress and report as follows:

- DEO to report on the 30^{th} of every month
- WEO to report on the 25^{th} of every month
- VEO to report on the 20^{th} of every month
- FRG to report on the 10^{th} of every month

Copies of these reports will be distributed to SUA, ARI-Ilonga/ARI-Mlingano and INADES. It was agreed that Agriculture and Education Departments should form an executing committee and report to DED.

Table 1. Methods to extend and share knowledge of Striga control at Matombo.

Topics for training	Village (VEO)	Ward (WEO)	Division (DEO)	District
• Management, biology and ecology of striga • Use of fertilizers • Use of improved maize varieties • Rainwater harvesting	Through FRGs	Through Ward Development Committee (WDC) meetings by some participants of this workshop who are members	Through Division Development Committees (DDC)	DALDO to organize seminars for project groups e.g. PADEP
	Through school committees	WDC to form a small sub-committee to follow-up on issues	DDC to form a small sub-committee to follow-up on issues	Through farmers' day
	Through pupils in village meetings and parents' days	Through village meetings by participants of this workshop	Through monthly Division School Coordinators	DEO (District Education Officer) to organize seminars for Ward Education Officers, head-teachers and agricultural teachers

	Village leaders through village meetings	Head-teachers' and all teachers meetings	Head-teachers' and all teachers meetings	DALDO and DEO can organize the above seminars jointly to minimize costs
	Through extension agents	Through schools' competitions	Through meetings organized by agricultural school teachers	
		Maarifa ya jamii/stadi za kazi	Maarifa ya jamii/stadi za kazi	

Kyela (15TH – 19TH AUGUST 2005)

2.0 Background:
The project titled "On-farm verification and promotion of green manure for enhancing upland rice productivity on *Striga* infested fields in Tanzania" has been operating in two Districts, Morogoro rural and Kyela. The objective of the project was to verify and promote the use of green manure to improve soil fertility and control *Striga* in low fertile *Striga* infested soils. Thirteen villages are covered by the project in these two Districts, 8 villages in Kyela and 5 villages in Morogoro rural. Primary schools were also involved with the purpose of out-scaling the technology these included 15 schools in Kyela and 6 in Morogoro rural district. In order to ensure sustainability of the technology a training of trainer's workshop was conducted in both Districts where Researchers, farmers, Extension officers, Teachers, Ward Secretaries and Ward executive officers participated.

2.0 Objectives:
To empower workshop participants with the knowledge on the use of green manure to increase soil fertility and control Striga.
To ensure the sustainability of the activities when the project comes to the end. This was done by conducting training of trainer's workshop, and to supply them with teaching materials to be used for training in the field.

OPENING SPEECH
S.P. Linuma
District Executive Director (DED) - Kyela

Dear,
Ward Secretaries
Ward executive Officers
Agriculture Extension Officers
Education coordinators
Farmers
Workshop facilitators
Ladies and Gentlemen

May I take this opportunity to thank you for preparing this workshop for we people of Kyela. The combination of participants will enable others outside the workshop to access the message obtained in the workshop. This will make them put much effort on their daily activities related to Marejea technology in their fields.

Second, I would like to thank the facilitators of this workshop for appointing me to make my few remarks as an opening to this workshop.

Dear Participants and facilitators; Agriculture is the mother sector in this District like other Districts in the country. More than 80% of the residents of this District depend directly on this sector for their livelihood. These are the people who are living in the villages and who have poor resources cannot meet their basic needs leave alone investing. I have given this introduction so that each one of us understands the task ahead of us in relation to surplus production in agriculture if we real want to alleviate poverty.

Dear participants from Kyela, the results the improvement of soil fertility and control of *Striga,* have shown a great success which I have personally observed in the fields. To remind you a few

a. The fertility in fields planted with Marejea has improved.
b. Marejea reduces *Striga* infestation by putting in rotation with cereals.
c. The use of Marejea has improved rice production greatly
D. It is very cheap source of fertilizer, which each farmer can afford

A Major task ahead of us is to make sure that the knowledge gained here in these five days should be used to increase Agriculture production.

I know that the task is hard to be full filed but I believe the facilitators in this workshop will provide you with new strategies that will make farmers in our areas to understand why we want them to use the technology of Marejea.

May I emphasize the poor production in agriculture sector affects greatly performances of other sectors. People can not contribute to the development leaving aside good health which is important for their daily activities. Pupils can't concentrate in their classes because of hunger. How many pupils are coming from farmers households, therefore this technology must be given a due profile.

Dear participants this project enable farmers to form Farmer groups, as trainers you have also to follow the same procedure in order to reach many farmers in the community. It is important to have good plans, good strategies that will enable you to complete the task and we can be able to evaluate performance/out put of your work.

May I take this opportunity to remind you about the spread of HIV/AIDS. Take care of yourself and wherever you will be teaching the technology please remind your audience about HIV/AIDS

After this note, I officially declare the workshop opened. Thank you for listening

4. 0: PRESENTATIONS AND DISCUSSIONS

4.1 PROBLEM OF *Striga* IN TANZANIA

A.M. Mbwaga

Striga infestation is a very big problem in countries south of Sahara. In Tanzania, almost all regions are under infestation of this parasitic weed. There are different species of Striga in Tanzania and these include

1. *Striga hermonthica* – Spreading in Mwanza Tabora, Mara, Shinyaga
2. *Striga asiatica* – Spreading starting from Mwanza to Mtwara and Coast to Lake Tanganyika'
3. *Striga forbesii* – Found in Coast, Morogoro and Mbeya (Kyela) regions

There is another parasitic weed infesting low land flooded rice in Kyela called *Ramphicarpa fistulosa* or Mbosyo in Kinyakyusa. This weed belongs to Scrophulariacea family the same as *Striga species.*

In Tanzania *Striga,* affect the following crops upland rice, maize, sorghum, finger millet and sugar cane. In the absence of cereal crops *Striga* is observed infesting some grasses in the fallow fields and sometimes it is seen in football pitches.

Striga has many effects to the crops including the following

1. Stunted growth
2. Poor formation of seed e.g. few and short panicles
3. Wilting of the plants
4. Yellowing of the plants in the field

Traditionally farmers use Striga for the following purposes ornamental plants, as local medicine for curing chest pains and wounds and sometimes to scare witches in homesteads

The Biology of *Striga*

In order to control *Striga* in our field it is important to know its life cycle. *Striga* can have 400 –500 seed in a capsule depending on the species and the growth conditions. The seeds fall on the soil waiting for the host. In order to germinate *Striga* seeds need to be supplied with germination stimulant that is produced by the host plant. Then *Striga* seed germinate and attach themselves to the roots of the host plant and start feeding by extracting nutrients, water and minerals through its haustorium. In the field *Striga* spreads through animals, wind and rainwater. Other means of spread are crop seeds harvested from *Striga* infested fields and farm implements like ploughs, hoes used during land cultivation.

Exercise 1:

If one stem of sorghum is attacked by 100 *Striga* plants and if a plant of *Striga* has 50 capsules that contain400 seed what will be the number of seed in a season per sorghum plant?

Calculations:

Number of *Striga* plants 100
Number of Capsules per plant 50 x 100 = 5000
Number of seeds per Striga plant 400 x 5000 = 2,000,000
In one season, one sorghum plant can enable 2,000,000 Striga seed to be produced. These seeds can remain viable for 15 to 20 years and the more they stay in the soil the more they become effective in attacking the host.

***Striga* control measures**

Indigenous control measure in Kyela included hand weeding, hoeing, rotation of cereals with cassava and fallowing

Control measures

What is the right stage of growth can we start to control *Striga?*
Striga control in the field starts when the plants emerge on the soil surface before seed setting. There are a number of control measures including the following

- Weeding - This is done to avoid seeding but the destruction to the crop is not avoided. On the other hand, hand weeding is not feasible due to size of the *Striga* plants it is too short to weed.

- Intercropping - Where intercropping is practiced, there is a reduction of infestation due to creation of microclimate unfavorable for *Striga* growth and development. If intercropping involves legumes, there chances of improving soil fertility at the same time legumes behave as trap crops.

- Resistant varieties - The use of resistant varieties like Wahi and Hakika sorghum varieties, and Mwangulu rice variety.

- Use of clean seeds

- Application of herbicides like 2,4–D can be done after the emergence of *Striga* in the field like in hand weeding the destruction to the crop is not avoided

- Crop rotation – When legumes are rotated with cereals *Striga* is reduced by improvement of soil fertility and reduction of *Striga* seed population in the soil due to legumes behave as trap crops. Under crop rotation, Marejea can be rotated successfully with cereals.

Discussion:
Q: Is the government aware of the problem of *Striga* and its magnitude
A: The Government is aware and it has put every thing in place to fight against *Striga* that is why researchers are working on the problem

Q: Why some cultivars of rice are not attacked
A: These cultivars have some resistance against the witch weed - Striga

Q: Can all *Striga* seed germinate or some will remain in the soil
A: In order to germinate the Striga seed need a supply of germination stimulants from the host plant, those seeds reached by the stimulant will germinate, the others not.

Q: What if we decide to put fire on crop residues
A: Seeds that are on the soil surface will be destroyed but those below the soil surface will still survive

Q: I thought 2,4-D doesn't control *Striga* but control other weeds
A: 2,4-D is a systemic herbicide that can kill young attached seedlings before they emerge above the soil surface

Q: How can we talk about inorganic fertilizers while the subject is under Marejea
A: It is important to have all the information so that who can afford inorganic fertilizer can use it to supplement Marejea technology

4.2 SOIL FERTILITY ENHANCEMENT BY USING GREEN MANURE

G.Ley

Soil fertility is very important in crop production therefore we have to improve soil fertility in order to improve crop production, to avoid further depletion of soil fertility and to increase income from crop production. Soil fertility is determined by soil physical and chemical properties. One component of soil chemical properties is determined by plant nutrients available in the soil.

Plant nutrients

Pant nutrients are obtained from two sources, air and water
-Carbon – obtained from air as Carbon dioxide
-Hydrogen – obtained from water and air
-Oxygen – obtained from water and air

There are two groups of plant nutrients, these are
1. Major nutrients: Nitrogen, Phosphorous, Potassium, Magnesium, Calcium, and Sulfur. These are needed in large quantities.
2. Minor nutrients: Boron, Zinc, Manganese, Copper, Iron, Cobalt, and Molybdenum: these are needed in small quantities

There are two major sources of soil nutrients including inorganic fertilizers and Organic fertilizers. Examples of sources of plant nutrients, Nitrogen is obtained from inorganic fertilizers like Urea, Calcium Ammonium, Sulphate, Sulphate of ammonia, Di-ammonium phosphate, Ammonium sulphate, NPK, and Calcium nitrate. However phosphorus is obtained from Di ammonium phosphate, Triple Supper Phosphate, Single Supper phosphate and Minjingu Rock phosphate. Potassium is obtained from Potassium chloride, Potassium sulphate, Potassium ammonium nitrate and NPK.

Organic fertilizers contain all nutrients in various proportions. Types of organic fertilizers are compost, animal manure and night soil to mention a few. It is advised that if these fertilizers are available it is important to apply them to the fields due to the advantages they have over the inorganic sources.

4.3 IMPROVED RICE VARIETIES

J Kayeke

It is very important to have improved seed in order to attain the goal of insurance of food security and income earning from household level to national level. Improved seed must have good qualities that appeal to farmers. The following are some of the qualities of a good variety of rice for Kyela farmers

1. High yielding
2. Early maturing
3. Tolerant to diseases and insect pests
4. Tolerate to Striga infestation
5. Tolerate to unfavorable soil conditions
6. Good tillering ability
7. Good plant height
8. Large grains
9. Aromatic

In the context of a resource poor farmer in Kyela, there are two major ways to obtain a good variety of rice

1. Buying
2. Selecting from re-cycled seed or farmer saved seed. This is done by
    - Removing volunteer and other unwanted plants
    - Select plants that are free of diseases
    - From the selected plants select and cut good panicles
    - The harvested panicles must be collected in a container i.e. should be put a container to avoid contamination with *Striga*/ *Ramphicarpa* seed
    - The panicles must be dried well, threshed and stored in dry ventilated condition

Good rice varieties are needed to ensure good yield under the situation where we have diseases and pests, unfavorable climate and soil condition existing in rice producing areas. In the presence of *Striga* infestation we need a variety that

- Has the ability to resist Striga infestation
- Matures early
- Can perform good when transplanted under upland condition

Example of experimental rice lines which may be suitable for Kyela conditions

Variety	Yield	Maturity period	Plant height
URO 1	4-6t/ha	120	110cm
URO 2	9t/ha	90	80cm
URO 14	7-9t/ha	105	80cm
URO 87	9t/ha	120	110cm
Kalalu*	3 – 6t/ha	120	115cm
SDD 35*	3-5t/ha	105	105cm

- Resistant to Rice Yellow Mottle Variety but still under experimentation

4.3 ECONOMICS OF GROWING MAREJEA

J. Hella

What is economics?: The knowledge of using limited resources to produce much and gained a lot. In the production process resources are very important, however in order to produce economically the following resources are needed: land, manpower, means of production and good management. That means you are needed to utilize well the available limited resources under good management in order to get benefit. Some of the resources available from farmers in Kyela include seed, fertilizers, man-power, means of production and agricultural advisory services.

Resources → Production process → **Profit and satisfaction**

The aim of any producer is to use available limited resources under good management in order to get income/benefit and satisfaction

Benefit: Profit – costs of production
Income: Yield of rice (bags) x Price of rice
Costs: Resources x the price of resources

******Where there is no profit measure the reduction in loss is regarded as a profit***

A: Income *B: Costs*
Therefore Profit = (Bags of rice x price of rice) – (Resources x costs of resources)

In order to increase profit you need to

A	B
Increase Production	Reduce resources
Increase price of product	Reduce costs of resources
Increase income	Reduce costs

To increase crop production you need to fertilize the soil, use proper spacing, observe the planting dates and use improved varieties. On the other hand, you need to increase price by using a reliable market, improve the quality of the product and selling when prices are high.

There were three farmers using different farm practices in their rice fields. Matatizo (practicing traditional farming), Mawazo (Using inorganic fertilizers) and Ubatizo (practice marejea rotation). The following table shows the trend of costs and profits of rice production in 6 years period where average yield 4bags/ha under traditional farming and average prices 18000 Tshs per bag of rice, hence average income per ha = 18000 x 4 = 72000 Tsh. (Income or Profit?)

Normal Rice production	**Farmer A (Matatizo)** **Traditional farming**	**Farmer B (Mawazo)** **Inorganic fertilizers**	**Farmer C (Ubatizo)** **Marejea**
Land preparation	**Costs 141100**	**Costs 141100**	**Costs 141100**
Ploughing 12000	**Profits 72000**	**Profits 72000**	**Profits 72000**
Furrowing 8000		**-50600**	**-50600**
Broadcasting 7000	**Year 2 -50600**	**-38600**	**-41300**
Weeding 40000			
Fertilizers 18000	**Year 3 -68600**	**+0000**	**+33000**
Bird scaring 10000			
Harvesting 6000	**Year 4 -68000**	**+92000**	**+35000**
Threshing 4000			
Transporting 5000	**Year 5 -68000**	**+97000**	**+69000**
Packaging 1600			
Total cost 141100	**Year 6 - 86000**	**+100000**	**+195000**

The above table shows that in the first two years all the farmers will be making loss but from the third year farmer B (Mawazo) will have no loss no profit made but farmer C (Ubatizo) will start realizing profit while farmer A will continue making a loss. From the third year to the sixth year farmer A (Matatizo) will be making a loss while farmer B (Mawazo) and C (Ubatizo) will continue making profit. The profit made by these two farmers differ in the following way, the profit made by B was higher than that of farmer C in the fourth and the fifth year but in the sixth year farmers C had the highest profit of all. This means when you are practicing traditional farming you will be making loss throughout, if you apply inorganic fertilizers you will make profit but in a long run the one who practices Marejea rotation will be making profit as time goes. The example is vivid in the sixth year where farmer C has the highest profit.

4.4 RAIN WATER HARVESTING

Patrick Lameck

Rainwater harvesting includes catching, collecting, conserving and utilization of rainwater. Rainwater can be harvested from the roofs, tree stem in areas with rainfall, cemented pits, water bunds, soil surface, rocks and sandy rivers. Water harvested from rain can be used for domestic purposes crop production, animal production, and for making fish/duck ponds. Generally, most of the rainwater harvesting is done for domestic purposes and little for other uses.

There is a difference between irrigation and rainwater harvesting. Water harvesting is collected from local rain water only, while irrigation can use water from any other source like rivers, springs, underground water, lakes and seas.

The history of rainwater harvesting

Fist information about rainwater harvesting goes as back as 4000 years ago in Negev desert. From there the technology spread to neighboring deserts in Lebanon, Syria, India, Egypt, Libya, Sudan, and West Africa. The technology of rainwater harvesting didn't continue much due to the invention of steam engine then Diesel engines in 1600-1800. The invention of these engines resulted in the use of water pumps for irrigation purposes. On the other hand, the political leaders did not emphasize any more on the use of rainwater harvesting hence the technology collapsed. In East Africa, Kenya has done a lot of work on rainwater harvesting whereas in Tanzania work on rainwater harvesting was started by Sokoine University of Agriculture. In Tabora and Shinyanga there is a lot of activities in bund construction in rice cultivation.

Principles of rainwater harvesting:

There are three components of rainwater harvesting these include catchments, collection and utilization area

- Harvested water = Plant water requirement – Local rainfall

Example maize or upland rice requires 750mm of rainfall per year. In Kyela the rain season starts November/December up to May /June. Total rainfall per year range from 2000 – 3000 mm as compared to Dodoma, which receives only 500mm of rainfall per year. The yield of rice and maize realized in the these two areas differ as shown on the box below

	Kyela	Dodoma
Maize	2bags/acre	24bags/acre
Rice	4bags/acre	20bags/acre

Characteristics of soil water

1. Gel water- microscopic water attached to soil particles that can be removed by heating at 104^0C. This type of water constitute about 0 - 12% in the soil held by van de Wal forces and it is not available to the plants.
2. Plant available water (12 – 28%), this water can be accessed by plants i.e. available for plants to use.
3. Gravitation water (28 – 50%) all air spaces are filled with water and the excess flows out

Characteristics of rain

- It normally ends at the normal end of the rain season. If the rain season is November to May the duration will be 6 months, if it starts on January the duration will be four month and ends may and so on
- Normally there is a dry spell for Kyela, which occurred between February and March
- There is a total amount of rainfall per period for example to plant maize you need 21mm in seven days
- There is the period called Return Period; this is the period which draught or excess rains reoccur in a certain period for example every 10 years

Methods of rainwater harvesting

- Plowing more than 15cm (6")– This is done to loosen the soil particles so as to improve seepage of water into the soil in order t o fill the water reservoir in the soil.
- For sloping areas the use of terraces, but they must be close enough to ensure that collected water does not escape
- The use of tie ridges
- The use of pit farming invented in Dodoma by the farmer called Keneth Sangula
- The use of trench farming invented by a farmer called Albert Mhembano in Dodoma
- The use of compost in fertilizing the soil; this improves percolation and water holding capacity of the soil.
- Growing of legumes as their roots penetrate deep in the soil, in the course of the process they break soil hardpan hence improve percolation of water and conserve moisture by pulling water from the underground water table. On the other hand, legumes improve the environment by improving humidity hence reduce evapo-transpiration
- The use of Sudan Tera; these are improved tie ridges commonly used in Sudan
- The use of V notch
- The use of Somali caag, invented in Somalia
- Dry farming i.e. cultivation harrowing and planting are dine in a dry land therefore when rain comes soil is friable and seed are in the soil.

5.0 Group work

Four different groups in each discipline were formed; they were composed of farmers, primary school teachers, agriculture extension officers and policy makers. The groups were given two assignments to conduct a class on a given topic and to report on the strategy to disseminate the knowledge gained in this workshop to others.

The topics given to each group were as follows

- **Farmers:** The economics of using marejea/pigeon pea in legume-cereal crop crop rotation
- **Teachers:** Different species of Striga in Tanzania and their control measures
- **Extension officers:** Different methods of improving soil fertility and improved rice varieties
- **Policy makers:** Different methods of rainwater harvesting to improve crop performance and control of *Striga*

Each group presented a given topic followed by a discussion after every presentation. This was meant to give them a teaching practice and an experience of the real situation in the field.

Presentations

5.1 Farmers: The economics of using marejea/pigeon pea in legume-cereal-crop rotation

What is Marejea? Marejea is a leguminous plant grown for the purpose of improving soil fertility

Advantages of growing Marejea and pigeon pea

1. Improving soil fertility
2. Improving soil structure
3. Improve soil water retention
4. Reduce Striga infestation
5. Reduce infestation of other weeds

6. Increase productivity
7. They are cheaper than inorganic fertilizers

Costs involved in Rice production per acre

Activity	Costs in Tshs
1.Plowing	12000
2.Harrowing	8000
3.Broadcasting	7000
4.Covering seeds	4000
5.1st weeding	40000
6. 2nd weeding	25000
7.Inorganic fertilizers	18000
8.Bird scaring	10000
9.Harvesting	6000
10.Threshing	4000
11.Packaging	1600
12.Transport to the store	5000

There is a case of three farmers using different farm practices in their rice fields. Matatizo (practicing traditional farming), Mawazo (plant marejea in November followed by rice in February) and Ubatizo (practice marejea rotation) In the following table it shows there is a trend of costs and profits of rice production in 6 years period with an average yield of 4bags/ha, Average prices 18000 Tshs hence average Profit = 18000 x 4 = 72000

Normal Rice production	**Farmer A (Matatizo)** **Traditional farming**	**Farmer B (Mawazo)** **plant marejea in Nov followed by rice in February**	**Farmer C (Ubatizo)** **Marejea rotation with rice**
Land preparation Ploughing 12000 Furrowing 8000	**Costs 141100** **Profits 72000**	**Costs 14100** **Profits 72000** **-50600**	**Costs 141100** **Profits 72000** **-50600**
Broadcasting 7000 Weeding 40000	**Year 2 -50600**	**+22000** (4bags)	**-41300 (4 bags)**
Fertilizers 18000 Bird scaring 10000	**Year 3 -68600**	**+57400** (8 bags)	**+33000** (8 bags+20kg Marejea)
Harvesting 6000 Threshing 4000	**Year 4 -68000**	**+93400** (10 bags)	**+35000**(10 bags+20kg Marejea)
Transporting 5000 Packaging 1600	**Year 5 -68000**	**+129400** (12 bags)	**+69000**(12 bags+20kg Marejea)
Total 141100	**Year 6 - 86000**	**+147400** (15 bags)	**+195000**(15 bags+20kg Marejea)

The table shows that when practicing traditional farming the farmer will be making loss and the loss increases with years but for those who use Marejea they will be making profit. The farmer who grows Marejea in November followed by rice in the February will be making a profit than the one rotate Marejea except in the sixth year, the rotating Marejea will have the highest profit

**** Planting of Marejea and rice the same year is very risky due to unreliable rainfall, therefore not applicable and not recommended for Kyela situation.

5.2 Teachers: Different species of *Striga* in Tanzania and control measure

Introduction: *Striga* is a parasitic weed that depends on cereals for nutrients. The hosts of *Striga* are maize, sorghum, upland rice and finger millet

Types of Striga that are found in Tanzania

- *Striga hermonthica* this has purple flowers, in Tanzania it is found in Mara, Shinyanga and Mwanza
- *Striga asiatica* this has red flowers and it is found in Dodoma, Singida, Southern Highlands regions. It also found in the regions along the Indian ocean from Tanga to Mtwara
- *Striga forbesii* This has pink flowers and it is found in Morogoro and Pwani regions

Effects of *Striga* to the crops

- Stunted growth
- Drying of plants and leaves turning yellow
- Reduction of yield and sometimes no yield at all when the infestation is heavy

One *Striga* plant can bear 50 capsules and each capsule can have 400 to 500 seed. The seed can stay viable in the soil for 15 to 20 years. One plant of cereal can be infested by up to 100 *Striga* plants. Symptoms of *Striga* infestation are seen after second weeding in Kyela

Striga in the field spread by

- Human beings and animals
- Wind and water
- Farm implements
- Crop seeds during harvesting

Control measures include the following

1. Hoeing and hand pulling
2. Crop rotation cereals with legumes
3. Intercropping of cereals and legumes
4. to plant *Striga* resistant varieties
5. Selection of seed from fields which are infested
6. Use of compost
7. Use of green manure like marejea, pigeon pea and other legumes
8. Use of herbicides like 2,4 – D
9. Use of animal manure

Discussion

Q: What is supposed to be done after hand weeding
A: Since hand weeding is done before flowering then nothing is done after hand weeding. If hand weeding would be done after seeding, there would be a special treatment like burning to make sure that seeds are destroyed

Q: Does weeding completely control the effect of *Striga* to the plant
A: Weeding control regeneration of the weed since it control seeding but effect the host cannot be avoided

Q: How are you going to conduct practical in your schools
A: Demonstration plots will be used for practical and Striga plants.

5.3 Extension officers:

Different methods of improving soil fertility; Improved rice varieties

Reasons for improving soil fertility

1. To improve soil productivity
2. To control fertility depletion
3. Control Striga
4. To increase income

Sources of soil nutrients

1. **Inorganic fertilizers:** Sources of nitrogen are Urea, CAN, SA, DAP while those for Phosphorus are TSP, DAP, SSP and Minjingu Rock Phosphate. Potassium is obtained from NPK, Potassium ammonium nitrate, Potassium sulphate and Potassium Chloride.
2. **Inorganic fertilizers:** Compost, animal manure, night soil, green manure like marejea and pigeon pea

Improved rice varieties

There are to ways to obtain a good quality seed of a variety, which can be through buying and selecting from the field during harvesting. The selected good varieties must have the following qualities

- Easy to breed
- Ability to produce high yields
- Short period to maturity
- Resistance to diseases and pests
- Tolerance to unfavorable soil and harsh climatic conditions

A good variety that can tolerate *Striga* infestation in Kyela must have the following qualities short maturity period, resistance to *Striga*, varieties that can be transplanted in upland condition. Examples of good varieties are

Variety	Yield	Maturity period	Plant height
URO 1	4-6t/ha	120	110cm
URO 2	9t/ha	90	80cm
URO 14	7-9t/ha	105	80cm
URO 87	9t/ha	120	110cm

Discussion:

Suggestions:

1. The measurements used must be familiar with farmers e.g. Bags per acre instead of kg/ha or t/ha
2. When teaching farmers about improved varieties start with locally available varieties
3. When teaching farmers their participation should be encouraged in order to share their experiences

Q: Where can farmers get improved variety seeds
A: Improved seed can be obtained from research centers

5.4 Policy makers:

Different methods of rainwater harvesting to improve crop performance and control *Striga*

History of Rainwater harvesting

- The history went back to 4000 years ago in Negev desert in Israel
- Then other countries practiced rainwater harvesting these include Lebanon, Syria, India, Egypt Sudan and West Africa
- The technology was then neglected due to discovery of steam engine and water pumps and politician did not put any emphasis on the technology
- Rainwater harvesting researchers are still going on in Kenya (Kitui and Baringo), Tanzania SUA, extensively water banding in Tabora and Shinyanga

Rain Water Harvesting involve tapping, collecting, storing and use of rainwater
Rainwater is collected from house roofs, tree trunks, pits, bunds, soil surface, rocks and sand rivers.

Why do we harvest rainwater?

1. For household uses

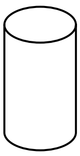
2. For supplementing crops
3. For livestock
4. For keeping fishes

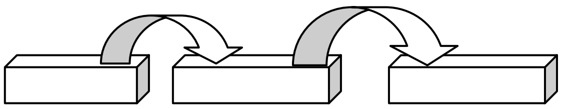
Rainwater harvesting differs from irrigation because rainwater comes from rainfall only while that for irrigation comes from rivers, springs, underground water, lakes and sea

Characteristics of rainfall

1. It rains in a specific period
2. There are dry spells where you need to harvest water to supplement the period of draught
3. Normally it rains 20 – 50mm a day
4. In order to sow seed there must be 21mm within 7 days
5. Rains have some repeated events like drought and excessive rains. For example after every 10 years from 1955 there is a draught and excess rains after every 10 years since 1968

Methods of rainwater harvesting

- Deep plowing
- Contours on steep slopes
- The use of tie ridges
- Pit farming  The diameter and the depth each must be 9 inches inches
- Furrow cultivation: Furrows are made and filled with crop residues and other trashes in the field, when sowing seeds are sown at the top of the filled furrow.
- The use of compost
- Growing leguminous plants: These have the ability to break hardpan, improve water percolation and they rejuvenate soil environment
- Sudan Tera



- V notch
- Somalian Caag
- Sand river farming

Discussion:
Suggestions:

1. The teaching must be relevant to the farmers situation i.e. don’t teach based on the literature or your past experience
2. The language used must be simple enough to convey the message to the target population
3. Apart from teaching the policy makers must supervise and monitor what is done by teachers, extension officers and farmers

6.0 Strategy to disseminate TECHNOLOGIES
GROUP PRESENTATIONS

6.1 FARMERS

Activity	Target population	Methods to be employed	Requirements	Time	Participants
Train others the use of	1.Farmers Research group	1Farmers training 2.Meetings of the	Brochures Posters	2005-2007 50% of the	Farmers who attended TOT,

Marejea/pigeon pea and water harvesting in rice production	members 2.Village leadership 3.All villagers 4.Neighbouring villages	3.Village government meetings 4.Demonstration plots 5.Teach the economics of using Marejea/pigeon-pea	Marejea and rice seeds Agriculture inputs Rain-gauges Stationeries and technical assistance from researchers	farmers will have received the knowledge	Agricultural extension officers, Village government

6.2 POLICY MAKERS

Activity	Target population	Methods to be employed	Requirements	Time	Participants
To disseminate the education on 1.Species of *Striga* that are found in Tanzania 2.The benefit of using Marejea and pigeon peas in crop rotation 3.Mothods of soil fertilization and good varieties 4.Mothods of rain water harvesting	District Commissioner, District Executive Director, District Administrative Secretary, Head of Departments in the District and Councilors	1.Seminars, Meetings and brochures 2.To create good environment for those who attended the TOT workshop to teach 3.Cultural activities like traditional dances, choirs, poems, drama 4.formation of a committee that will be responsible with dissemination of the education to schools, villages and sub villages	Stationeries, Transport, trainers, trainees and allowances	November-December 2005	TOT trainees
1.Follow-up on the implementation of all activities 2.Improve the by laws so that they can address the technology taught to our people 3.We have to be in the fore front in practicing the technologies taught		Visiting farmers in our working areas Enforcing the bylaws guiding this education We must practice the technology	Transportation	After November-December 2005	Trainers and policy makers

6.3 TEACHERS

Activity	Target population	Methods to be employed	Requirements	Time	Participants
To educate on 1.improving soil fertility and *Striga* control by using Marejea and pigeon-pea. 2.Rain water harvesting 3.Improved rice seeds	1.Teachers 2.Pupils	1.Teachers meetings in schools 2.Teachers meetings in wards 1.Teaching in classes (Skill studies) 2.To prepare demonstration plot	Stationeries, brochures, posters, booklets. Marejea seeds, improved rice seeds and pigeon pea seeds	From September 2005 on wards	All trainers

	3.Village School committee 4.Neighboring schools	3.Cultural activities Meetings, open days, Cultural activities, WDC		January – April 2006 May – July 2006	

6.4 EXTENSION OFFICERS

Activity	Target population	Methods to be employed	Requirements	Time	Participants
To educate on 1.benefits of using Marejea to improving soil fertility and *Striga* control in order to improve production of maize and rice from 2bags/acre in 2005 to 10 bags/ acre in 2010 2.Improved rice/maize seeds 3. Early preparation of fields	Division Development Committee Farmers research groups	1.Division meetings 2.Farmers research group meetings 3.Plots of Farmer research group members 4.farmers exchange visits 5.Follow ups	Posters, brochures, booklets and stationeries. Allowances for extension officers. Marejea and pigeon-pea seeds Transport and allowances Transport	November – December 2005 January 2006 February 2006 March 2006 March – April 2006 up to 2010	Extension officers and farmers

Appendix 1. List of participants

S/N	Name	Organization
1	Dr. A.M. Mbwaga	ARI-Ilonga
2	Dr. A. Moshi	ARI-Ilonga
3	Dr. G.J. Ley	ARI-Mlingano
4	Dr. J.P. Hella	SUA
5	P. Lameck	INADES-formation, Dodoma
6	Evelyne A.B. Msangya	
7	Emiliana Kishinda	
8	Grace S. Timothy	
9	Jotham Sanga	
10	Bulilo Masatu	
11	Sudi Msonjwa	
12	H. kisumo	

13	H. Malila	
14	Twaibu Abdu Niga	
15	Kunambi Moris	
16	Josephine Amos	
17	Paulo Mathew	
18	Valaleia Lui	
19	Osward Tadei	
20	Prisca Dimoso	
21	V. Msawanga	

Appendix 2 Programme

Date/time	**Activity**	**Responsible**
Monday, 11 July 2005 Chairperson: Mrs E. Masangya		
0800-0830	Registration	All
0830-0845	Opening	Division secretary
0845-0900	Introductions	All
0900-0930	Species of striga found in Tanzania and their economic importance	A.M. Mbwaga
1000-1130	Biology of striga and control measures by farmers	A.M. Mbwaga
1130-1300	Striga spread and control measures	A.M. Mbwaga
1300-1400	Lunch break	All
1400-1600	Soil fertility improvement	G.J. Ley
1600-1615	Tea/coffee break	All
1615-1700	Soil fertility improvement	G.J. Ley
Tuesday, 12 July 2005 Chairperson: A.M. Mbwaga		
0830-1000	Economic benefits of using Crotalaria in crop rotation	J.P. Hella
1000-1030	Tea/coffee break	All
1030-1300	Economic benefits of using Crotalaria in crop rotation	J.P. Hella
1300-1400	Lunch break	All
1400-1600	Improved maize varieties for lowland and mid-altitude areas	A.J. Moshi
1600-1615	Tea/coffee break	All
1615-1700	Improved maize varieties for lowland and mid-altitude areas	A.J. Moshi
Wednesday, 13 July 2005 Chairperson: G.J. Ley		
0830-1000	Rainwater harvesting, soil erosion and striga control	P. Lameck
1000-1030	Tea/coffee break	All
1030-1300	Rainwater harvesting, soil erosion and striga control	P. Lameck
1300-1400	Lunch break	All
1400-1600	Rainwater harvesting, soil erosion and striga control	P. Lameck
1600-1615	Tea/coffee break	All
1615-1700	Group formation	J.P. Hella
Thursday, 14 July 2005 Chairperson: J.P. Hella		
0830-1000	Group work	Group chairperson
1000-1030	Tea/coffee break	All
1030-1300	Group presentation	Group chairperson
1300-1400	Lunch break	All
1400-1600	Group presentation	Group chairperson
1600-1615	Tea/coffee break	All
1615-1700	Workshop evaluation and closure	Zonal director (E)

Appendix 3:
TRAINING OF TRAINERS – MAREJEA PROGRAM 15^{TH} AUGUST 2005 HELD AT TAFIRI HALL KYELA

Day 1: Monday 15 Augusti2005
Chairman: Mr Abraham – DALDO Kyela

TIME	ACTIVITY	RESPONSIBLE
2.30- 3.00	Registration	All
3.00 –3.45	Self introduction	All
3.00 – 3.30	Objectives of the workshop	A. M. Mbwaga
3.30-4.00	Opening	District Executive Director
4.00 – 4.30	**Tea break**	
4.30 – 5.30	Striga spp that are found in Tanzaniia	A. M. Mbwaga
5.30 – 7.00	The biology of *Striga* and control measures	A. M. Mbwaga
7.00 – 8.00	**Lunch break**	**All**
8.00 – 9.00	Means that facilitate spreading of *Striga* and their control	**A. M. Mbwaga**
9.00 – 10. 00	Measures to improve soil fertility	G. Ley
10.00 – 10.15	**Short break/soft drinks**	**All**
10.15 – 11.00	Measures to improve soil fertility	G. Ley
3.00 – 4.00	Measures to improve soil fertility	G. Ley

Day 2: Tuesday 16 August 2005
Chairman: Dr. G. Ley

TIME	ACTIVITY	RESPONSIBLE
3.00 – 4.00	Advantages of using Marejea or pigeon pea in crop rotation	J. Hella
4.00 – 4.30	**Tea break**	
4.30 – 7.00	Advantages of using Marejea or pigeon pea in crop rotation	J.Hella
7.00 – 8.00	**Lunch break**	
8.00 – 10.00	Rice varieties suitable for *Striga* infested area	J Kayeke
10.00 – 10.15	**Short break/soft drinks**	
10.15 – 11.00	Rice varieties suitable for *Striga* infested area	J. Kayeke

Day 3 :Wednesday 17 August 2005
Chairman: Dr. G..ley

TIME	ACTIVITY	RESPONSIBLE
2.30 – 4.00	Rain water harvesting	P. Lameck
4.00 – 4.30	**Short break/soft drinks**	
4.30 – 7.00	Rain water harvesting	P. Lameck
7.00 – 8.00	**Lunch break**	
8.00 – 10.00	Group formation ready to practice training	J. Hella
10.00 – 10.15	**Short break /Soft drinks**	
10.15 – 11.00	Group work	Chairman and secretary for each group

Day 4 : Thursday 18 Augusti 2005
Mwenyekiti: **Dr. J. Hella**

TIME	ACTIVITY	RESPONSIBLE
2.30 – 4.00	Group work	Chairman and secretary for each group
4.00 – 4.30	**Short break/ soft drinks**	

4.30 – 7.00	Group presentation	Chairman and secretary for each group
7.00 – 800	**Lunch break**	
8.00 – 10.00	Group presentation	Chairman and secretary for each group
10.00 – 10.15	**Short break/ soft drinks**	
10.15 – 11.00	Group presentatio	Chairman and secretary for each group

Day 5 : Friday 19 Augusti 2005
Chairman: **Dr. J. Hella**

TIME	ACTIVITY	RESPONSIBLE
2.30 – 4.00	Suggestions from the groups	Chairman and secretary for each group
4.00 – 4.30	**Short break/soft drinks**	
4.30 – 7.00	Group presentation	Chairman and secretary for each group
7.00 – 7.30	**Closing**	**District education Officer**

Appendix 4:
List of participants

1.Dr A.M. Mbwaga	Researcher	ARI Ilonga Private bag Ilonga	
2.Dr G.Ley	Researcher	ARI Mlingano, P.O. Box 5088, Tanga	0744 295276
3.Dr J.P. Hella	Lecturer	SUA P.O.Box 3007, Morogoro	0748 582110
4.Dr J Kayeke	Researcher	ARI Uyole, P.O. Box 400 Mbeya	0744 488112
5.Ester Hamis	Teacher	Mbula Primary School. P.O. Box 72 Kyela	0744 645909
6.Asiutu Barua	Teacher	Kasumulu Primary School 497 Kyela	
7.Jacob A. 8Kamwela	Teacher	Nduka Primary School P.O.Box 497 Kyela	
9. Edwin Mpayo	Teacher	Mbako Primary school P.O.Box 274 Kyela	0744 954205
10.Mbena V.E.	District Education Office	P.O. Box 72 Kyela	0748 380640
11.Rashid Mwaisaka	Ward Secretary Ntebela	P.O. Box 44 Kyela	0748 981984
12.Edward Mwaiswelo	Education Supervisor Ngana	P.O. Box 27 Kyela	0745 484641
13.Wilson K. Mwaipasi	Education Supervision Ikolo	P.O. Box 72 Kyela	0744 345284
14. Michael Mwankupili	Agriculture Extension officer (Ikolo)	P.O. Box 188 Kyela	0748 526605
15. Henry Mwangosi	Agriculture Extension officer (Busale)	P.O. Box 188 Kyela	
16.M Mwampaja	Agriculture Extension officer (District Office)	P.O. Box 188 Kyela	
17.Ernest Nyato	Agriculture Extension officer (Ngana)	P.O. Box 188 Kyela	0748 345711
18. A. Abraham	Agriculture Extension	P.O. Box 188 Kyela	

	officer (DALDO)		
19.Charles Mwaipopo	Agriculture Extension officer (Ipande)	P.O. Box 188 Kyela	0748 327685
20.Said Mwakasala	Farmer Njugilo Village	P.O. Box 125 Kyela	
21.Asegelisye Mwaseba	Farmer Kilasilo village		
22.Ipyana Twijulege	Ward Executive Officer Ntebela		
23.Andondile Mbisa	Farmer Ngana village	P.O. Box 125 Kyela	
24.Robert Mwailubi	Farmer Konjula village	P.O. Box 545 Kyela	0748 370988
25.Lusekelo Kawilo	Farmer Sinyanga	P.O. Box 161 Kyela	
26.Evance Mwaipopo	Ward Executive Officer Ngana	P.O. Box 320 Kyela	0748 940593
27.Enock P. Mwambene	Farmer Kandete village	P.O. Box 623 Kyela	
28.Boniface Kajuni	Farmer Kandete	P.O. Box 278 Kyela	0744 667938
29.Edward Mwang'onda	Farmer Itope	P.O. Box 201 Kyela	
30.Tusajigwe Mwakyusa	Ward Executive Officer Ipande	P.O. Box 320 Kyela	
31.Mary James	Teacher Lema primary school	P.O. Box 72 Kyela	