ENHANCING PRODUCTIVITY OF UPLAND RICE ON STRIGA INFESTED SOILS OF TANZANIA

Village Meetings to design the Demonstration Program
Kyela-Matombo

A.M. Mbwaga- ARI Ilonga
C.R. Riches and R.I. Lamboll-Natural Resources Institute, UK

Project No. R8194 (ZA0511)
Project Working Paper No. 1

January 2003
Preface

Striga species, the so-called witchweeds, are widespread on the fields of small holder farmers in semi-arid areas of Eastern and Southern Africa. These noxious parasitic weeds principally attack and reduce the yield of finger millet, maize, sorghum and upland rice in these regions. In many areas it is the crops of resource-poor households that are affected by these weeds. In Tanzania upland rice is attacked by \textit{S. asiatica}, in a number of areas. Since 1996 staff from Ilonga Agricultural Research Institute and Sokoine University in Tanzania, and Natural Resources Institute in UK have been collaborating with district agricultural extension in studies aimed at developing integrated \textit{Striga} management practices for the rice crop. Studies have been undertaken with two groups of rice farmers in Kyela District located in the Southern Highlands agricultural zone. Through on-farm trials the farmers came to appreciate that \textit{Striga} infestation and poor rice production are associated with and indicators of low soil fertility. This in turn is a consequence of continuous rice cultivation in the absence of using any fertiliser or manure. While the trials demonstrated that up to a 60\% reduction in \textit{Striga} numbers and a 40\% increase in rice yield could be achieved by using urea fertiliser farmers decided they did not wish to invest scarce cash in fertiliser. Instead they became interested in the opportunity, also observed from trials, to improve rice productivity on infested soils by introducing the green manure crop \textit{Crotalaria}.

The current project “On-farm verification and promotion of green manure for enhancing upland rice productivity on \textit{Striga} infested fields in Tanzania”, operating from October 2002 to March 2005, aims to scale up the demonstration of using the green manure in rotation with rice in both Kyela (Mbeya Region) and Matambo (Morogoro Region).

The purpose of this report is to outline the initial activities of the project, which involved the formation of farmer groups, which will undertake demonstration in the 2003 rice-growing season.

Further information on the project or further copies of this report are obtainable from:

Dr A M Mbwaga
Ilonga Agricultural Research Institute
PO Kilosa
Tanzania
Ilonga@africaonline.co.tz

Acknowledgement

The UK Department for International Development and the Government of Tanzania fund this work. The views expressed are not necessarily those of DFID (Project R8194 Crop Protection Programme).
## Contents

Introduction  
Background to study areas  
  Kyela District  
  Matambo District  
Village seminars and farmer group formation  
Follow-up meetings  
Monitoring and evaluation  
Scaling-up  
Involving schools  
Appendix 1 Notes on Marejea  
Appendix 2 The content of village seminars  
Appendix 3 Group membership  
Appendix 4 Questionnaire  
Appendix 5 Plot record form  
Appendix 6 Plot record form - Swahili
1. INTRODUCTION

Upland rice is an important cash crop in many areas of eastern and southern Tanzania, including Morogoro Rural and Kyela districts (Riches, 1999\(^1\)). Under continuous cultivation, rice yields have been in decline in recent years. This is associated with falling soil fertility and an increase in infestation by the parasitic witchweed, *Striga* asiatica. In order to tackle this problem a group of researchers and extensionists have been undertaking trials in two villages in Kyela. Working with farmer groups in Kyela since 1996 it has been demonstrated that up to 60% reduction in *Striga* numbers and 45% increase in rice yield can be achieved by applying urea fertiliser (Mbwaga, 2001\(^2\)). Although the farmer groups involved in the on-farm trials described how they had learnt through this work that *Striga* infestation is associated with low soil fertility they also indicated an unwillingness to adopt the use of urea as a widespread practice. This is largely due to a lack of liquidity for fertiliser purchase. Although a seasonal credit programme is available in Kyela, operated on a group basis through the district agricultural extension programme, many farmers consider the terms to be unfavourable. In particular loans have to be repaid at harvest time when rice grain prices are low.

Another approach to managing *Striga* was therefore needed. The green manure species *Crotalaria ochroleuca*, called Marejea in Kiswahili, has been grown for many years at St Benedicts Abbey, Peramiho, southern Tanzania, where it is used to maintain the fertility of organic gardens (Appendix 1). At Peramiho, this *Marejea* grows up to 2 m in height and has been found to be fairly drought tolerant, recovering well when rain returns. When broadcast as a sole crop growth is vigorous so that weeds is suppressed. This provides a clean entry for the subsequent crop. Seed obtained from Peramiho was distributed to the two farmer groups in Kyela by the research team and was planted at few sites by participating farmers in 2000. A number of farmers were familiar with *Marejea* as it had been included in on-farm trials undertaken in Kyela in a number of years before by Uyole Research Institute. For example according to farmers in Njugilo village a team from Uyole was active in Kyela in 1989-90 season. They are also aware of OFTs in near by Mbula village, which are said to have been operational in about 1996 for four seasons. These looked at using *Marejea* in rotation with upland rice. However the farmers view is that this was “just an experiment” and there seems to have been limited farmer participation and no follow up promotion. It is also understood that there has been little reporting of these field activities although a further search in the Uyole library may reveal grey literature covering the work.

Although farmers had expressed interest in testing the species further no seed was supplied. Farmers were very impressed by the growth of the plots planted in 2000, especially those placed on what was judged by the community to be poor, worked out land. Farmers took particular interest in one site where the farmer had planted sufficient *Marejea* to allow a comparison in 2001 of rice growth following the green manure compared to that following rice. Farmers observed that no *Striga* emerged on the plot previously sown to *Marejea*. This yielded 2100-kg ha\(^{-1}\) rice compared to 1000 kg where no fertiliser was used and 1600 and 1900-kg ha\(^{-1}\) respectively where 25 and 50 kg N ha\(^{-1}\) had been applied.

\(^1\) Riches C R (Ed.) 1999 *Striga distribution and management in Tanzania*. Proceedings of a stakeholder workshop, Dar es Salaam, 8-9 December 1999. Natural Resources Institute, University of Greenwich, UK.

\(^2\) Mbwaga A M 2001 *Striga* research activities in Central, Eastern, Lake and Southern Highlands Zones of Tanzania: on-station and on-farm trials for 2000-01 season. Ilongo Agricultural Research Institute, Tanzania.
At a field day held in Kyela May 2001 and at results and planning meeting for 2001/2002 season in November 2001, both held in Kyela, farmers picked out the green manure plots and requested further support to test the use of *Crotalaria* more widely. Following village seminars conducted by Ilonga staff 33 farmers requested seed of *Crotalaria* to plant in the 2002 season. The District Agricultural and Livestock Development officer and village based extension officers held a farmer’s day for non-participating farmers and arranged a farmer exchange visit, with farmers from participating communities in Itope/Busale and Kilasilo villages visiting each others fields.

The process of farmer evaluation of green manure, which was initiated by the research team, has subsequently become farmer driven. This has been built on to implement a new project designed to promote the use of the green manure *Crotalaria* for improving the fertility of *Striga* infested upland rice fields.

This project is led by Ilonga Agricultural Research Institute and is funded until March 2005. The current project will undertake field demonstration and other promotional activities in two districts of Tanzania – Kyela district in Southern Highlands Zone and Matombo division, Morogoro Rural district in Eastern Zone. In addition to Ilonga, local partners include district agricultural extension and education staff, the NGO INADES, which specialises in community analysis and empowerment and a soil fertility specialist from Mlingano Agricultural Research Institute. Natural Resources Institute, UK, are assisting with developing a protocols for monitoring farmer involvement in the demonstration work being undertaken by the project; development of the field programme, dissemination materials and monitoring of demonstration plots.

The project will use two routes to promote the soil fertility enhancement for *Striga* management. The major focus will be the formation of farmer groups, which will undertake on-farm demonstrations to be used as sites for field days. In addition there will be interaction with teachers at village primary schools in both districts. Awareness of the *Striga* problem and of methods to improve soil fertility will be included in agricultural science classes. Supporting training materials including posters and leaflets will be prepared as the need is identified.

2. BACKGROUND TO THE STUDY AREAS

**Kyela district in Southern Highlands Zone**

Rice is generally recognised as a very important crop in Kyela. The *Striga* research process has evolved quickly in this area at least partly in response to the enthusiasm of extensionists and farmers. One outcome of this has been limited socio-economic research under the Integrated *Striga* Research project. One particularly useful previous study was carried by a combined team from ICRA (International Centre for development oriented Research in Agriculture) and Uyole ARI (1994³). Part of the study involved a survey of 123 respondents across seven villages (five on the flood plain and two in higher areas).

Some background information:
- Kyela district - est. pop 159, 000 (1994); densely populated (est. 203 people/ sq. km in 1994)

• High rainfall - annual average 2726 mm (1972-93).
• Kyela district can be broadly divided into flood plain (with high, middle & low
  benches) and higher land. Large areas of the flood plain are prone to flooding.
• Soils
  Flood plain: alluvial, poorly drained with high clay content;
  Higher land: weathered red clay; leached and acidic.
• Crops- household land allocation: rice (44%); home garden e.g. banana, cocoa (28%);
  other e.g. sweet potato/cassava (16%); maize (6%). Rice most favoured crop in Kyela
  - food and cash income.
Livestock - cattle numbers in decline. Pig and poultry increasing.

The District Extension Service has divided Kyela district into four agricultural
ecological zones. According to Mr Mwambungu (DALDO) there are a total of 20
extension staff working at division, ward or village level in the district.

Some Farmer perceptions

Fertility status varies between villages (generally decreasing moving from flood plains
to higher land). Weeding is most laborious task. Manure is associated with increase in
weeds (5-15% of respondents). Weeds in general, particularly on the floodplain,
considered a major constraint on rice production

Farmers classification of soils
In the higher areas, the ICRA study reports two main soil types Kibumba and Ntitu.

<table>
<thead>
<tr>
<th>Local name</th>
<th>Kibumba</th>
<th>Ntitu</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA classification</td>
<td>Ferrasols/ luvisols</td>
<td>Fluvisols</td>
</tr>
<tr>
<td>Location</td>
<td>Slopes</td>
<td>Valley bottoms</td>
</tr>
<tr>
<td>Colour</td>
<td>Red</td>
<td>Black</td>
</tr>
<tr>
<td>Texture</td>
<td>Clayloam</td>
<td>Clay</td>
</tr>
<tr>
<td>Water holding capacity</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Crops</td>
<td>Cassava, groundnuts, sweet potato, pigeon pea, bambaranut</td>
<td>Rice, maize</td>
</tr>
<tr>
<td>Fertility rank</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Farmer knowledge
A high proportion of farmers has knowledge (through use) of chemical fertilisers and
animal manure.
Discussion with farmers during studies undertaken by the DFID Striga project indicate
farmers have little knowledge of Striga biology but associate it with declining soil fertility.
The name for Striga in Kinyakusya is Kyumika

Upland Rice production practices
Cultivation- Ox ploughing (a male activity) is used by 70% of households across land
types but by only 46% in upland areas. Other farmers use hand hoes.

Planting on both lowland and upland areas is by broadcasting over 2-3 months (to spread
labour demand). Upland rice is planted in late December to early January, usually grown
as a monocrop. Some farmers plant a sparse stand of pigeon pea within the rice.
Weeding is predominantly a female responsibility. 20% of respondents in the ICRA survey had used herbicides, most probably on lowland areas.

Harvesting of panicles in undertaken with a sickle.

Soil fertility management
Chemical fertilizer 54% of respondents have used at some time BUT following the national Economic Structural Adjustment Programmes, district sales of fertilizer (tonnes) by two main suppliers have fallen:

<table>
<thead>
<tr>
<th>Year</th>
<th>KYERECU</th>
<th>RTC</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>200</td>
<td>69</td>
<td>269</td>
</tr>
<tr>
<td>1993</td>
<td>2.5</td>
<td>25</td>
<td>27.5</td>
</tr>
</tbody>
</table>

Current use, based on discussions with farmer groups is thought to be low.

Up until recently there was high dependency on credit made available through IFAD project.

Crop Rotation- upland: 63% of respondents; Floodplain: 36%

Fallowing- practised by 50% of respondents - average period of 2 years.

Crop residues- grazed by cattle; used for thatch; burnt; Incorporated.
Rice fields: Hand hoe - residues burnt
   Ox plough - incorporated

Animal manure
29 - 43% of respondents ‘use ‘ animal manure but actual areas treated are thought to be small.

Constraints
Chemical fertilizer
The high price is generally considered as the major problem.
Response (Kg/ Ha) to fertilizer varies with location e.g.

<table>
<thead>
<tr>
<th>Location</th>
<th>Without</th>
<th>With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher area (Lema)</td>
<td>198</td>
<td>395</td>
</tr>
<tr>
<td>Floodplain (Itunge &amp; Mababu)</td>
<td>1186</td>
<td>1580</td>
</tr>
</tbody>
</table>

Difficulty with the credit conditions associated with the IFAD project reduces the attractiveness of this route into fertiliser purchase. These include the need for group membership and particularly the need to re-pay the loan at harvest time when rice prices are low (has been 250% variation in farm gate price for paddy over season).

Animal manure
Insufficient quantities and the distance to fields constrain widespread use of animal manure.

Time to walk to fields (minutes)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Flood</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>Maize</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Cass/SP</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

Some negative perceptions are associated with increased weed growth following use of manure.
Matombo division, Morogoro Rural district in Eastern Zone

Morogoro Rural district has a population of about 600,000 and is to be split in two becoming Mvomero district in the north (4 divisions) and Morogoro Rural in the South (6 divisions). Matombo lies to the south in the area of the Uluguru Mountains. A study by Bhatia and Ringia (1996) provides some useful background to the Uluguru mountain area. PRAs were carried out in 11 villages, one of which was Kiswira (one of the project villages).

The Uluguru mountain area in general is relatively densely populated (more than 150-persons/ sq. km) and has a high rate of population increase (up to 6.5% per annum). The area is most inhabited by Waluguru people whose livelihoods are reported to be based on subsistence farming –particularly maize, beans and rice and, from selling vegetables and fruits to urban markets.

The mountains rise from about 300m at the coastal plain to 2638m. Rainfall varies from 900m at Morogoro municipal to 1200-3100m on the drier western slopes to 2500-4000 m on the eastern slopes. There are generally two rainy seasons with the long rains (Masika) usually from February to June and the short rains (Vuli) October-January. The forests on the Ulugurus are considered to be one of the top priorities for biodiversity conservation in Africa, as well very important as catchment areas for rivers, maintaining a humid climate and preventing soil erosion. There is a long history of external interventions aiming to conserve natural resources in the area.

Deforestation and other resource degradation are attributed to land scarcity. The system of land ownership at the time of the study was based on lineage systems, which is reported to lead to inequitable distribution, land scarcity and poor land management. Some families suffer from land shortage; others hold land, which is not being used. Some farmers are tenants, paying in cash or kind, and they are restricted from practising permanent land development, including planting of trees. According to Bhatia and Ringia (1996), Kiswira was identified as a special case where the land for the village is leased from the Catholic mission (dating back to the time of Tanzania’s villagization programme). Under this arrangement all trees planted belong to the mission and a percentage of any produce (ngoto) from the farms also has to be paid to the mission. A diverse range of crops is grown for food and cash in a number of cropping systems (see below).

<table>
<thead>
<tr>
<th>Season/ type of shamba</th>
<th>Long rains (Masika)</th>
<th>Short rains (Vuli)</th>
<th>Dry season (Kiangazi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hilly/ forest fields (Mwituni)</td>
<td>Maize/ rice relay (upland rice) Vegetables, potatoes, yam, cassava Bananas</td>
<td>Maize/rice relay Banana, beans</td>
<td>Woodlots Banana</td>
</tr>
<tr>
<td>Home gardens (Jaladani)</td>
<td>Intensive agro-forestry, banana, fruit trees, multi-purpose trees, beans, peas, livestock, maize, sweet potato</td>
<td>Maize and beans Banana and multi-purpose trees</td>
<td>Agroforestry Multipurpose trees and banana</td>
</tr>
</tbody>
</table>

Inter-cropping is common. Maize is produced in all zones, but is not sufficient to meet food needs. Low yields are attributed to low soil fertility, low yielding local varieties, pests and diseases, particularly vermin. Rice appears to be cited as a food crop rather than a cash crop. Weeds in general are cited as a problem (growing fast in response to the favourable climate) and difficult to control, although *Striga* is not specifically mentioned in the report.

Shifting cultivation is still commonly practised although fallow periods are generally much reduced and in some areas land is cultivated continuously. The majority of farmers practise flat cultivation with contours constructed using grass, shrubs and trees. Bench terraces and other soil conservation practices are unpopular and are considered unproductive, labour intensive and less effective in erosion control than indigenous practices. Minimum or zero tillage is often practised especially on hilly fields. Hand hoes are the main tools for cultivation. Due to the presence of weeds, fire is used in many places to facilitate land preparation.

Most households in the Ulugurus experience shortage of cereal food, particularly maize. Households supplement home produced maize with maize imported from Kilosa and Iringa.

During the PRA constraints were identified and prioritised in seven villages. 18 major constraints were identified: Communications, Hospital/health, Land scarcity, Mine ownership, Education/schools, Lack of milling machines, poor upbringing of youth, clean and safe water, lack of markets, poor agriculture/forest extension, vermin, poor village leadership, deforestation, unemployment, high cost of agricultural inputs, corruption of officials/leaders, lack of credit facilities and pests and diseases. In Kiswila village the top 6 constraints were ranked as Hospital/health, Lack of milling machines, Vermin, Clean and safe water, Communications, Lack of markets. Loss of soil fertility due to shorter fallows was specifically mentioned in the Kiswira PRA. Manure is not used because of insufficient livestock. Villagers are discouraged from erosion control practices such as planting ‘kaskas’ because they feel this would reduce land availability for cropping even further.

In Morogoro rural district there are 235 villages and 132 extension staff outside the district HQ. The aim is to have at least one extension officer in each ward.

### 3. VILLAGE SEMINARS AND FARMER GROUP FORMATION

Initial village meetings were held in Kilasilo, Itope and Sinyangu (Kyela), Kiswira, and Kibangile (Matombo) during mid-September and in Njugilo in Kyela in November. Staff from the district extension office opened meetings. There then followed a discussion on the crops grown and identification of production constraints. Following this Ilonga staff made a presentation on *Striga* control and options for improving soil fertility. A possible layout for demonstrations was discussed and farmers willing to be involved were facilitated to form a group and to vote for group leaders. The meeting...
agenda followed is shown in Appendix 2. The existing *Striga* research groups in Itope and Kilasilo, who already have pots of *Marejea* were updated on the new project and plans were agreed for the coming season.

**Kilasilo**

The team consisted of Dr A Mbwaga (ARI Ilonga), Dr. G. Ley (ARI Mlingano), Mr. J. Kayeke (currently a student at Sokoine University of Agriculture), Dr. A. M. Mbwaga (ARI Ilonga), Mr Mwambungu (DALDO Kyela), Mr Mwaipaja (DCO-Kyela) and Mr Mwangosi (VEO - Kyela).

Kilasilo village is entering in the third phase of working on *Striga* management. The Chairman of the Farmer Group (Mr. Mwaseba) briefed the team on the activities undertaken during the 2001/2002 season.

The activities included
1. Multiplication of *Crotalaria* seed for the 2002/2003 season
2. Evaluation of the performance of the pigeon pea cultivars (ICEAP 0068 and ICEAP 00068) for wilt resistance and yield.
3. Farmers reported to have produced enough seed of *Crotalaria*, which they are ready to share with other farmers who are either, new or they did not harvest enough from their fields during the season.

Pigeon pea needed spraying against flower sucking insects. Those farmers who did not spray had poor harvest, but those who sprayed they harvested between 6-8kg/50m².
3. *Ramphicarpa fistulosa* is a problem in lowland rice. Plots sprayed with 2, 4D plus Ronstor performed the best and farmers are requesting to find the availability and price of the chemical so that they can share the cost of buying the chemical.

Plan for the coming season 2002/2003:
1. They will continue with evaluation of pigeon pea, as only five farmers had participated last season. Next season every farmer would like to try plots of pigeon pea.
2. The plots, which were under *Crotalaria*, are to be grown with rice to see effect on *Striga* and rice grain yield.
3. Plots which were under pigeon pea last season are to be planted with rice and to evaluate its effect on *Striga* numbers and rice grain yield compared to where there was continuous rice.
4. Increase number of farmers from 5 to 10 to continue with evaluation of herbicides on control of *Ramphicarpa fistulosa*.

Briefing on the New project i.e. promotion of green manure

The farmers were briefed on the start of the new phase of the project with objectives of scaling up the use of *Crotalaria* to improve soil fertility and control of *Striga* as they had earlier requested from the former project. They were briefed also on the research team composition, activities to be carried out and the role of their group for the new joining farmer groups from within Kyela and Matombo – Morogoro. They were requested to receive fellow farmers from new villages and from Matombo-Morogoro to learn how to grow Marejea, to learn its effects on *Striga* and increase of soil fertility – hence increase rice grain yield. They all responded very willing to receive and show other farmers on the technology on the advantage to use *Crotalaria* instead of inorganic fertilisers. Twenty farmers participated at this meeting, but we were told that they are 25 farmers in total.
Group registration

The group is in the process of developing a constitution for formal registration. Each farmer member is contributing 5,000 Tsh as entry fee. The group is called KIMBALU.
Demonstration Plots for 2002/2003

5 x 30 m each

<table>
<thead>
<tr>
<th>Crotalaria plot</th>
<th>Rice plot</th>
</tr>
</thead>
</table>

Itope (Chilambo)

On the same date in the after noon the team visited Itope (Chilambo) and met farmers. The number of farmers was much small compared to Kilasilo, because other farmers were involved in other National activities at that day. The chairman of the group briefed the team on the activities of the 2001/2002 season. Majority of the farmers did not plough under the *Marejea* plots but harvested enough seed to be used for the demonstration plots in the 2002/2003 season.

Their pigeon pea performed poorly due to water lodging and late spray against pod borer insect pests.

Activities for the next season

Plots planted with Crotalaria last season will be planted with rice and compared to those planted with rice to evaluate *Striga* infestation and rice grain yield. Similarly those plots, which were under pigeon pea, will be cultivated with rice to see effect of preceding crop on *Striga* emergence and grain yield of rice.

The group was also briefed on the new phase of the project and it was happy to have the project to continue and promised to involve more farmers to participate as way of scaling up. For the coming season 2002/2003, the group decided for each participating farmer to have a plot size of 10 x 30m. The number of farmers who participated at this meeting was only 9 out of 12 in the group. The plot layout will be as in Kilasilo.

The group is also going to receive two pigeon pea varieties to plant, each farmer ¼ kg ICEAP 00068 and ICEAP 00040.
Sinyanga

This was not a very convenient day to visit this village which is new to the programme. It was Sunday and majority of the farmers had attended church services and also it was a market in the village. 12 farmers attended the seminar.

Information gathered from the farmers

Farmers in the village grow maize, lowland flooded and upland rice. Pigeon pea is an important legume. The major problem reported on crop production was low soil fertility and Striga. Farmers have observed Striga on cereal crops grown on sandy soils, elevated areas, and fields with low soil fertility. The Striga problem has been increasing over the years and farmers think the problem has been caused by continuous growing of the same crop on the same field year after year. The effect of Striga on the crop was reported to be stunted growth, scorching of the crop leaves, and poor grain yield (from 10 bags of rice in the past to 3-2 bags/acre now). Striga starts emerging after the 1st weeding around February/March and initial symptoms start with yellowing of leaves.

Efforts of Striga control

- Application of farm yard manure for farmers having cows
- Weeding the Striga
- Rotation of crops especially maize with groundnuts
- Leave land fallow for 2 years

From the discussion non-of the methods listed reduced Striga problem completely.

The relationship between Striga and the crop from farmers point of view

- Striga utilises much of the water from the soil hence deprive the crop for water
- Striga has a special way of affecting the crop
- Striga attaches itself to the roots of rice crop.

This last point was the entry point for educating seminar participants on the Striga biology and control options.

Farmer research group formation

12 farmers volunteered to participation in the trial demonstration.

- Mr Lusekelo Kawilo elected chairman of the group
- Ms Mbutolwe Panja elected secretary of the group

Demonstration plot size

Each farm size: 5m x 20m with one plot of Crotalaria and one of rice.

Njugilo village

Research team consisted of Dr Mbwaga, Dr C Riches, Dr G Ley, Mr R Lamboll, Mr P Lameck, Mr J Kayeke, Mr A Mwambungu (DALDO- Kyela) H Mwangosi (WEO) A Mwakalinga (DVEO)

The session started by self-introduction, the farmers, researchers and District officers. Then a situation analysis was done to explore information related to crop production in order to introduce Striga awareness and Striga control measures in the form of Participatory Technology Development.
**Crops grown:** Rice, maize, cassava and ground nuts

**Rice varieties grown:** Kilombero and Mwangulu (Lowland and upland production systems are common in the village)

**Yield of rice obtained/acre:** Years ago farmers used to get 5 – 8 bags per acre but now farmers get 3 – 4 bags per acre

**Production constraints:**
- Rice Yellow Mottle Virus (RYMV) in low land rice
- Striga in upland rice and maize
- Low soil fertility
- Weed infestation in rice (Cynodon spp)
- Birds in rice fields
- Cutworms and ants on upland rice

**Striga history:**
The witch weed has been in the village long time ago, but it is increasing because of low soil fertility, seed multiplication, use of ox-plough and climate changes (Low rainfall)

**Indigenous control measures:**
- Early planting, one-year fallow, hand pulling and the use of animal manure. The later is not common because of the bulkiness of the manure and the distance to the rice fields.

**Farmers knowledge on Striga:**
Farmers were not aware of the Striga biology and how Striga affects crops. There was no specific use of the witch weed. The spread was known to be by seeds moved by water, cattle and ox-plough.

Then farmers were taught the biology of Striga and Integrated Control Measures. After Participatory technology Development farmers agreed to use Crotalaria and Pigeon-pea to improve soil fertility at the same time control Striga in their rice fields. The agreed plot size was 5x20m.
Matombo, Morogoro rural

The team, which visited Matombo consisted of C. Massawe and A. Mbwaga (ARI Ilonga), Mrs Masangya (District information officer represent DEO) and H. Amir (VEO – Matombo).

Kiswira village

In the morning starting from 9 am to 1.30pm the team had a seminar with the Kiswira village farmers. 17 farmers attended the seminar and at the end of the seminar all volunteered to participate in the demonstration and evaluation of the green manure technology.

Crops grown
Maize
Upland rice, Cassava, and sorghum

Production constraints
Diseases
Stem borer (Messo)
Striga (Sani)
Storage pests
Army worms
Decline of soil fertility.

Crops attacked by “Sani” (Striga)
Maize
Upland rice
Sorghum
Hanakolo (creeping weed on cassava).

Symptoms on the crops attacked by Striga
Stunted growth
Yellowing and drying of the leaves
Reduced grain yields (barren heads).

Striga control measures practised by farmers
Leave land fallow for at least 3 years
Deep ploughing
Crop rotation cereal with cassava or sesame
Use of animal manure (very few farmers practise due few animals)

Uses of Striga
No uses

Farmers perception on the relationship between Striga and host plant:
Striga produces poison, which affects the cereal crop
The weed attaches itself to the cereal roots and draws water and food and hence affects the crop. From here farmers were educated on the biology and available Striga control options.

Group formation

All 17 farmers who participated at the seminar volunteered to participate in demonstration and evaluation of the Marejaa and pigeon pea technology. The group was named “Tuwalole” meaning “let us watch you”.
Mr. Jorge Mkami was elected chairman of the group.
Mr. Adolf Mawango was elected secretary of the group.
Agreed plot sizes would be 5m by 10m. It was further agreed there would be 4 plots at each site. These would be rice, marajea, pigeon pea and “kiraka”. The latter is a green legume first brought to the village, for use in coffee, by a British Agricultural Officer in about 1954. From samples brought to the meeting this appears to be the legume Pueraria phaseoloides (“kudzu”). Although not used by farmers, plants have persisted in the area and farmers decided to collect seed to use on the plots.

Parameters to evaluate:
- Soil fertility (vegetative growth)
- Striga intensity
- Rice grain yield

**Kibangile Village**

16 farmers participated at the seminar.

Cereal Crops grown in the village:
- Maize
- Upland rice
- Sorghum

Production Constraints:
1. Weeds
   - Striga “Sani”
   - Cyperus SP
2. Low soil fertility
3. Vermin (Ngedere, Nyani and Kima)
4. Poor agricultural working tools

Crops affected by *Striga*:
- Maize
- Sorghum
- Upland rice

Symptoms of *Striga* on the host plants:
- Yellowing of the leaves
- Stunted growth
- Reduced grain yield

History of *Striga*:
It is as old as the crop and observed 1953 explained from one of the aged farmer

Reasons for increase:
- Decline in soil fertility
- Reduced fallow periods as the population of people increased
- Cropping of the same type of crop year after year

Control measures practised by farmers:
- Deep ploughing
- Crop rotation
- Early planting
- Leaving land fallow for at least 3 years
- Weeding

The relationship between *Striga* and the cereal crop from farmers perception.
- *Striga* roots suffocates host roots
- Compete with host plant for water and food
Produce poison to affect the host plant
- *Striga* roots are stronger than those of the host plant, they attach themselves to the host plant and absorb water and nutrients from the host. This was the entry point to talk about *Striga* biology and control options.

**Group formation**
All seminar participants volunteered to participate on demonstration of the Marejea technology.

**Plot size agreed:**
5m x 35m

**Observations:**
- Soil fertility by looking at the vegetation of the crop
- *Striga* population
- Rice grain yield

**Leadership**
Filbert Roman was elected chairman of the group
Josephene Amosi was elected secretary of the group

4. **FOLLOW UP MEETINGS:**

The project team, including Dr Riches and Mr Lamboll from NRI and Mr Lamek of INADES, visited all the participating villages again in November 2002. This provided an opportunity for farmers to meet the whole team and for issues on the biology and control of *Striga* to be clarified. Demonstrations plans suggested at the seminars were confirmed.

5. **MONITORING AND EVALUATION**

Discussions among the project team identified a number of reasons why monitoring is important. These included:

1) To understand why or why not farmers are participating in the demonstration programme and are adopting the technology;
2) To generate information to use in the preparation of promotion material;
3) To provide information to the donor.

**Baseline data collection**

The community situation analysis, led by INADES and scheduled to take place in January 2003, will provide an opportunity to gain a much better understanding of the communities with which the project is working. Either as part of this exercise or in addition to it, it would be very useful to characterise the population of the villages in terms of some key criteria, particularly poverty. A relatively easy way of doing this would be through a wealth ranking exercise. This will provide an understanding of how the community perceives wealth/poverty and through the use of a random sample an indication of the proportion of the community in broad wealth groups. This would allow the project to see which farmers we are currently working with and whether or not different target groups should be identified which will have different needs and approaches to addressing soil fertility/ *Striga* constraints.

The communities may also be characterised through a questionnaire survey similar to the one used in the Integrated management of *Striga* project. This includes some indicators of wealth/livelihood status (these may have to be modified following the wealth ranking eg cattle are fairly scarce in the Ulugurus) and a few questions relating to access to and management of soil resources. The sample should be random to represent
the community. If the resources allowed participating farmers could also be interviewed to give an indication of the wealth groups represented by participants hosting demonstration plots. A draft questionnaire (which will need to be modified after wealth ranking) is included in Appendix 4.

Farmers’ perceptions of soil resources appear to be very important and the project would benefit from a clear understanding of farmers’ soils classification. This again could be part of the community situation analysis to be carried out in January.

Either as part of the baseline survey or the situation analysis it would appear to be important to learn from previous initiatives. One clear example appears to the experience of Uyole ARI with *Crotalaria* and rice in Mbula village (about 3 km from Njugilo village). As mentioned above it was reported that Uyole had trials in Mbula village for 4 years from 1996. It would be good to see what could be learnt from participants in that village.

**Monitoring the process**

It would very useful to systematically record activities at the project sites and how these are reported. This may be particularly useful when a wide range of individuals and organizations are being asked to carry out activities. An example of a possible format is shown below. This could also be used to plan out activities and reporting over the next 12 months and, at a more general level, until the end of the project. The first document produced reporting seminars and farmer group formation provides a good example of the type of information to be recorded.
### Project activities to date

<table>
<thead>
<tr>
<th>Activity</th>
<th>Who participated</th>
<th>Location</th>
<th>Date</th>
<th>How reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar and farmer group formation</td>
<td></td>
<td>Kyela district:</td>
<td>19th-23rd October 02</td>
<td>Internal project document to be upgraded to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kilasilo</td>
<td></td>
<td>working paper?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Itope (Chilambo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sinyanga</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Njugilo (9th November 02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matombo, Morogoro Rural district:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kiswira</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kibangile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers seminars</td>
<td></td>
<td>Kyela district:</td>
<td>7th November 02</td>
<td>Internal project document</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matombo, Morogoro Rural district:</td>
<td>11th November 02</td>
<td></td>
</tr>
<tr>
<td>Follow-up visit to participating</td>
<td></td>
<td>Kyela district:</td>
<td>8-9th November 02</td>
<td>Report from District Extension/ Framers?</td>
</tr>
<tr>
<td>villages</td>
<td></td>
<td>Kilasilo</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Itope (Chilambo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sinyanga</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Njugilo (9th November 02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matombo, Morogoro Rural district:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kiswira</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kibangile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting of demonstrations</td>
<td></td>
<td></td>
<td></td>
<td>Report from INADES?</td>
</tr>
<tr>
<td>Community situation analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possibilities of setting up a participatory monitoring system with farmers, extensionists and others should be explored in the community situation analysis workshop. Such a system clearly depends on participants having an incentive to monitor activities. If no such incentive exists, then the project will need to allocate responsibilities and resources to people/ organisations able and willing to carry out the job. This again could be decided around, if not part of, the community situation analysis workshop.

Some thought needs to go into how to monitor and evaluate the outcome of promotion through teachers and schools. In particular, does the message/ technology pass from children to parents or others in the community. This may require a specific targeted study towards the end of the project.
Monitoring demonstration plots

The discussions with participating farmer groups have led to agreement on implementation of a series of field demonstrations. The main aims for these is to provide a focus for farmer evaluation AND a farmer training aid for wide-scale promotion of using either *Crotalaria* or pigeon pea in rotation with rice. To date the project has viewed *Crotalaria* as a tool for enhancing soil fertility and reducing *Striga*. Farmers who are gaining experience with the cover crop in Kyela are reporting that it also suppresses weed growth and that less weeding is needed in a rice crop following *Crotalaria* than in continuous rice. On the other hand the green manure needs to be incorporated into the soil. Some farmers have done this by making ridges with a hoe, others have ploughed in the biomass with an ox drawn plough. These experience need to be captured and documented so that they can be incorporated into updated extension materials as the project proceeds. A suggested proforma for collecting information from each plot is attached in appendix 5. As the layout of the demonstrations may vary from site to site it is suggested that one sheet is maintained for each plot. Greater ownership of the demonstrations by the community can be encouraged if a member of the farmer group agrees to maintain the records. This process will need to be overseen by the village extension worker. If for some reason the farmer-recorder can not continue this work IT MUST BE adequately undertaken by the extension worker and/or project staff.

6. SCALING-UP

The project is currently opting for district extension, teachers and farmer-farmer approaches to scaling up. One way to identify other possible options would be to carry an AKIS (Agricultural Knowledge Information Systems) or equivalent study again perhaps as part of the Community Situation analysis workshop. This could identify key players and approaches to scaling up relatively quickly.

The demonstration plots will provide sites for field days. District extension staff should be encouraged to use these to promote the concept of *Striga* management through soil fertility enhancement to the wider farming community. Supporting extension literature will be needed to hand to interested farmers. A leaflet showing the main points which need to be disseminated will be drafted. This will need to be translated into local languages and tested with farmers to ensure it contains the information which farmers need. Use of the term *Striga* will need to be substituted by the appropriate local name.

7. INVOLVING SCHOOLS

Seminars for primary school teachers from villages in Kyela and Matambo were held in November. Teachers were presented with an overview of the *Striga* soil fertility problem and the project plans to undertake a demonstration programme on the use of green manure. Mr Lamek undertook a situation analysis with them to identify the usual sources they use for teaching materials and information and to identify constraints. Subsequently the teachers proposed ways that they can become involved in raising awareness of *Striga* management in their communities. These include teaching at school, by having a school demonstration plot and by speaking at village meetings. Posters showing the *Striga* life cycle and control measures were distributed with leaflets and a training manual summarising aspects of the biology and control of *Striga*. It was agreed to meet both teacher groups again in May to discuss their progress. Full details of the seminars and follow-up activities will be presented in a future working paper.
Appendix 1. A Popular Multipurpose Green Manure in Tanzania

Crotalaria ochroleuca, an annual legume from Africa commonly known as Marejea, or sunnhemp, has emerged as a promising under exploited crop. Vol 3. No.1 of the ILEIA Newsletter reported on this promising legume. Recently, Fr. Gerald, a Benedictine missionary in Tanzania published a manual on Sunnhemp, called Sunnhemp/Marejea, which covers the many beneficial characteristics of this plant.

Among sunnhemp's many uses are the following: green manure, nitrogen fixation, weed suppression, livestock forage, and pest control. Farmers in Tanzania have found tillage easier in fields where sunnhemp has been grown and incorporated into the soil, due to improved soil texture. These farmers can plough their fields before the rains, giving crops the benefit of the full rainy season, improving their chances of a successful harvest. Sunnhemp's deep root system aerates the soil and increases water Infiltration. The deep roots also retard soil erosion.

Nitrogen fixing rhizobium associated with these roots, fix atmospheric nitrogen normally unavailable to plants. Professor M. P. Salema of Sokoine University of Agriculture, Morogoro, has isolated superior kinds of rhizobium for improved nodulation on sunnhemp. By inoculating their seeds with the rhizobium farmers can now increase their production.

Nitrogen that has been fixed by the soil rhizobium is made available to crops by composting sunnhemp or turning it into the soil in situ. The organic matter added to the soil also improves soil moisture retention and texture. Cut sunnhemp can be used as a mulch to suppress weed growth and to control erosion. Ultimately the sunnhemp mulch will decompose, adding nitrogen to the soil to benefit succeeding crops. Sunnhemp's low carbon to nitrogen ratio causes it to decompose readily, quickly adding nutrients to the soil. Sunnhemp, unlike most nitrogen fixing legumes, performs well on poor and acidic soils. For this reason farmers in Tanzania have used sunnhemp to revitalise weedy or infertile fields.

In addition to its soil improving qualities, sunnhemp also controls weeds. Under appropriate conditions sunnhemp establishes quickly and grows abundantly, thus out competing weeds. If planted densely, sunnhemp prevents weed growth in the first year, and reduces subsequent weed growth for the following 1-3 years. Sunnhemp can out compete couch grass (Digitaria SP) but not blackjack (Bidens pilosa). Over the course of 3 years sunnhemp eventually out competes stargrass (Cynodon SP) in paddies.

The same rapid, abundant growth that out competes weeds also controls erosion. Planting sunnhemp between crops, both spatially and temporally, maintains a continuous plant cover, which stabilises the soil and breaks the impact of raindrops. Since sunnhemp is drought tolerant, it is able to protect the soil when rains begin again.

Cultivation of Sunnhemp

Experienced sunnhemp farmers mix 10 kg of seed for each 0.5 hectare to be planted with sand or dry soil at the ratio of 1: 2 litres to assure a proper planting density (plants spaced 10-15 cm apart). Above ground growth is slow initially, as the plants develop deep roots. Eventually sunnhemp reaches a height of two meters or more, and flowers appear three or four months later. Sunnhemp does not re-seed itself, since its pods stay closed after the seeds have matured, even protecting them for months into the rainy season. After six months the plants begin to senesce. The stems, however may persist for
as long as eight or nine months, and will develop new leaves when cut one foot above ground, or when eaten by animals.

**Other Uses of Sunnhemp**

Sunnhemp can be grown as a fodder crop. Farmers in Tanzania have found that sunnhemp can constitute 60% of their cattle's feed. The stems that are left over are mixed with manure to compost them. Chicken will eat any part of the sunnhemp plant except for the seeds. One acre can yields up to 100 to 300 kilos of seeds; one kilo seed sells at 25/shillings in Tanzania. Some farmers let their cattle graze sunnhemp for one hour a day if they do not want to harvest the seed. Sunnhemp can also be used to feed tilapia.

According to farmers' observations, sunnhemp controls nematodes, which attack tomatoes. Farmers plant sunnhemp about four months before planting the tomatoes. Cut the sunnhemp and dig it in to the soil one-month before planting the tomatoes or when the sunnhemp is about one meter high. Sunnhemp also hosts a beneficial insect, the earwig. Earwigs enter stem borer tunnels in search of larvae. Occasionally they climb the foliage to prey on leaffolder larvae. Earwigs can consume 20-30 prey daily, and live 3-5 months. Farmers in Tanzania have noticed few harmful insects in fields where sunnhemp is inter-cropped with maize.

Farmers in Tanzania have discovered several successful management techniques for growing sunnhemp in association with their food crops. Some farmers plant single stands of sunnhemp before and after maize when chemical fertilizer is unobtainable. Although an extra ploughing is required to plant the sunnhemp, weeding is reduced, and maize yields are higher. Other farmers sow sunnhemp along with maize, and incorporate it into the soil when it nears the height of the maize.

Farmers who rotate sunnhemp with maize or sorghum plough the sunnhemp under at flowering. At this stage the sunnhemp has accumulated near to maximum amounts of nitrogen, and the biomes is still succulent enough for fast decomposition and release of nutrients. In very poor soils sunnhemp improves soil fertility most when the mature plant, including the seeds, are incorporated into the soil.
Sunnhemp can also be used in a rotational planting schedule along with rice and beans. Sunnhemp is planted in the rice fields at the time of the first rice weeding. The sunnhemp is still short when the rice is ready for harvest. After harvesting the rice, sunnhemp covers the field, and is ploughed in before planting beans. Farmers in Tanzania have found this method quite effective in controlling weeds. A later issue will feature a community where Sunnhemp is used as a fertilizer, and its seeds are valued as a cash crop.

For more information, or to order a copy contact:

Fr. Gerold Rupper, O.S.B.
Sunnhemp Seed Bank
Bos 1, Peramiho Tanzania
Appendix 2

The content of village seminars

1. Understanding cereal crops grown by farmers
2. Production constraints
3. Striga problem
   Types of crops attacked by Striga
   Biology and ecology of Striga
   Damage symptoms caused by Striga and effect on crop yield
4. Control measures practiced by farmers themselves
5. Introduction of already available Striga control options and their limitations depending on locality
6. Why green manure as an option for increase soil fertility and Striga control
7. Reason for scale up on the use of Crotalaria experience from Kilasilo farmers in Kyela
8. Lay out of the demonstration/evaluation plots

9. Volunteer Farmers i.e. willing to participate in the demonstration/evaluation plots
   Democratic election of Group Chairman
   Democratic election of Group Secretary
10. Distribution of Crotalaria seed @1kg for participating farmer
    Distribution of ¼ kg of pigeon pea to be included in the fertility improvement
    (ICEAP 00040 - late and ICEAP 00068 – medium maturing)

Appendix 3. Village Group membership

Kilasilo village - Kyela

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asegelisye Mwaseba</td>
<td>male</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>A. Aliko</td>
<td>male</td>
<td>Secretary</td>
</tr>
<tr>
<td>3</td>
<td>P.K. Fumbo</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>A. Mwandenuka</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>E.R. Mwaipopo</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>A.L. Mwakanyasi</td>
<td>Male</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Lea Kyusa</td>
<td>female</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Kibalika Mwandenuka</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Ezekiah Mwakapona</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Alfred Mwamudeza</td>
<td>Male</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Jaili Mwakatage</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Tusajigwe Isumo</td>
<td>female</td>
<td>Member</td>
</tr>
<tr>
<td>13</td>
<td>Flora Mwaseha</td>
<td>female</td>
<td>Member</td>
</tr>
<tr>
<td>14</td>
<td>Ruth Mwakibole</td>
<td>female</td>
<td>Member</td>
</tr>
<tr>
<td>15</td>
<td>Saidia Mwkafyuju</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>16</td>
<td>Oscar Mbrown</td>
<td>male</td>
<td>Member *</td>
</tr>
<tr>
<td>17</td>
<td>Benard Mwakalinga</td>
<td>male</td>
<td>Member</td>
</tr>
<tr>
<td>18</td>
<td>Angumbwisye Mwakesa</td>
<td>male</td>
<td>Member</td>
</tr>
</tbody>
</table>

* Village government Chairman
### Itope village – Kyela

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E. Mwang’onda</td>
<td>M</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>A. Mbalangwe</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Mwema Hamisi</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Hamisi Mwema</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>Rehema Mwalaba</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Christopher Mwaisabila</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Yusufu Kayuni</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Elizabeth Kahuka</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Upendo Haule</td>
<td>F</td>
<td>Member</td>
</tr>
</tbody>
</table>

### Sinyanga village - Kyela:

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lusekelo Kawilo</td>
<td>M</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>Mbutolwe Panja</td>
<td>F</td>
<td>Secretary</td>
</tr>
<tr>
<td>3</td>
<td>Henry Simfukwe</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Robinson Kiposolo</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>Abel Mwakalinga</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Israel Mwijande</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Boscal Mgetile</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Andwele Mwalukimba</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Angumbwisye Mwakipesile</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Lupakisywe Mwamakula</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Godon Mwakibambo</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Atupele Chinganya</td>
<td>M</td>
<td>Member</td>
</tr>
</tbody>
</table>

### Njugilo village - Kyela:

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robert Mwailubi</td>
<td>M</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>Twitike Jungwa</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Aden Mwakatabale</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Jason Mwasege</td>
<td>M</td>
<td>Secretary</td>
</tr>
<tr>
<td>5</td>
<td>Philemon Mwakasege</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Francis Mwalyagile</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Steven Mwanjalaba</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Edson Mwapasi</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Jackson Salim</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Andwele Mwakasege</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Frank Mwaisumo</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Jacob Mwaijobile</td>
<td>M</td>
<td>Member</td>
</tr>
</tbody>
</table>
### Kiswira village - Matombo

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>George Mkami</td>
<td>M</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>Germana Peter</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Patrick Francis</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Otto Nzeru</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>John Msimbe</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Alloycé Dominick</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Vicent Midongo</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Paulo Mloka</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Adolf Mawango</td>
<td>M</td>
<td>Secretary</td>
</tr>
<tr>
<td>10</td>
<td>Michael Roman</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Felista Rock</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Simforosa Michael</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>13</td>
<td>Enstaki Theodory</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>14</td>
<td>Lydia John</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>15</td>
<td>John Yully</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>16</td>
<td>Albetina Thomas</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>17</td>
<td>Wilvina Dimoso</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>18</td>
<td>Herriel Amir</td>
<td>M</td>
<td>VEO</td>
</tr>
</tbody>
</table>

### Kibangile Village - Matombo

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmers Name</th>
<th>Sex</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Filbert Roman</td>
<td>M</td>
<td>Chairman</td>
</tr>
<tr>
<td>2</td>
<td>Adam Ally</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Ally Shomary</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Salum Mizambwa</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>Mohamed Ally</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Josephina Amosi</td>
<td>F</td>
<td>Secretary</td>
</tr>
<tr>
<td>7</td>
<td>Yahaya Selemani</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Jumanne Rashid</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Mzeru mbaruku</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Juma Hussein</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Hussen Mbaruku</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Anjela Aloyce</td>
<td>F</td>
<td>Member</td>
</tr>
<tr>
<td>13</td>
<td>Salehe Ahamadi</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>14</td>
<td>Gabriel Joseph</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>15</td>
<td>Thomas John</td>
<td>M</td>
<td>Member</td>
</tr>
<tr>
<td>16</td>
<td>Abdul Rajabu</td>
<td>M</td>
<td>Member</td>
</tr>
</tbody>
</table>
Appendix 4: FARMER QUESTIONNAIRE

District………………………………Village…………………………

1. Farmer information
Name:…………………………..Age:…….. Sex:………Relationship to head of household:………………

2. Livelihood situation
2.1 Livelihood group………..  2.2 How many cattle do you own?…….. 0; 1-5; 6-10; >10

2.3 a In the past 12 months have you hired in labour? YES/ NO?
   b On what basis do you hire labour? (eg cash, food)…………………………

2.4 a In the past 12 months have you hired out your labour? YES/ NO
   b On what basis do you hire out your labour? (eg cash, food)…………………………

2.5 (a) In the past 12 months for how many months did your household have enough food?……months
   (b) In a GOOD year for how many months does your household have enough food?……months
   (c) In a BAD year for how many months does your household have enough food?……months

2.6 (a) Do you have any sources of non-farm income? YES/ NO
   If YES (b) What are your sources of non-farm income?……………………………………………….
   (c) Approximately what proportion of your income comes from non-farm sources?
       (1) 0 (2) > 0 <=¼ (3) >¼ <=½ (4) >½ <=3/4 (5) >3/4 < All (6) All

2.7 How do you cultivate/ prepare the ground for upland rice?
   (1) Hand hoe (2) Ox plough (3) Other …………………

2.8 (a) In the past 12 months did your household sell any rice YES/ NO?
   (b) If YES, how many bags?…………..
   c) How many bags would sell in a good year ?……….
   (d) How many bags would you sell in a bad year?……………

3. Land
3.1 What is the total area of land available to you for farming?………acres
3.2 What is the total area of land available to the household to which you belong for farming?……..acres
3.3 How many separate plots of land do you have available to you for farming (including land under fallow)?……..
3.4 Please provide the following information about each plot

<table>
<thead>
<tr>
<th>No.</th>
<th>How land was acquired +</th>
<th>Year in which land was acquired</th>
<th>Location or type of shamba^</th>
<th>Distance from h’-stead Minutes walking</th>
<th>Area acres</th>
<th>Soil type-farmer classification</th>
<th>Suitable for Rice *</th>
<th>If NOT suitable for rice explain why not</th>
<th>Suitable for which other crops **</th>
<th>Land use last season **</th>
<th>Last time green manure was applied</th>
<th>Last time animal manure was applied</th>
<th>Last time chemical fertilizer was applied</th>
<th>STRIGA***</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+ How land acquired; VG =village govt; I= Inherited; P =Purchased; B =borrowed; R = rented; G =Gift; Co= Communual; O = Other.
^ Eg Matombo division: Hilly/ forest fields (Mwituni) Home gardens (Jaladani) Valley bottoms (bustani) Lower plains (makondeni)
* Suitable for rice: N= not suitable; S = suitable; VS = very suitable
** BE=Bean; BN= bambaranut; CA = cassava; CAB –cabbage; CO= cotton; COP= cowpea; CP =chickpea; FA = Fallow; GG = green gram; GN=g’nut; MA=maize; PM = Pearl millet; RI= Rice; SF=sunflower; SO = Sorghum; SP=sweet potato; SS=simsim; OT=Other;
*** Striga: 0 =Zero/ None; L= low; H =High.
Appendix 5: Demonstration plot monitoring sheet.

<table>
<thead>
<tr>
<th>Village:</th>
<th>Farmer name:</th>
<th>Recorder:</th>
</tr>
</thead>
</table>

For each plot:

2002/03 season crop: .......... 2003/04 season crop: ............

For 2002/03:

1. Tillage undertaken before planting: .................................................................
2. Planting date: ...................................................................................
3. Weeding dates: First weeding:............ Second weeding:............... Third weeding:............

**FOR RICE PLOTS ONLY**

4. Number of *Striga* shoots in 5m x 5m area when rice is flowering: ..................
5. Kgs of rice harvested from a 5m x 5m area in the plot.

**FOR PIGEON PEA PLOTS**

6. Kgs of pigeon pea seed harvested from a 5m x 5m area in the plot

For 2003/04:

**FOR RICE PLOTS PLANTED AFTER *CROTALARIA* or “Kiraka” (Matombo only)**

1. Date of incorporation of *Crotalaria* or kiraka: ............................................
2. Method of incorporation: As whole plants or chopped:.................. With hoe or plough:................

**FOR ALL RICE PLOTS (following rice, Crotalaria or pigeon pea)**

2. Rice Planting date: ..............................................................
6. Rice Weeding dates: First weeding:......... Second weeding:............... Third weeding:............
7. Number of *Striga* shoots in 5m x 5m area when rice is flowering: ..................
8. Kgs of rice harvested from a 5m x 5m area in the plot: ..................................
Appendix 6
MRADI WA KURUTUBISHA UDONGO KWENYE MASHAMBA YA MPUNGA YALIYOATHIRIKA NA VIDUHA (ZA0511/R8191)

Kijiji…………………………Mkulima……………………………………
Mchukua takwimu……………………………………

KARATASI YA KUCHUKUA TAKWIMU MUHIMU

Mpangilio wa Vipando:

Msimu wa kwaqnza..Mwaka ..200…

<table>
<thead>
<tr>
<th>Majere</th>
<th>Mbaazi</th>
<th>Mpunga</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Tkwimu za kuchukua:

<table>
<thead>
<tr>
<th>Plot ya Mpunga</th>
<th>Tarehe ya kupanda mpunga</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tarehe ya palizi ya kwanza</td>
</tr>
<tr>
<td></td>
<td>Tarehe ya palizi ya pili</td>
</tr>
<tr>
<td></td>
<td>Tarehe ya palizi ya tatu</td>
</tr>
<tr>
<td>Idadi ya viduha eneo la 5m x 5m</td>
<td></td>
</tr>
<tr>
<td>Mavuno ya mpunga eneo la 5m x 5m (kg)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plot ya Mbaazi</th>
<th>Impigwa dawa mara ngapi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mavuno ya mbaazi eneo la 5m x 5m (kg)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plot za marejea</th>
<th>Tarehe ya kupanda…….</th>
</tr>
</thead>
</table>

Tarehe ya kufukia marejea---------------------------------
Njia iliyotumika kufukia marejea-
A) mimea mizima au imekatwakatwa
B) Kutumia jembe la mkono
C) Tractor

Tia tick iliyokuhusu
Msimu wa pili...200........

Mpangilio wa upandaji

<table>
<thead>
<tr>
<th>Mpunga</th>
<th>Mpunga</th>
<th>Mpunga</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Takwimu za kuchukua:

<table>
<thead>
<tr>
<th>Plot 1</th>
<th>Idadi ya viduha eneo la 5m x 5m Wakatimpunga unachanua (12WAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Idadi ya palizi</td>
</tr>
<tr>
<td></td>
<td>Mavuno ya mpunga eneo la 5m x 5m (kg)</td>
</tr>
<tr>
<td>Plot 2</td>
<td>Idadi ya viduha eneo la 5m x 5m, wakati mpunga unachanua (12WAP)</td>
</tr>
<tr>
<td></td>
<td>Idadi ya palizi</td>
</tr>
<tr>
<td></td>
<td>Mavuno ya mpunga eneo la 5m x 5m (kg)</td>
</tr>
<tr>
<td>Plot 3</td>
<td>Idadi ya viduha eneo la 5m x 5m, wakati mpunga unachanua (12WAP)</td>
</tr>
<tr>
<td></td>
<td>Idadi ya palize</td>
</tr>
<tr>
<td></td>
<td>Mavuno ya mpunga</td>
</tr>
</tbody>
</table>

12WP = Wiki 12 baada ya kupanda mpunga

Tarehe za kupalili mpunga

Palizi yakwanza------------------------------------------
Palizi ya pili--------------------------------------------
Palizi ya tatu--------------------------------------------

Idadi ya watu
Waliofika kuulizia na kutaka ushauri------------------
Walioomba mbegu za marejea-----------------------------

Matatizo uliyo yaona na ushauri wako.

Matatizo