

**Report of a visit to Tanzania to assess small scale paddy
dehulling in the Morogoro region**

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Background

In many developing countries, small-scale rice mills are operated on a custom milling-fee basis. In urban areas rubber roll mills are often used, whilst in rural areas single-pass steel dehullers are more widespread, often powered by a diesel motor if electricity is not available.

There are differences in the quality of rice produced by rural processors in Ghana and Tanzania. In Ghana the quality of rice, both parboiled and raw, is often poor. In the case of raw milled rice the percentage of broken grain can be very high. In Tanzania the quality of locally produced raw rice, using similar milling systems, is very high. The project aims to identify specific post harvest practices employed to produce good quality rice (e.g. variety, tempering, harvesting and milling techniques, using small scale technologies). If such practices could be transferred to other countries such as Ghana, then rural farmers and processors in those countries would benefit

Purpose of visit

The purpose of this visit was to provide preliminary baseline information from throughout the rice production chain in order to gain an insight into aspects which might affect the quality and marketing of milled rice including:

- details of current post harvest practices prior to milling
- typical prices for milled rice to identify quality/value relationships.
- sustainability of milling operations
- current sources and types of mill:
- physical quality attributes of milled rice (grain size, colour, broken grain, extraneous matter etc)
- socio-economic factors including the role of women in rice processing systems

Structure of visit

A total of 18 rice mills in Morogoro town, Ifakara, Kilombero and Matombo were visited. Informal discussions were held with millers, traders and farmers in each district. Wherever possible samples were taken for analysis. A visit to a large commercial mill in Dar es Salaam was also made. Brief summaries of the discussions held may be found in Appendix 3 and are summarised below.

Introduction

It is estimated that 400,000 hectares of rice are grown throughout Tanzania, located mainly on alluvial plains, coastal regions and valley bottoms (Kanyeka et al 1995). Rice consumption has steadily increased from an estimated 9.5kg per capita in the 1970s to the current estimation of 14.1kg. Currently demand exceeds production with an estimated National annual requirement of 423,000 tonnes against production figures of 353,812 tonnes (Tanzania Ministry of Agriculture, Food Security Department data)

Although rice is grown throughout Tanzania there are six major regions of production: Shinyanga, Morogoro, Mbeya, Tabora, Mwanza and Coastal regions/Dar es Salaam. The two regions selected for this project (Morogoro and Mwanza) generally produce around one third of the national paddy production (Table 1).

Table 1

% Contribution of major paddy growing regions to total National Paddy Production (,000 MT)

Region	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Mbeya	59	47	112	120	163	162	114	120	114
Morogoro	129	57	109	119	118	123	121	87	84
Mwanza	100	64	113	113	101	96	58	67	74
Shinyanga	95	64	118	112	88	83	55	190	26
Tabora	45	22	47	46	57	78	31	20	42
Total	428	254	499	510	527	542	379	484	340
National total	624	370	641	614	723	734	550	811	506
% contribution by 5 regions	69	69	78	83	73	74	69	60	67
% contribution by Morogoro and Mwanza	37	32	44	38	30	30	33	19	31

The majority of the rice (74%) is grown on rainfed lowland ecosystems (Kanyeka et al 1995). There are two major production systems in these regions:

- Bunded and shallow flooded (32% of production)
Typically 500-700mm rainfall. Includes Shinyanga, Tabora and Mwanza regions
- Unbunded and flooded (42% of production)
Typically 800-1200mm rainfall. Includes Kilombero valley (Morogoro region)

Most rice is grown by small scale farmers with an average holding of 0.5-2.5 acres. The rice is usually harvested by hand, cutting the stalks about 25 cm from the ground and piling them into small heaps in the field where they are kept for 1-2 days before threshing.

A cultivar preference survey conducted in 1995 showed that the rice variety *Supa India* is grown throughout the country. This is a traditional variety (of unknown origin, thought to have been introduced in the 1960s) preferred for its aromatic characteristics, processing and eating qualities. Up to 200 other varieties are grown throughout the regions, these encompass traditional, improved and introduced varieties. Most of the rice grown is, however, of traditional origin. Introduced varieties are grown mainly on irrigated land, and despite the promise of higher yields, have not been widely accepted by the majority of farmers and consumers.

Rice Breeding

Due to a rising demand for rice, by increasing populations and changing eating patterns. In 1965 Tanzania embarked on a breeding programme, led by Dr Monyo at Kilosa Research Institute, aimed at increasing yields. Using genetic material from IRRI and WARDA crossed with local varieties, scientists at Katrin Research Station selected a

number of high yielding varieties. However, there was low farmer uptake for these as the taste was unacceptable. It was therefore decided to embark upon a *Supa India* improvement programme. To date the most successful crosses have been:

- Line 88 - awnless, slender, aromatic
- Line 85 - aromatic but awned (therefore unpopular)
- TXD 220 - aromatic but prone to lodging
- Line 275 - narrow aroma profile (unscented)
- Naro fupi - narrow aroma profile

Line 88 therefore seemed to be the most promising. On-farm trials found that Line 88 is susceptible to breakage on milling if harvested at 12-14% moisture content. Farmers were therefore encouraged to harvest it before drying had occurred and to dry it carefully for 2-3 days, spread in a layer 5-10cm deep. In the area surrounding Katrin research station (where the improved varieties are available) over 90% of the rice grown is still *Supa India* (also known as *Chipa* and *Supa Kilombero*)

Rice farming in the Morogoro region

Morogoro region covers an area of 73,039 km² some 20% of which is cultivated with an average farm size of 2 ha. It is divided into four main districts: Morogoro Rural, Kilosa, Kilombero and Ulanga (Appendix 1). Paddy is the primary crop in the lowland and river basin regions and contributes to some 20% of the total cultivated land producing 238,281 tonnes in 1995.(RALDO Morogoro office Appendix 2).

The majority of paddy is grown by smallholder farmers with a long tradition of rice growing associated with high labour inputs. Farmers around the irrigated schemes are adopting new technologies such as high yielding varieties and the application of chemical fertilisers and herbicides. (Laizer R K 1998)

Structure of the rice trade in Ifakara

Farmers sell most of the paddy directly after harvest. Most farmers will retain a portion of the crop either for sale at various times throughout the year, or for home-consumption, until the next year's harvest.

The paddy is sold to itinerant traders who arrange for the paddy to be milled in any one of the several rice mills located around the rice-growing area. Traders will purchase any quantity; the amount is dependent on the amount of ready cash they have available to pay farmers. Traders will identify a buyer for the milled rice and are prepared to pay transport and storage costs prior to using the milling facilities. The traders use the rice-mills on a custom-milling basis. The millers are paid in cash for this operation. The survey showed that the cost for milling varied only between 800/- and 1200/- per Kg.

The rice husk is virtually all discarded in large heaps around the rice mills. Since it is not removed it can be classed as zero value. Nobody seems to have a use for it.

Mill owners often provide short-term free credit to potential customers (either traders or farmers) to encourage them to use the facilities. This suggests that there is competition for services between millers.

Traders sell to secondary traders who are prepared to aggregate small quantities of rice into larger quantities ready for haulage to Dar es Salaam, or to Oman via Pemba.

The rice levy system in operation leads to rice being transported in extremely large bags known as "lumbesas". These bags are of 100kg and upwards and are frequently 230kg. The charge for haulage is "per bag" and is the same for a bag of 100kg or for anything up to 230kg. There is a tendency, therefore, for traders are therefore encouraged to package in as large a quantity as is feasible. Hauliers set this quantity at 230kg since this is the maximum that a man can load on his back to carry from the bagging site onto a truck.

Rice and paddy duties payable within district and payable on import to Dar es Salaam

- Lifting charge is Tshs.1,000/= per bag of lumbesa type.
- When selling paddy within the District, a trader has to pay a District levy of Tshs. 800/= per bag of 100kg or more. For rice the charge is Tshs. 2,000/= per bag of 100kg or more.
- Rates for export from district.
Paddy: 1000/= per bag.
Rice: 2000/= per bag.
- Import duty of rice to DSM is 25% of the purchase price.

Rice milling.

When paddy is harvested the edible kernel is covered by a protective, hard, inedible husk (hull) which must be removed before the rice can be consumed. Rice with only the husk removed is known as brown rice. Beneath the husk are the bran layers which are rich in vitamins, minerals and protein. These layers are usually removed by gentle abrasion to produce milled white rice (see diagram in Appendix 4).

Rice milling in Tanzania is generally carried out on a custom-fee basis. Farmers may take small quantities of paddy for home consumption to the mills but the majority of the custom is from traders. The majority of rice mills are small-scale (up to 1 tonne per hour) though there are a few large scale rice mills throughout the country. Even these large scale mills operate mainly on a custom fee basis though some purchase paddy directly from farmers at harvest time and process for sale as a branded product.

Small scale mills fall into two categories: Steel hullers and rubber roll mills

- Steel hullers (for diagram see Appendix 4)

Steel huller mills, also known as Engleberg-type mills are a one pass operation with a throughput in the region of 250-450kg per hour.

The mill consists of a central, cylindrical, horizontal rotating steel shaft with a short Archimedian screw at the intake end and horizontal ribs along the rest of its length. This is encased in a cylindrical chamber slightly larger than the mill, the lower side of which is comprised of replaceable perforated screens. An adjustable steel blade protrudes into the chamber to create a variable gap between the blade and the horizontal ribs on the shaft.

Paddy is tipped into the grain inlet and is fed into the milling chamber via the Archimedian screw. The paddy grains are then forced through the gap between the rotors and the horizontal ribs, creating a shear force which splits the husk open, allowing the separated rice kernels and husk to fall into the milling chamber. The smaller sized kernels pass easily through the gap between the blade and ribs. As they are forced along the length of the milling chamber the soft bran layers are removed by frictional forces between the metal components of the mill, other rice grains and residual husk. These fine bran particles are discharged from the mill through the perforated screens. The rice and husk is then discharged from the mill. Some models may have a blower fitted to the mill which aspirates the husk from the milled rice at the point of exit. If no blower is fitted the rice has to be winnowed by hand.

These mills are fabricated world-wide, particularly in India and China. However the technology required for producing them is relatively simple and, in many cases, they can be constructed locally. They are powered by means of a drive belt from a diesel engine or electric motor. Maintenance is simple, screens need replacing when damaged and the blade may need periodic regrinding/replacement. The millers interviewed reported that they had never replaced the main shaft of the machine.

In Tanzania, the Mangula factory fabricates steel huller mills prices quoted at the time of the visit were:

Steel huller mill 350,000 /-
Replacement shafts 40,000 /-
Blade 9,000/-
Screens 3000/- each (2 required)
20hp motor and belts 650,000/-
Blower 60,000/-

The cost of an imported Indian machine (without blower) was 280,000/- (ex Auto Sokoine Ltd, Dar es Salaam)
(exchange rates 800/- = \$1; 1250/- = £1)

- Rubber roll mills (for diagram see Appendix 4)

Small scale rubber roll mills are also a one pass operation in that a batch of paddy is processed in a single machine through which it passes by gravitation. Within the machine are a number of processing components each with a dedicated purpose. Throughput is dependant on the size of the machine but is generally in the range of 500-2500 kg per hour.

Paddy is fed into the mill through a controlled flow hopper. It then passes through one pair of rolls, coated with a layer of rubber. These rolls rotate at differential speeds but in the same direction, thus creating a shear force. The gap between the rolls is variable and should be set for each batch of paddy. The gap is set in such a way that the husk is split open and removed but the rice grain is not damaged. If mixed varieties are used, this creates a problem for the miller as optimal settings for a larger-grained variety would result in inefficient dehusking of smaller grains of a different variety, conversely, if settings are chosen for smaller grains the larger ones are likely to have their kernels broken.

After passing through the rubber rolls the husk is aspirated from the kernels and discharged, usually to a point outside of the building. The dehusked grain (brown rice) then passes to an integral polisher, usually an abrasive cylinder, where the bran is removed. The degree of milling is controlled by the residence time within the polishing chamber. Bran is removed via perforated screens and the milled rice is discharged from the machine.

Rubber roll mills are mainly manufactured in China and Japan. The technologies used are unsuited to local fabrication in Tanzania. The composition of the rubber is commercially confidential. Similarly spare parts such as rubber rolls, shafts and abrasive cylinders need specialist manufacture and therefore need to be imported. Screens can also be imported though sometimes these may be locally fabricated. Rubber rolls need frequent replacement, (approximately every two weeks) in order to maintain product quality.

There are several companies importing rubber roll mills of Chinese origin into Dar es Salaam. These are usually supplied with a dedicated electric motor (though a 30-36hp diesel engine could be used). Current prices were obtained from Auto Sokoine Ltd, though it was stated that there is some room for negotiation within these prices.

SB 10 with motor (throughput estimated at 900 kg /hr)	1,400,000/-
SB 30 with motor (throughput estimated at 1800 kg /hr)	1,600,000/-
SB 50 with motor (throughput estimated at 2700 kg /hr)	2,200,000/-
SB 50 without motor	1,600,000/-
Replacement screens for SB10	6,000/- (pair)
Rubber rolls	28,000/- each

Large scale mills (typically 2-4 tonnes per hour) usually operate on the same principle as the small rubber roll mills though there is a separate machine for each unit operation and extra equipment may be added to further improve product quality. A typical mill might consist of the following operations:



All of the mills visited appeared to be well maintained. Millers were conscious of the quality implications associated with good maintenance and regularly replaced screens and rubber rolls. The spare parts were readily available both in Dar es Salaam and in local towns.

Quality perceptions

All of the farmers, traders and millers interviewed considered that both variety and post harvest operations had an effect on quality. Most considered that Supa India was the best variety for milling and was also well-liked by consumers for its flavour and aroma. All agreed that harvest time and subsequent drying were vital to obtain good quality milled rice. Paddy needed to be harvested before it had completely dried on the plant in the field but should be adequately dried before storage to prevent it from becoming mouldy. A few millers also stressed the importance of machinery maintenance, correct adjustment of the mill and timely replacement of worn screens and rollers.

Analysis of samples

• Moisture content of paddy samples

Paddy samples were collected immediately prior to milling. Moisture content was determined by Kett moisture meter and later confirmed by oven moisture analysis (reference method). The moisture meter gave lower readings than the reference method but the two sets of results were strongly correlated ($r=0.989$). Oven moistures are reported in Table 1.

• Milled rice quality

Milled rice was collected from both rubber roll and steel huller mills. The percentage broken grain was determined and the physical characteristics assessed.

Table 1

Mill number	Mill type	Moisture Content of paddy	% broken grain	% extraneous organic matter	% extraneous inorganic matter	% paddy	% red/red streaked kernels
2	RR	11.30	31.20	0.01	0.00	0.72	1.87
3	E	13.22	24.52	0.06	0.00	0.20	0.05
4	RR	11.79	43.86	0.00	0.00	1.23	1.70
5	RR	12.79	19.80	0.01	0.00	0.34	0.00
9	E	9.33	42.52	0.00	0.00	2.85	0.95
10	MP	10.50	33.46	0.13	0.00	0.11	1.34
11	RR	10.62	44.12	0.04	0.07	0.16	0.00
15	RR	10.99	17.86	0.04	0.02	0.12	0.25
16	RR	8.56	27.20	0.01	0.19	0.00	0.95

RR Rubber roll

E Engleberg

MP Multi-pass (large commercial mills)

red/red streaked grain = rice kernels having bran with natural red pigmentation

The moisture content of the paddy samples ranged from 9.3 –13.22, there was no correlation between the moisture content and the % broken grain. Breakages for the single pass roller mills ranged from 17.9 - 44.12%, the two samples collected from Engleberg mills were with this range at 24.5% and 42.5%. The Grade 1 milled rice from the more sophisticated multi pass mill contained 33.5% broken grain.

Levels of organic and inorganic matter were very low for all samples. ISO 7301 Rice specification stipulates that the level of organic and inorganic matter should be below 0.5% in each case. The ISO standard also stipulates a tolerance of 1% for paddy in milled rice, samples from Engleberg mill No. 9 (2.85%) and Rubber roll mill No 4

(1.23%) would therefore not comply with the International standard. The aggregate red/red streaked rice content of all samples was well within the International Standard specification of 4% (red) and 8% (red streaked).

The International Standard does not stipulate breakage levels as this is usually left to individual purchase contracts. However, with the exception of the two samples with excess paddy, all samples collected would easily meet the quality criteria of ISO 7301.

The milled rice samples were stained with methylene blue/eosin yellow to enable the degree of milling to be assessed. This staining technique colours the endosperm (starch) pink and the inner and outer bran layers blue and green respectively. All of the samples collected appeared to be well milled. The two samples collected from Engleberg mills (Figure 1, dishes 3 and 9) were visually very similar to those collected from the rubber roll mills and also to the samples collected from large scale, multi-pass machine (dishes 10a and 10b)

Conclusions

Following this visit the following conclusions were drawn

- Rubber roll mills are superseding steel dehullers in the major areas of rice production in the Morogoro region.
- This is largely due to increased availability and demand from traders who demand a highly polished product and fast throughput
- Millers consider that proper management of rice harvesting time and subsequent drying and storage is paramount for the production of good quality milled rice.
- *Supa India* is the preferred variety due to its good processing characteristics and the presence of ready markets.
- Rice millers are quality-conscious and maintain their mills well.
- Moisture content and % broken are very variable from mill to mill but the two factors are not correlated.
- The majority of samples would comply with the ISO7301 quality criteria

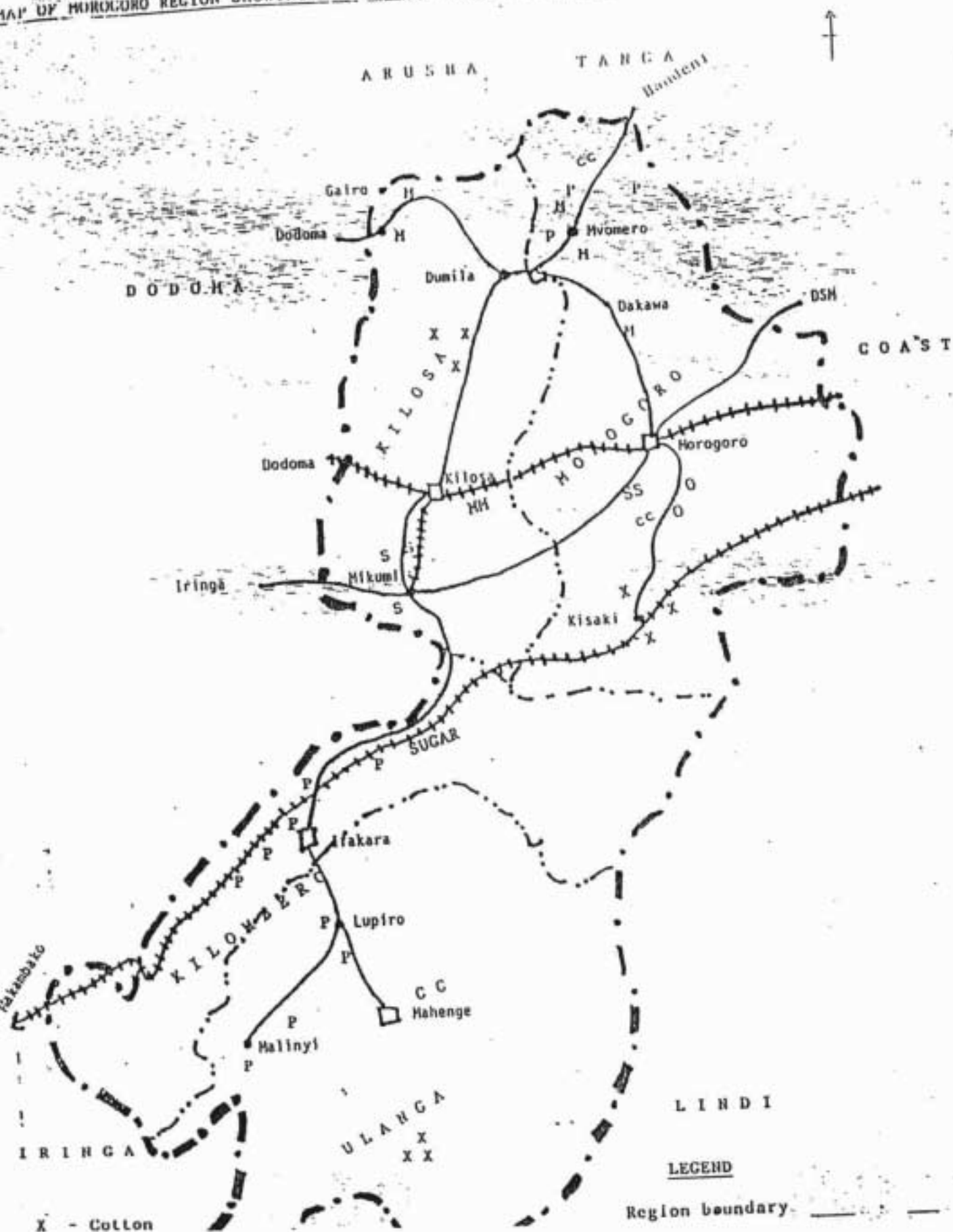
Recommendations for the second phase of the project

- A visit should be made second rice growing region (Lake Zone) to determine the extent of use of rubber roll mills and steel hullers and to examine harvesting and milling practices.
- A further visit to Morogoro region to examine harvesting and milling practices.
- A direct comparison of the effect of rubber roll and Engleberg milling on the quality of milled rice.

Appendix 1

Map of Morogoro region

FIGURE 1
MAP OF MOROGORO REGION SHOWING DISTRIBUTION OF THE MAIN CROPS



Appendix 3

Summary of meetings held

Mill 1

Name of mill	Kibaoni,
Location	Ifakara
Type of mill	Chinese Rice Milling unit #N21
Age of mill	3 years
Cost	800,000 Tsh
Source	Dar es Salaam
Spare parts - availability and cost	Easy to obtain in Ifakara Rubber rolls replaced after each 100 bags at a cost of 20,000 Tsh each Screens replaced more frequently cost 2000 Tsh each
Capacity	100 bags per day (12 hours) in peak season
Quality perceptions	Supa India is the best variety for milling because of reduced breakage.
Charges	1000 Tsh per bag
Storage facilities	Ample storage available
Drying facilities	
Other comments	Most custom is from traders A new, modern, large capacity mill has recently been installed locally which has taken a lot of custom Considered that rubber roll mills gave a better quality product than steel huller mills
Samples taken	No. The only paddy available (Remota variety) was too wet for milling (Approx 15.3%)

Mill 2	
Name of mill	Boma Road
Location	Ifakara
Type of mill	Chinese Rice Milling unit SB30(Shan Dong Yu Tai Machinery Works)
Age of mill	1 year
Cost	1,150,000 Tsh
Source	Dar es Salaam
Spare parts - availability and cost	Easy to obtain in Ifakara Rubber rolls replaced after each 1000 bags
Capacity	1 bag (75kg) in 2 minutes
Quality perceptions	Paddy must be harvested punctually and adequately dried before storage. Supa India and Dunduli (red) are good for milling
Charges	1000 Tsh per bag
Storage facilities	No storage facility
Drying facilities	
Other comments	Thought to be in the region of 50 rice mills in Ifakara. Almost all are rubber roll type (mostly small Chinese type). About 3 of the larger mills in Ifakra, preferred by traders
Samples taken	Yes Kalinganauala variety

Mill3	
Name of mill	Maendeleo milling machine (Mr Killian)
Location	Kibaoni
Type of mill	Steel Huller mill, "Chorima" local fabrication
Age of mill	unknown
Cost	(300000 Tsh 1998 price of similar mill)
Source	
Spare parts - availability and cost	Easy to obtain in Ifakara Sreens last 1-2 weeks during peak period
Capacity	450kg per hour Only does 2-3 bags per day as traders prefer Satake type of mill
Quality perceptions	Paddy must be harvested punctually, before it dries too much. Threshing in this area carried out by hand beating or by driving a tractor over panicles Not considered to have an adverse effect on breakage
Charges	1000 Tsh per bag
Storage facilities	No storage facility
Drying facilities	No drying facilities
Other comments	traders Farmers hire tarpaulins to thresh on. Panicles are usually stored in a heap for some time before threshing
Samples taken	

Mill 4	
Name of mill	Derek N Ubwe Tel 0811 602904 Box 65179 Dar es Salaam
Location	Ifakara
Type of mill	Chinese Rice Milling unit SB30(Shan Dong Yu Tai Machinery Works)
Age of mill	6 months
Cost	
Source	Dar es Salaam
Spare parts - availability and cost	Easy to obtain in Dar Rubber rolls replaced when rubber is reduced to a depth of 2mm
Capacity	15 bags per hour, depending on type of rice (1bag =91kg yields 68-70 kg milled rice)
Quality perceptions	This type of mill gives cleaner rice because the husk is aspirated. Most samples need a period of sun drying before milling to ensure they are properly dry. Preferred varieties: Kisegesya, Supa India, SP88,Karinga Nawula Mixed varieties cause milling problems
Charges	1000 Tsh per bag (15/- per kilo)
Storage facilities	Large storage facility
Drying facilities	Tarpaulins available
Other comments	Thought to be in the region of 50 varieties grown in this region. Depending on grain and careful setting of mill can achieve 90-95% whole grains Sometimes subsidises transport costs to attract business
Samples taken	Yes Mixture of Sigira, Kalanyuala and Supa India

Mill 5	
Name of mill	Cosovo mill
Location	Ifakara
Type of mill	Chinese Rice Milling unit SB50
Age of mill	3 months
Cost	
Source	Dar es Salaam
Spare parts - availability and cost	Easy to obtain in Dar Rubber rolls replaced 6 times so far at a cost of 35000 each Screens replaced 10 times -cost 2000each
Capacity	150 bags in 12 hours
Quality perceptions	Early harvesting essential Need a good, modern mill. Supa India is best variety for milling
Charges	1000 Tsh per bag
Storage facilities	Large storage facility used by both farmers and traders Pays a security guard 30,000 per month
Drying facilities	None, rice is fit for milling on arrival at mill
Other comments	Traders buy and store paddy to speculate on prices.
Samples taken	Yes Mixture of Mwanza and Supa India

Mill 6	
Name of mill	Kikwawila
Location	Ifakara Road
Type of mill	Steel Huller type
Age of mill	10 months (second hand)
Cost	
Source	
Spare parts - availability and cost	
Capacity	3 bags per day in season
Quality perceptions	Need to harvest at high moisture content. Need to set machine correctly
Charges	1000 Tsh per bag (66.5 kg) Weighs each bag (range 75-90kg and charges accordingly)
Storage facilities	No storage facility
Drying facilities	No drying facilities
Other comments	
Samples taken	

Mill 7	
Name of mill	Signale
Location	Ifakara Road
Type of mill	Chinese Rice Milling unit SB30(Shan Dong Yu Tai Machinery Works)
Age of mill	9 months
Cost	
Source	
Spare parts - availability and cost	
Capacity	80-85 bags per day in high season
Quality perceptions	
Charges	15 Tsh per kilo
Storage facilities	Free storage facility
Drying facilities	
Other comments	
Samples taken	

Mill 8	
Name of mill	Signale
Location	Ifakara road
Type of mill	Steel huller type
Age of mill	Installed within the last month
Cost	
Source	
Spare parts - availability and cost	
Capacity	
Quality perceptions	
Charges	1000 Tsh per bag
Storage facilities	Limited storage facility
Drying facilities	
Other comments	
Samples taken	

Mill 9	
Name of mill	Kiberege
Location	Ifakara Road
Type of mill	Engleberg type used for small quantities SB50} used during peak season for large quantities #N23]
Age of mill	
Cost	
Source	
Spare parts - availability and cost	
Capacity	
Quality perceptions	Paddy must be harvested punctually as soon as it is dried Prompt threshing and good storage Mixed varieties do not cause any problems for milling Supa India and Dunduli (red) are good for milling
Charges	600 Tsh per bag (steel huller) 800 Tsh per bag (rubber rolls)
Storage facilities	Large storage facility
Drying facilities	Large concrete drying area for 30-40 bags. Some customers bring up to 200 bags so provides tarpaulins on adjacent land.
Other comments	Cost of husk disposal is a problem and is an additional cost.
Samples taken	Yes Paddy, milled rice and bran

Mill 10	
Name of mill	Rahim rice mill, Tobacco road
Location	Morogoro
Type of mill	Large scale multi pass Buhler mill Previously owned by NMC
Age of mill	2 years since privatisation
Cost	
Source	Germany
Spare parts - availability and cost	Easy to obtain in Dar es Salaam
Capacity	1 bag (75kg) in 2 minutes
Quality perceptions	Good quality paddy yields 2.4% broken grain (Chenga - sold for use in rice buns) Poorly treated paddy has 4,8% broken. Need to harvest promptly and dry for 1 day
Charges	1300 Tsh per bag (125kg)
Storage facilities	Very large storage facility (5000 bags) no charge
Drying facilities	Some tarpaulins available
Other comments	Rubber rolls which had been replaced were very badly worn, in some cases down to the metal. Mostly used by traders who typically bring in 10 bags per week Produce two grades - Standard and Grade 1 Paddy sells at 10000/- at harvest rising to 20000/- just before harvest
Samples taken	

Mill 11	
Name of mill	Teti opposite Chuma Garage
Location	Morogoro
Type of mill	Chinese Rice Milling unit SB10 and SB50
Age of mill	Present operator has been renting for 10 months
Cost	
Source	
Spare parts - availability and cost	Easy to obtain in Morogoro
Capacity	100 bags per day (both machines)
Quality perceptions	<p>Suba variety breaks easily Supa India less breakage VIP (from Indonesia) does not command a good price as customers do not like the taste (imported milled rice -but is sometimes mixed with local rice to improve the colour so as to attract customers)</p> <p>All paddy is dried and then cooled before milling.</p> <p>Varieties should not be mixed in order to attract a good price</p>
Charges	1000 Tsh per bag
Storage facilities	Storage facility for 500 bags
Drying facilities	Large drying area available
Other comments	<p>At harvest time business is mostly from farmers.</p> <p>Traders start moving in after 1 month</p>
Samples taken	Yes Kihogo red variety (4 samples #10 mill)

Mill 12	
Name of mill	Al-Burhani mill
Location	Morogoro
Type of mill	2 Chinese Rice Milling units SB50
Age of mill	
Cost	
Source	
Spare parts - availability and cost	Rollers obtained locally - replaced after 500 bags Sieves last about a month, replaced as soon as a single hole appears
Capacity	1 bag takes 4 minutes (100 bags per day)
Quality perceptions	All rice is dried and then cooled before milling "because it is a bit moist when it comes in from the shamba". Moisture content is crucial -variety not so important though Suba (line 88) is not thought to be good for milling. Old/new rubber rolls have no effect on quality. If paddy is seen to be very dirty it might be winnowed before milling
Charges	1000 Tsh per bag 1200 Tsh per large bag (bags not weighed)
Storage facilities	Traders may store for up to 1 month (no storage charges) Storage facility for 1800 bags
Drying facilities	Large drying area available
Other comments	At harvest time business is mostly from farmers. Traders start moving in after 1 month Most business is from traders. If paddy is brought from Mwanza,Tabora, Shinyanga it is too stony for these mills so traders take it to the large mill with a destoner. Traders sell from premises usually trade in quantities of 20-30 bags per day most rice destined for Dar es Salaam, Arusha and Tanga Variety does not contribute to breakage of

	rice
Samples taken	Yes Kihogo red variety (4 samples #10 mill)

Mill 13	
Name of mill	Mbaraka
Location	Morogoro Korogwe Rd
Type of mill	Chinese Rice Milling unit SB50 (previously a "Satake type", before that Steel Hullers)
Age of mill	1 year
Cost	
Source	
Spare parts - availability and cost	Rollers last 1 month cost 70-80000 per pair
Capacity	1 tonne per day (may do 130 bags per day in harvest time but this lowers the quality)
Quality perceptions	Quality starts on the farm. Must harvest before too dry, need to be put into storage promptly and not left on field. Condition, adjustment and operation of machinery is important Supa India is best variety for milling, Suba (IR88) is the worst
Charges	1000/- per bag (80-90kg) 1200/- per large bag (120-127kg)
Storage facilities	Guard provided
Drying facilities	Large area available
Other comments	Most custom is from traders. Farmers come at harvest time. Most rice is destined for Dar / Zanzibar
Samples taken	

Mill 14	
Name of mill	Binzor mills
Location	Morogoro
Type of mill	4 Englebergs used for maize Chinese SB 30
Age of mill	1987
Cost	
Source	
Spare parts - availability and cost	Rubber rolls are worn out after 300bags
Capacity	
Quality perceptions	All rice is dried and then cooled before storage/ milling.
Charges	800 Tsh per bag 1000 Tsh per loubesa
Storage facilities	Storage facility for 3000-4000 bags
Drying facilities	Tarpaulins available
Other comments	At present there might only be one customer per month
Samples taken	

Mill 15	
Name of mill	Seleman Salum's mill
Location	Mvomoru
Type of mill	Chinese SB 50 Satake type Model NZJ 10/85
Age of mill	7 months
Cost	
Source	
Spare parts - availability and cost	Only replaces one rubber roll at a time Sieves last about 6 months replaced as soon as holes appear Available in Morogoro
Capacity	At start of harvest 10 bags a day rises to 100 in August/September then falls off
Quality perceptions	Needs to have a high moisture content when harvested. Every bag of paddy brought to the mill is dried and cooled before milling
Charges	1200 Tsh per standard gunny bag
Storage facilities	Available -no charges 100-150 bags
Drying facilities	Tarpaulins (worn) provided (at time of visit 2 bags were being dried on a tarpaulin 14x18 feet) Plans to provide a concrete drying area
Other comments	Milled rice sells at 420/- per kg All paddy must be dried before milling
Samples taken	

Mill 16	
Name of mill	Douglas Lukaye
Location	Turiani
Type of mill	SB10 Also steel huller type mill - sometimes used for paddy
Age of mill	2.5 years
Cost	
Source	
Spare parts - availability and cost	
Capacity	At peak does 70-80 bags per day 1 bag takes 7 minutes to process
Quality perceptions	Customers (traders) are demanding rubber roll mills as they think the quality is better as the red rice is "removed" Some varieties have excess breakage unless the rubber rolls are replaced promptly
Charges	200/- per debe 1200/- per gunny bag
Storage facilities	
Drying facilities	
Other comments	Most custom is from traders who may bring in 30-40 bags at a time Traders come from Arusha, Tanga and Dar es Salaam
Samples taken	

Mill 17	
Name of mill	Shaban Chande
Location	Matombo
Type of mill	Steel huller type mill used for both paddy and maize
Age of mill	2 years
Cost	250000 for huller +50000 for blower Engine cost 1,500,000 (also used for hammer mill)
Source	Dar es Salaam (Mangula fabrications)
Spare parts - availability and cost	Available from Morogoro Screens cost 5000 for a pair may only need replacing every two years if no foreign objects in the grain Has never needed to replace blade
Capacity	Mills around 10 bags a day at harvest time, mainly for small-scale traders
Quality perceptions	Some varieties are better for milling. These include Supa India, Mbawambili, Rangimbili. Important that paddy is not rained on but should have a high moisture content at harvest. If paddy lodges quality is affected Produces very clean rice because of the blower
Charges	2000/- per gunny bag
Storage facilities	None
Drying facilities	Limited space available, most customers dry at home before bringing to mill
Other comments	This miller has never seen (or even heard of) rubber roll mills Most rice is sold in the local market but some may be taken to Morogoro
Samples taken	

Mill 18	
Name of mill	Jumanne Ramadhani
Location	Matombo
Type of mill	Steel huller (Chinese) (also hammer mill and diesel engine)
Age of mill	Unknown - bought second hand in his possession for 1.5 years
Cost	700,000 (? V high for 2 nd hand machine)
Source	Dar es Salaam
Spare parts - availability and cost	Screens replaced monthly @ 3000 each from Morogoro. Has never changed the blade
Capacity	Could do up to 15 maxi bags a day 9150-160KG) Usually at harvest time 8 bags per day
Quality perceptions	Paddy is clean and rice of good quality if harvested before lodging occurs Supa India , Nyati, Kipindupindu and Karafuu are good varieties for milling Lunyuki is worst variety for milling
Charges	2500/- per bag (150-160 kg)
Storage facilities	200 bags -no charges
Drying facilities	
Other comments	No blower but bran separation through screens is very effective Sometimes buys paddy and sells the milled rice Harvest prices 10-11000/- rising to 20000/- Milled rice sells for 250-400/- per kg 60kg milled rice from 1 bag paddy Traders with less purchasing power sell locally others may go to Morogoro (54km) and Dar es Salaam
Samples taken	

Interviews with farmers on FAO sponsored irrigation scheme at Turiani.

1. Growing Suba (IR88) because seed is provided free of charge by FAO (HYV) before this he grew Supa India
Harvests in June/July, looks at panicle to determine readiness
Cuts stems and places in heap on field until next day
Next day threshes in field onto tarpaulin
Each farmer has own tarpaulin cost in range 5000-15000 /-
Sells his crop to traders
Suba grows well in all conditions
2. Women were transplanting, he hires 10 people for 1 day to plant 1 acre
Growing Line 88 supplied by FAO
1 acre yields 30 bags if 2 bags of urea are used.
Important that harvest is at correct time not too fresh or too dry
He cuts stalks and heaps them in the field for 1 day before threshing onto tarpaulin
After threshing hires women (6 or 7) to winnow grain pays them 300/- a bag
Then taken to Shamba and dried for 2 days on corrugated sheets
Stored for about 2 months (sells as soon as traders arrive)
Sells 20 bags to traders keeps 10 for own use
If he sells ex farm price is 13,000/-, if ex shamba price is 15,000/-
3. Not in FAO programme but farming on edge of it.
Has 0.25 acre.
Growing Suba as it yields better.
Will get 5 bags from his field and sells 3 of them.
Stores it in his house for about 2 months, sells to local people when land preparations are about to start.
At harvest heaps the cut panicles for 1 day and then beats them on a log on tarpaulin.
4. Large scale farmer growing rice and sugar cane.
This year growing around 62 acres paddy (Supa India) no inputs
Has tried IRRI varieties but he did not like the taste and found the markets to be poor.
Considers harvest time to be important for milling quality (and to prevent shattering)
Farmers think the mills are not suitable for rice and therefore break the grain.

All of his fields will be harvested in 2-3 days. Cut paddy is placed in small heaps on the fields (1 armful in each heap) and left for 2-3 days, if longer suffer from shedding losses.

Threshing carried out by hitting panicles straight onto a mat. Will get about 1000 gunny bags which are brought from the fields without winnowing.

Winnowed in yard and dried for 3 days. If threshed when raining then it is dried

before winnowing otherwise may be kept for up to a month before winnowing but is usually done straight after harvest. Considered to be a matter of convenience.

Sells to traders, some farmers have tried to market their own rice but were disappointed with prices "as you need the right connections"

Stores for as long as possible to get a good price. Price ranges 10000-20000/-, he tries to sell at 18000/- (around Christmas) One year the price did not rise above 12000/-

Price is affected by the amount of imported rice entering the markets.
Major consumer is Dar es Salaam