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The Role of Traditional Irrigation Systems (Vinyungu) in Alleviating Povery in Iringa Rural District, Tanzania

T.A.J Mkavidanda
A. L. Kaswamila

RESEARCH ON POVERTY ALLEVIATION

Research Report No. 01.2

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Abstract

This study was conducted to assess the role of *vinyungu* irrigation system in alleviating poverty in Iringa rural district in the southern highlands of Tanzania and covered five villages, Wasa, Uhominyi, Kihanga, Kising'a, and Lulanzi, representing three different Agroecological zones. Qualitative statistical methods were used to identify priorities in *vinyungu* farming and to establish relationships for categorical data sets while basic quantitative statistical tools were used to analyze quantitative information and establish relationships between the information collected.

Results show that *vinyungu* is widely practised in the District and has a great potential in generating income to farmers and in ensuring year round food security. Unlike the past where *vinyungu* farming was mainly women's work, now-days all members of the family irrespective of the gender are involved in it such that is one of the main employer to 85-100% of farmers during off-rain season.

In terms of income groups almost all farmers with medium income are involved in *'vinyungu;* while few farmers with no *vinyungu* fields do other activities and are not poor and those farmers with *vinyungu* fields of less than 0.25 acre and not involved in any other activities are in the poor category.

The weaknesses noted in *vinyungu* include: not following proper agronomic practices, low water use efficiency, cutting water conserving'trees, slush and burn and cultivating very near to water sources causing environmental degradation and low crop yield. Use of agro-chemicals and disposal of containers in water sources is another threat of *vinyungu* to the environment.

Key recommendations include (a) extension services to *vinyungu* farmers on proper agronomic practices such as proper spacing, improved varieties, use of organic fertilisers and how to control pests and diseases, (b) increased efficiency by encouraging proper lay out and cleanness of irrigation channel, water application schedule and introduction of improved irrigation equipment, (c) Creation of farmers awareness on how best to use the valley-bottoms, provision of irrigation advisory services, enforcement of environmental protection by-laws and provision of short and long term credit facilities with soft conditions.

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Special thanks are to the farmers of Wasa, Kihanga, Kisinga, Lulanzi and Uhominyi who dedicated their time and resources to ensure we collected all the required data.

We are also indebted to the leaders and extension staff of the respective villages for the organization and providing logistic and technical information which was very valuable to the study.

1. Introduction

A pronounced dry season of about six months and unreliable dates of onset of rainy season are major constraints to rain-fed agricultural production and food security in Iringa rural district (RADP, 1986). As an alternative to rain-fed agriculture, farmers cultivate in the valley bottoms locally known as *vinyungu* in which they either harvest rainwater and irrigate by traditional means or benefit from a high ground water table (Ravnborg, 1990; Lema, 1996, Masiga, 1993).

Vinyungu is a Swahili version of the Hehe/Bena word *kinyunga* (singular) or *fyungu* (plural) which is a valley bottom dry period farming practice in which farmers harness water from rivers and or springs to produce both food and cash crops at subsistence level using traditional irrigation techniques. According to Maltby (1986) who defines wetland as "a collective term for ecosystem whose formation has been dominated by water and whose processes and characteristics are largely controlled by water" *vinyungu* is one form of exploitation of the wetlands in Tanzania. However, they have no characteristics of most wetlands for supporting biodiversity.

Despite the high potential of *vinyungu* farming in alleviating poverty by ensuring year-round food production, very little research has been done to understand the contribution and limitations of this type of farming in ensuring food security during the dry season (Lema, 1996). On the other hand there are arguments among environmentalists and politicians that the practice leads to environmental degradation. On this account, in some villages in Iringa rural district the practice is threatened to be prohibited, although there are no quantitative empirical evidences to support this claim (Mwaduma, 1998.pers. comm.).

Prohibiting *vinyungu* farming is not only against the country agricultural policy which encourage farmers to shift from rainfed to irrigated agriculture, but may also adversely affect water users down the stream and those who depend on *vinyungu* as their source of food and cash-income.

Considering the fragility of wetlands and their responses to different forms of uses (Kamukala, 1993), there is a need of a thorough understanding of the practice before deciding whether to improve or restrict it.

This study was therefore, conducted to:

(i) Get an insight into peasant's knowledge and practices concerning traditional irrigation systems *(vinyungu).*

(ii) Assess the role of *vinyungu* in alleviating poverty through increased food and cash income.

(iii) Identify the strengths and weaknesses of the practice in conserving soil, moisture and environment.

(iv) Assess the impact of restricting *vinyungu* practice to water users down the stream and those who depend on *vinyungu* for their food and cash income.

(v) Propose possible options for improvement and sustainability of the practice.

2. Literature Review

2.1. Irrigation practices and problems

Irrigation is any process other than natural precipitation which supplies water to crops, orchards, grass or any other cultivated plants (Stern, 1989). Traditional irrigation practices therefore, refers to the irrigation practices which have evolved over the cause of time, without any known outside institutional intervention. These practices are the results of gradual learning processes and emerge from a knowledge base accumulated by rural people by observing, experimentation, and processes of handing down through generations people's experience and wisdom. Traditional irrigation practices are also shaped and emerge from detailed understanding of local conditions and are modified in response to changing socio economic, political and ecological conditions (modified from Hans et al, 1996).

Tanzania has a very large irrigable land for farming, out of which only a small coverage is utilized. According to The Ministry of Agriculture (MoA, 1992) there are about 933,000 ha of land potential for irrigation from surface water resource including underground water, out of which about 144,000 ha are under partial or full scale irrigation of which traditional small scale irrigation systems account for 120,378 ha while 23,622 ha are under large scale estate farms. Hence, there is an ample scope to expand irrigated area in the country.

According to Mrema (1984), irrigation farming in Tanzania can be grouped in three main categories: The first is the traditional small holder irrigation owned by individual and /or groups of farmers who have attempted to harness the available water from rivers, springs, and large river flood plains. This category covers relatively small and scattered areas, often not more than 5 ha. They employ traditional methods and their intake structures are often temporary, having to be replaced from time to time. Much of the diverted water is lost due to seepage before reaching the field and efficiency in the field is very low. This category covers more than 79 % of the total irrigated land in Tanzania. Major areas with this category are Kilimanjaro, Meru and the Usambara as well as in the flood plains of the major rivers.

Traditional irrigation systems have sustained small-scale farmers not only in Tanzania but also elsewhere in Africa. For instance, Haward (1996) reports that " the traditional irrigation techniques *(fadama)* has enabled farmers on the jos plateau in northern Nigeria to generate a large amount of income in the slack period for rain-fed cultivation. The technique is suitable for the production of wide range of vegetable crops as well as others such as sugar cane, wheat, maize and barley. As such it has been incorporated into highly productive and profitable round-the year system of farming".

The most common problems with traditional irrigation are lack of drainage (resulting in progressive accumulation of salts), improper organization and planning which results in some fields receiving much water while others receive too little. Other problems include trampling of animals in farms after harvest resulting in destruction of soil structure and unfavorable environment for crop growth, deforestation of the catchment area resulting in soil erosion and frequent flood damages.

Almost all the above mentioned problems prevailed in Kirya, Mvuleni, Kileo and Kigonigoni traditional irrigation schemes in Kilimanjaro (Banzi et al, 1992). Studies by Kaswamila and Tenge (1997) in Lushoto district reveals that, over-cultivating around water sources is also a threat to the sustainabiliry of traditional irrigation practices and environment in general. The second category is the modern small scale holder/village irrigation schemes which in most cases are planned and constructed by the central/ local government which bears the costs of head works, the main canal and where necessary the storage reservoir and some laterals. In the majority of the cases the distribution of the water, land preparation and decisions on what should be grown as well as scheduling are the responsibilities of the farmers. Although a lot of money has been spent to build and sustain these schemes, nearly all of them have been unsuccessful and have degraded after few years. Examples of these are Mlali in Morogoro, Mombo in Korogwe, Mto wa mbu in Arusha (Mrema, 1984) and Kitivo irrigation scheme in Lushoto (Kaswamila and Tenge, 1997). There are normally two main problems with these irrigation schemes. The first one is the problem of ensuring fair distribution of water to all. This problem frequently results in dissatisfaction and conflicts among farmers, particularly within schemes for which the water supply is inadequate to meet all the farmers' needs. The other main problem arise out of the need for adequate and prompt maintenance of the canals, which in turn can affect the first problem, the fair distribution of water.

Mrema (1984) identifies the following three factors as essential for the success of small-scale holder irrigation scheme: first the scheme must be centrally managed i.e. the interest of the individual farmers must be subordinated to the interests of the scheme. Second is availability of well-trained and multidisciplinary extension manpower and essential inputs. Third, farmers must have ownership of the scheme to ensure responsibility.

The last category is large-scale irrigated private/public farms. These are large-scale farms growing high value crops for export and/ or local consumption. They are centrally managed by either private or parastatal companies and generally have quite efficient irrigation system. They require large capital investment and well-trained manpower.

Lack of capital, low technological level and high maintenance costs of large irrigation schemes for majority of rural farmers in Iringa and Tanzania in general, necessitates the need to look into the potential for traditional irrigation practices in increasing agricultural production and alleviating poverty in the country.

3. Research Methodology

3.1. Choice of the study area

Three out of nine divisions in Iringa district and two villages in each division were randomly chosen for the study. The villages are Wasa and Kihanga in Kiponzelo Division, Lulanzi and Kisinga in Kilolo Division and Kipaduka and Uhominyi in Mazombe Division. The selection criteria of the study areas were:

(i) To cover areas with different agricultural potentials (ii)

To cover areas with different agro-ecological zones.

(iii) To cover areas that represent typical *vinyungu* farming in Iringa district

(iv) Accessibility.

3.2. Characteristics of the study area

Iringa is one of the six districts in Iringa region in southern Tanzania. Administratively, the district is composed of nine divisions which are located between 35 °30' and 35° 50' E and 8 °20' and 8° 30'S. The rainfall pattern is monomial with single rainy season from November through May and dry conditions during the rest of the year (RADP, 1986). It has a great number of perennial streams with great potential for agricultural production during the dry season under irrigation (DANIDA, 1982b).

Food shortage often occurs in Iringa because majority of farmers are peasant producers who depend upon rainfall and grow mainly single crop (maize) for both food and cash income. Approximately twice after every ten years there is semi-crop failure due to rainfall unreliability and production drops to more than half the normal (DANIDA, 982a). There is a great possibility to increase agricultural production in the district through improvement of traditional irrigation systems that are already being practiced though at low technological levels (Ravnborg, 1990; Lema, 1996).

3.2. 1 Kilolo division

Kilolo division is about 45 km South-east of Iringa municipality and is situated in the high rainfall areas which make it one of the potential productive areas in the region (NSS 1994). The division is at an altitude of approximately 1700-2100 m. a. s. 1.

The rainfall pattern is monomodal with annual rainfall of about 1000-1600 mm. The rain season starts in November and ends in May. Annual evapotranspiration is about 1200 mm and the area has a cool climate. The physiography of Kilolo division is characterized by steeply sloping hills and wider valley bottoms which are used for *vinyungu* farming. Most slope gradients are over 30 %. The predominant vegetation of the area is grassland with forest remnants. The dominant upland soils are red and yellow clay with dark top-soil. They are friable with good workability. Most of these soils have high organic carbon and nitrogen contents but low in phosphorus (NSS, 1994). The valley bottom soils vary from clay to silt clay loam. They are normally more fertile than upland soils due to movement of top fertile soil by water erosion to *vinyungu* fields. This could be one of the reasons why farmers are increasingly being involved in *vinyungu* farming.

3.2.2. Kiponzero Division

Kiponzero division is about 60 km south-west of Iringa town and is situated at an altitude of about 1700 -1900 m a. s. I. It is a transition zone between low and high rainfall areas hence a medium potential productive area. The division receives an annual rainfall of about 750-1250 mm in four out of five years (RADP, 1986). The landscape is gently undulating with slopes of less than 8%. The predominant vegetation is grassland characterized by shrubs and remnants of miombo. Upland soils are generally leached and further characterized by poorly developed structure and thus of low fertility (Rovnborg, 1990). Major soils in valley bottoms are clay loams with good drainage characteristics and more fertile than upland soils.

3.2.3. Mazombe division

Mazombe division is located about 50 km east of Iringa town along the Iringa-Dar es Salaam highway at an altitude of about 1250-1500 m a.s.l. The area is in Nduli-Isimani flats and is characterized by undulating topography with most slopes being less than 8%. Steeper slopes are along the incised drainage systems. Mazombe gets comparatively low annual rainfall of about 600 mm but evapotranspifation is high (1500 mm). Comparing the annual precipitation and evapotranspiration it is clear that the area experiences drought problem and is one of the low potential rain-fed agricultural areas in the district. The dominant upland soils are red clay loams and loams (RADP, 1986). Sandy soils with low fertility are also quite common. *Vinyungu* soils vary from clay to sand clay loam with mica. They are also more fertile than upland soils.

3.3. Sampling procedure

A list of adult farmers in all villages was obtained from village offices/leaders and stratified according to sex and hamlets (sub-village). A random sample of twenty (20) adult farmers from each village was selected by the principal investigators for the interview. Four extension staff serving the surveyed villages were also interviewed. In addition to the interviewed farmers and extension staff, majority of farmers attended the village meetings which increased the sample size and representation of the village.

3.4. Data collection

Data collection on *vinyungu* farming was done in three main stages and involved both formal and informal survey methods (Theis and Grady, 1991; de Graaf, 1996). First stage was formal survey using pre-designed questionnaires. This was used to collect specific and quantitative information on *vinyungu* from the twenty representative farmers. Extension staffs serving the surveyed villages were also interviewed at this stage to obtain technical information. The two principal investigators and two research assistants did the interviews.

Second stage involved group discussions in village meetings to obtain information and views about *vinyungu* from all farmers in the village. Principal investigators moderated the discussions in order to avoid bias and dominance of certain groups or influential persons.

The third stage was transect walk across *vinyungu* fields to obtain physical information and verify the information collected during formal and informal surveys. Secondary data from different sources such as key informants, maps and scientific reports were also used as additional sources of information.

The type of information collected included: Farmer's criteria for poor and rich villagers, the role of *vinyungu* in poverty alleviation, problems, gender division of labor in *vinyungu* farming and land tenure system. Other information included the hydrological changes that are likely to occur and their impacts on *vinyungu* and *non-vinyungu* farmers if the practice is prohibited. Management practices, their effectiveness and possible options for improvement were also discussed.

3.5. Data analysis

Data was analyzed using both qualitative and quantitative statistical techniques. The qualitative methods such as cross tabulation and ranking were used to identify priorities in *vinyungu* farming for each area and to establish relationships for categorical data sets. In order to assess the role of *vinyungu* on poverty alleviation, farmers were required to state their criteria for ranking the wealth status of villagers. Using these criteria and the information collected during the interviews, farmers were grouped in three categories, which are high, middle and low income. High-income farmers fulfilled almost all the criteria for high income, low income had none of the mentioned criteria of the high income group while the middle income group had some criteria of higher income group. *Vinyungu* farming was then analyzed to see if it had any role to play in any of the three farmer groups by comparing *vinyungu* and *non-vinyungu* farmers within and between those three income groups.

Major constraints to *vinyungu* were ranked according to the number of farmers affected, loss of yield or income caused by the problem, frequency of occurrence, ease on managing and getting advisory services.

Basic quantitative statistical tools such as mean, percentages, tables and charts were used to analyze quantitative information and establish relationships between the information collected. The quantitative analysis was also used as means to verify qualitative assessment.

3.6. Limitations

Kipaduka village was later excluded in the study after learning that *vinyungu* practice is no longer common due to water shortage and 7% of the selected farmers did not show up for the interviews. It is believed that these did not affect the results due to the diversity of sources of information and collecting techniques explained above. It was not possible to collect quantitative information on the actual expenditures from *vinyungu* incomes because farmers do not keep records on resources spent on .different activities. Information on the effects of *vinyungu* on the environment and

the likely impact of restricting *vinyungu* was also based on qualitative physical observations. However, there is sufficient evidence on the role of *vinyungu* in alleviating poverty.

4. Research Findings

4.1. Low Agricultural Potential Areas

4.1.1. Uhominyi village

This village represents low agricultural potential areas in Iringa district (Samki and Harrop,1982). It is in Mazombe Division about 20 km from Hula Town center along Iringa Dar Es Salaam high way. The village is accessible by mud road from Ikokoto village near Hula but there are no reliable means of transport especially during the rainy season. Administratively the village is divided into three sub-villages which are Uhominyi kati, Itungi and Makalala. Important organizations in the village include HIMA, a soil and water conservation project financed by DANIDA with emphasis on conservation of upland areas by tree planting and community development.

4.1.2. Demographic aspects

The socio-economic aspects of Uhominyi village are as shown in Tables 1 & 2. The dominant tribes are Wahehe and Wabena with distribution of about 80% Wahehe and 20% Wabena. The average number of people per household is 8. The distribution of household members into age groups show that majority of farmers are between 31 and 40 years (Table 2) which is the potential age for agricultural and other development activities.

About 80% of farmers in this village have primary school education, 15% secondary school education and the rest no formal education. This suggests that educated youths up to secondary school either are not interested in agriculture or end up settling in towns to look for other economic activities. According to the village census (1998) the village population was about 2,047 with 497 households. Out of this population only 580 are adult persons who are able to work, 260 men and 320 women.

Table 1: Demographic and social structures of the surveyed sample

Characteristic		Village name				
		Uhominyi	Wasa	Kihanga	Kising'a	Lulanzi
Division		Mazombe	Kiponzero	Kiponzero	Kilolo	Kilolo
Agricultural Potential		Low	Medium	Medium	High	High
Population (No)		2,047	NA	4,475	NA	2,384
Household (No)		497	NA	NA	NA	439
Household size (No)		8	11	8	6	6
Sample size (No)		20	18	18	20	17
Sex (%)	Female	45	47	6	50	50
	Male	55	53	94	50	50
Ethnic (%)	Hehe	80	100	83	100	100
	Bena	20	0	17	0	0
Educat. (%)	Secondary	15	6	11	0	0
	Primary	80	82	89	85	75
	Non	5	12	0	15	25
Rainfed farm (acre)		10	4	8	4	4
Vinyungu (acre)		0.8	0.9	1	1.5	1.8

Source: Field data November 1998

NA: Not available during time of this study

Table 2: Percentage of farmers in different age groups

Village	Age group (years)			
	21-30	31-40	41-50	>50
Uhominyi	15	55	20	10
Wasa	3	34	46	17
Kihanga	17	32	39	12
Lulanzi	31	38	19	12
Kising'a	30	55	10	5

Source: Field data November 1998

4.1.3. Major economic activities

Agriculture is the major economic activity in Uhominyi village. Other activities include brewing local brews, selling food *(mama nitilie)* and fishing. Agricultural activities are categorized into three groups: Rainfed (Upland) agriculture popularly known as *migunda,* Valley bottom *(vinyungu)* and livestock production (Table 3).

Almost all farmers are involved in rainfed agriculture, four out of five in *vinyungu,* about two thirds in livestock keeping and one fifth in other activities. The average area available to the household for agricultural

Table 3: Percentage of farmers in different economic activities

Village	Activity			
Uhominyi	Rainfed	*Vinyungu*	Livestock	Others
Wasa	100	85	65	20
Kihanga	100	100	82	53
Lulanzi	100	100	61	33
Kising'a	100	93	69	31
	95	92	40	35

Source: Field data November 1998

activities is 10 acres for rainfed and 0.8 acres for *vinyungu* (Table 1). Although the area under *vinyungu* per household appears to be very small, when combined together with other household's *vinyungu* the area under *vinyungu* in valley bottoms is very extensive (Figure 1). The percentage of farmers involved in *vinyungu* is now higher than the 7% recorded earlier (DANIDA, 1987). This could be due to the increasing role *of vinyungu* in alleviating poverty, degradation of upland soils and rainfall unreliability. Reasons for not practicing *vinyungu* included having no access, being new to the area, not hard worker or being involved in other activities particularly business.

4.1.4. Wealth categories

Farmer's criteria for high (rich) and low (poor) income are as shown on Table 4.These criteria were used to group farmers in the surveyed villages into three wealth categories.

Figure 1: Vinyungu fields in Uhominyi village

Results on Table 5 show that about 58% of farmers in Uhominyi village are considered as of medium income, 10% low income (poor) and 32% as rich (high income). The results indicate that all medium income farmers are involved in *vinyungu* and all poor farmers have no *vinyungu* . The high income group consists of both *vinyungu and non-vinyungu* farmers. Possible

Table 4: Main criteria used by farmers in wealth ranking

High income	Medium income	Low income
1. Local cattle 15-20	1. Good thatched house.	1. Yearly food shortage.
2. Shop/milling machine/other business.	2. Farm size 3-5 acres.	2. Farm size <0.5 acres.
3. Farm size > 5 acres.	3. Food security	3. Poor houses.
4. Food security.	4. Petty business	4. Sell family labour to high-income farmers.
5. Employ labourers in some farm activities.		
6. Good house/corrugated sheet.		

Source: Field data 1998

explanations for this may be that *vinyungu* is one of the main factors for moving up but once at high income level one is able to get involved in other activities particularly businesses. When farmers were asked reasons for being poor they mentioned not working hard and being disabled as the major causes. On the other hand hard working and involvement in *vinyungu* was mentioned as factors for moving up the ladder and this is supported by the results on Table 5.

4.1.5. Land tenure

Four major land tenure systems exist in the village (Table 6) and are applied in passing *vinyungu* from one hand to another. The systems are:

(i) Inheritance *(Lungulu)* system. The land belongs to a certain family and is passed from one generation to another by the head of the family

Table 5: Wealth category of vinyungu and non-vinyungu farmers in Uhominyi village

Farmer category	Wealth group		
	High income	Medium income	Low income
Vinyungu famers (%)	27	58	0
Non-v/wytwgw farmers (%)	5	0	10
Total (%)	**32**	**58**	**10**

Source: Field data 1998

which according to Wahehe and Wabena customs is the husband. Under this system women have no control on land. They can only access and use family land or their husband's land if married.

(ii) Village government: The land belongs to the village government and is distributed to individual villagers who are in need. Under this system both men and women have equal rights to acquire and use the land.

(iii) Buying: This is acquired through buying mainly from *lungulu* system.

(iv) Renting: In some cases the land is acquired temporarily by renting. Although rented land is utilized very effectively, only annual crops are allowed for cultivation. For example, rented land may not be planted trees even if they are essential for its sustainability because the right of occupancy can be revoked any time.

Study results reveals that over three-quarters of farmers in Uhominyi cultivate *vinyungu* fields under *lungulu,* few have acquired from village government, about a third have bought and very few have rented. Where land has to be purchased the prices are normally negotiable depending on the location. *Vinyungu* plots are relatively expensive when compared to upland farms because they can be used to produce various crops throughout the year.

4.1.6. Vinyungu farming practice

Vinyungu construction and labour sources

Vinyungu construction involves four main stages namely land clearing, burning of cleared vegetation (small trees, grasses and crop residues), hand-hoe plowing *(kukatua)* and harrowing *(kupigapiga).* During plowing stage, ditches or furrows are constructed to make a big ridge *(kinyungu)* on which

Table 6: Percentage of Vinyungu farmers under different land tenure systems

Village	Land tenure			
	Inheritance	Allocation by village government	Buying	Renting
Uhominyi	55	10	15	15
Wasa	64	24	0	0
Kihanga	44	39	17	0
Lulanzi	73	20	0	7
Kising'a	75	0	10	0

Source: Field data November 1998

crops are planted. The size and orientation of the *kinyungu* plot depends on the quantity of water at the site. The more the water content the smaller the size and vice-versa. They are normally constructed parallel to the land slope where the moisture content is high.

The construction of *vinyungu* beds is both time consuming and labour intensive. The time required to make *kinyungu* varies according to the size and labour-force available. The main sources of labour are: family, hired, and neighbours or friends. Family labour, (husband, wife, children and other dependants) is the most dependable for *vinyungu* construction. Unlike the past where *vinyungu* farming was mainly women's work (Lema, 1996, Masiga 1993); currently all members of the family irrespective of the sex are involved in this activity. If family labour is not enough other labour alternatives are considered such as requesting neighbours to assist and be paid in kind (local brew/meal) a practice locally known as *mgove* or *lugota*. Hired labour is usually expensive and therefore is not often used.

Sources of water and its management

The large majority of farmers in this village use Uhongole, Mtitu and Itungi River streams as sources of water for irrigation. About one fifth utilize high water tables by digging wells. Water from river streams is diverted to *vinyungu* fields by earth canals, which are poorly constructed and maintained as they are constructed during *vinyungu* preparation and are not cleaned until next season resulting in water loss through seepage and erosion of the channel banks. Several wells are dug along these channels for collection and storage of water to irrigate near-by *vinyungu* fields using plastic buckets. Very few farmers use watering cans. The quantity of water per *kinyungu* per crop is determined by experience.

In order to improve water use efficiency, it is suggested that *vinyungu* farmers should get organized in small groups depending on water streams used, crops or other preferred criteria so that they can easily be trained on simple and more efficient irrigation technique. Financial institutions should provide soft loans to enable these farmer groups purchase improved irrigation equipment such as watering cans, small water pumps or drip pipes. With these equipment, farmers will be able to pump water uphill for storage and irrigation, minimize water losses, reduce erosion and *vinyungu* plots will not be necessarily located near the water sources. These equipment will also serve labor and time required for irrigating *vinyungu*.

Major crops and their cropping system

Major crops grown in *vinyungu* are maize, beans and different types of vegetables such as tomatoes and cabbage. Others include round potatoes ,

banana and sugar cane. Maize, beans and round potatoes inter-crop is the dominant cropping system. In some cases tomato was also found to be intercropped with other crops. Required plant spacing are not observed and this results in low crop yields because of competition for nutrients among the crops or low plant population. Although HIMA project has trained few farmers on how to reproduce seeds of short-term varieties of maize for rainfed farms (HIMA, 1987), the seeds reproduced are not sufficient and there was complaint that,trained farmers do not train others. It is expected that once produced in sufficient amount the improved maize varieties will also be planted in *vinyungu* and yield might increase. Many farmers in Uhominyi cultivate *vinyungu* twice a year to maximize the use of land and available water starting in August/September, during which maize, beans and other vegetables are grown and harvested in November/December (beans, vegetables and potatoes) and January/February (maize and vegetables). The second planting is in March/April mainly for beans and harvested in June and July. Vegetables are generally grown and harvested throughout the dry season if water conditions allow.

Growing these crops at least twice a year makes *vinyungu* contribute significantly to cash and food security compared to rainfed agriculture where crops are grown once in a year.

Fertilizer and pesticide uses

Few (25%) farmers use inorganic fertilizers in *vinyungu.* About 13% apply pesticides to control different crop pests. High costs and availability are major reasons for non-use of these inputs. Farmyard manure, which can be the best option, is also used by very few farmers (13%). Availability of enough farmyard manure and means of transport to *vinyungu* fields were reported to be a big limitation to its use. Introduction of improved wheelbarrow and training farmers how to make compost, which uses little farmyard manure, and crop residues/vegetation is the best alternative.

4.1.7. The role of vinyungu in food security and poverty alleviation

Field data reveals that *vinyungu* farming plays the following significant roles in food security and poverty alleviation:

(i) Food security

Farmers reported that even when rainfall is sufficient the production from rainfed agriculture is not enough to feed them throughout the .year. Table 7 shows the contribution of *vinyungu* to food security in the study villages. Under good weather conditions rainfed agriculture can contribute 67% (9 months) of food needs to majority of farmers. The

remaining 33% (3 months) of food needs come from *vinyungu*. Rainfall in many cases has been unreliable in onset dates and amounts, resulting to frequent crop failures. In these cases *vinyungu* is the most reliable option, that enables farmers to grow different types of vegetables, which cannot be grown under rainfed conditions thus improving their nutritional status while getting cash.

(ii) Income generation

Average prices for the major crops in *vinyungu* and rainfed fields are indicated on Table 8. Although there is no significant difference in prices, *vinyungu* crops generate more cash income than rainfed due to the following reasons; Most crops grown in *vinyungu* take shorter time to mature than in rainfed because of relatively higher temperature during dry season. This enables farmers to sell them and increase their cash income for different needs within a short time. Another factor for generating higher income from *vinyungu* than rainfed is that most of the crops in *vinyungu* are grown at least twice a year. Although this study did not quantitatively analyze the expenditures from *vinyungu*, the items mentioned by farmers which included paying school fees, buying building materials, clothing and medical expenses are evidence that the income from *vinyungu* contributes to poverty alleviation among *vinyungu* farmers.

If a farmer sells green maize *(mali mbichi)* at a reported price of 50Tsh/Pc, s/he gets Tsh 750 from 15 cobs which are equivalent to 1 kg of dried maize grain sold at only Tsh 120 /kg. This is almost six times the income from dried maize grain. This explains why farmers keep selling *mali mbichi* despite the frequent government ban. However, selling green maize encourages maize stealing and if the income is not used properly it may lead to food shortage because the cash obtained from selling *mali mbichi* is

Table 7: Contribution of vinyungu to food security in the study area

Village	**Food contribution (%)**	
	Rainfed	*Vinyungu*
Uhominyi	75	25
Wasa	67	33
Kihanga	75	25
Lulanzi	60	40
Kising'a	58	42
Average	67	33

Source: Field data November 1998

not in lump-sum, making planning for poverty alleviating activities difficult mostly ending being used for drinks and other minor items.

During the time of this study tomato prices were low due to the bumper harvest however, it is reported being one of the reliable cash generating *vinyungu* crop. The prices of crops such as tomatoes and green maize are higher if sold at Hula Town center than when sold within the village. Uses of high price fetching varieties such as soya beans is another option for increasing income from *vinyungu,* as well as timely planting so that crops are harvested and sold during the scarce period. Improved storage methods especially for perishable crops can also increase the income from *vinyungu.*

4.1.8. Major constraints to vinyungu farming

Major constraints to *vinyungu* farming in order of importance for the low agricultural potential areas include water scarcity, high costs of inputs and crop pests and diseases (Table 9). Ranking of these problems was according to the number of farmers affected, the loss in yield caused by the problem and ease on managing and getting advisory services.

Farmer's strategies to minimize these problems include water scheduling, applying farm yard manure, or the affordable inorganic fertilizers, and the use of local seed varieties. Farmers who have no access to *vinyungu* under *lungulu* or from the village government buy or rent although this option is limited to very few farmers with capital.

Table 8: Average income from major crops grown in vinyungu and under rainfed agriculture

Crop (local unit)	Growing season (No/year)		Average price (Tab/unit)		Average income (Tsh/unit/year)	
	Rainfed	*Vinyungu*	Rainfed	*Vinyungu*	Rainfed	*Vinyungu*
Beans (bag^{-1})	1	2	25000	27500	25000	55000
Cabbage (bag^{-1})	*	2	*	5250	0	10500
Cowpeas (bag^{-1})	1	*	12500	*	12500	0
Maize (bag^{-1})	1	2	6500	7500	6500	15000
Onion (bag^{-1})	*	2	*	10500	0	21000
Sunflower (bag^{-1})	1	*	13000	*	13000	0
Tomatoes (tenga^{-1})	*	2	*	2500	0	5000
R/potatoestbag^{-1})	1	2	*	8500	*	17000
Total					57000	123500

Source: Field data November 1998 *Not grown or sold

Description of the units used in Table 8: Bag = 100kg when filled with dry maize grain, Tenga = Tin = 16kg when filled with dry maize grain.

Some of these problems need technical assistance from experts especially on water application schedule according to crop water requirements, construction of intake and water storage structures, lining of channels, making compost manure and introduction of improved crop varieties and other agronomic packages for *vinyungu* crops. Other areas include security in land ownership and formation of *vinyungu* farmer groups through which they can get credits to buy inputs for *vinyungu* farming.

4.1.9. Vinyungu and the environment

The study results reveal that with current preparation and management practices *vinyungu* farming is detrimental to the environment in terms of water quality and quantity, soil erosion and bush-fires (Table 10). Because of relatively high yield and returns from *vinyungu* farming, there is over-cultivation of water source areas to the extent that even water conserving trees such as mivengi *(Syzygium Cordatum, S. quineense),* mihuu *(Pappea Capensis)* and *misolanganga* are cut for *vinyungu* cultivation. This has resulted into drying up of water sources, decrease in stream water flow and erosion of valley bottom sides. *Vinyungu* also affects water quality due to the use of fertilizers and other chemicals. During this study the effect of *vinyungu* on water quality was not quantified but there was sufficient evidence of fertilizers and other chemicals. However, the extent of degradation has not reached the critical stage.

Table 9: Average income from major crops grown in vinyungu and under rainfed agriculture

Problem	Rank				
	Uhominyi	Wasa	Kihanga	Kisinga	Lulanzi
Water shortage	1	2	1	NM	NM
Input costs	2	3	2	3	4
Crop pest and disease	3	1	3	8	4
Land tenure	4	NM	NM	NM	2
Appropriate crop varieties	5	NM	NM	1	NM
Transport of FYM	MM	4	NM	8	NM
Rodents	NM	5	7	6	NM
Persistent weed *(ludilo)*	NM	NM	4		NM
Lack of market	NM	NM	5	10	3
Water logging	NM	NM	NM	6	6
Lack of extension service	NM	NM	6	2	1
Lack of capital	NM	NM	NM	3	NM
Labor shortage	NM	NM	NM	5	NM

Source: Field data November 1998 NM: Not a priority problem

Soil erosion in *vinyungu* results from poor design and non-maintenance of irrigation channels which are poorly designed, not lined and cleaned to remove debris and other materials blocking water flow.

This leads to water accumulation, blockage of the channels and erosion. Cutting and burning of trees and other vegetation during *vinyungu* cultivation not only affects water but also result to losses of organic matter which is an important source of crop nutrients. Sometimes *vinyungu* fire gets out of control and destroys other vegetation and people's properties. On the other-hand, burning of residues in *vinyungu* helps to control pests, diseases and rodents.

Although the famous Hifadhi Mazingira (HIMA) project, a non governmental organization dealing with environmental conservation in Iringa region has been in existence in the division, not all villages have been covered. Even in those villages covered, the project emphasis has been on rainfed agriculture and conservation of catchment areas where farmers have been mainly educated on alley cropping in upland fields so as to reduce erosion (HIMA, 1987). The Traditional Irrigation Improvement program (TIP) which is based in Moshi with branches in Lushoto and Iringa has also concentrated on how to irrigate and conserve upland areas (TIP Staff. Personal Com., 1999). Very little, if any, attention has been paid to lowland areas such as *vinyungu.*

Attempts have been done to prevent environmental degradation by setting by-laws which restric cultivation very near water sources and require farmers to plant banana along valley channels so as to prevent erosion. However, non-enforcement of these by-laws by the village government makes them ineffective in preventing environmental degradation caused •by *vinyungu* farming. Furthermore only 60% of farmers were aware of the existence of these by-laws. The actual distance to be left from water source is also not clear, with each farmer leaving a distance that s/he thinks is appropriate. The distance of *vinyungu* from water source ranged from about 0.5 to 12 m. The by-laws are also difficult to enforce because of existing interrelationships in the village as in most cases the enforcer may be related to the violator in one way or another.

Creating awareness among farmers on environmental degradation, setting the minimum distance of cultivation from water sources and stressing bylaw enforcement mechanisms are necessary to achieve the objective of environmental conservation in *vinyungu* farms. Fire breaks and by-laws on village participation to extinguish any fire out-break are also needed.

4.1.10. Likely impact of restricting vinyungu

The likely impact of restricting *vinyungu* practices are summarized in Table 11. For *vinyungu* farmers the impact include food shortage, low income, malnutrition due lack of different food types particularly vitamins from vegetables and protein from beans. Downstream water users will get more water for different uses. Quality of water will also improve but it may be in excess and result in flood damages. Valley bottom areas will be flooded all the time with limited utility by small scale farmers. In places with little amount of water, land use is also likely to change such that *vinyungu* areas will be used for grazing. Farmers will compensate these by extensive cultivation of upland areas and cause more environmental damage. The negative impacts outweigh the positive indicating that prohibiting *vinyungu* will not only be against the National Agricultural Policy which emphasizes on irrigated agriculture but also will increase poverty among small scale farmers and may cause more environmental damage. This study did not find any place in the surveyed areas where the practice has already been prohibited as claimed before. As long as management options for improvement exist, what is needed is creating awareness to farmers on the effects of the practice on the environment and the corresponding measures, to be taken to reverse the situation.

4.2 Medium Agricultural Potential Areas

4.2.1Wasa and Kihanga villages

Both villages are in Kiponzero division and are accessible by mud road from Ifunda Town-centre along Iringa - Mbeya highway. Wasa and Kihanga villages are located about 45 and 42 km respectively from Ifunda. Both villages have no reliable means of transport, getting worse during rainy seasons.

Wasa village is composed of six hamlets namely, Kastamu, Itawi, Uhepwa, Nyakigongo, Utiga and Nyamagola. According to the village tax- payer record (1998) there is a total of 563 adult persons who are able to work, 342 being women and 221 men. There was no record on the total village population during the time of this study.

Kihanga village has ten hamlets namely Kidilo, Kinyang'ama A, Kinyang'ama B, Nzagaza A and Nzagaza B. Others are Muungano, Isoligona, Mkamilo, Itovakami and Mpwapwa. Although it was difficult to get the actual size and diversity of each hamlets, the relative size of the village was found to be proportional to the number of hamlets. According to the village census (1998), Kihanga village has a total population of about 4,475. Out of which 1,050 are adult persons who are able to work.

4.2.2. Demographic aspects

The social and economic aspects in the area are as shown in Tables 1 and 2. The dominant tribe is Wahehe with few Wabena indicating a minimal influx to the villages. The average number of people per household is 10. Majority of adult farmers have primary school education, very few have secondary school education and non-formal education. The age range for majority of farmers is between 41 and 50 years.

4.2. 3. Major economic activities

Major economic activities are agriculture (rainfed & *vinyungu),* livestock keeping and other minor businesses (Table 5). Unlike in low potential areas, all farmers in this area are involved in *vinyungu* farming due to availability

Table 10: Effects of *vinyungu* on environmental degradation in low agricultural potential areas

Activity	Effect	Evidence
Clearing, burning of tree and other vegetation.	Erosion, reduced water flow, drying up of water sources.	Water shortage, erosion, uncontrolled fire, cleared water-conserving trees. NE
Use of agro-chemicals.	Water pollution.	
Cultivating very near water sources. Poor channel/furrow design.	Drying up of water sources. Erosion, water loss.	Water shortage than before, cultivation very near water sources. Furrow bank erosion, loss of water.

Source: Field data November 1998

NE: No evidence observed

Tablell; Likely impacts of restricting *vinyungu*

Farmer group	Impacts
Vinyungu farmers	Food shortage. Low income. Vegetable scarcity. Animal grazing in *vinyungu* areas. Over-cultivation of upland areas. Unemployment to rural people. Rural-urban migration.
Down stream water users	Enough water for large scale irrigation and other uses. High quality water. Off-site erosion effects from upland areas. Flood damages. Food shortage. Low income.

Source: Field data November 1998

of different water sources and valleys suitable for *vinyungu.* Other activities include butchers, pottery, masonry, brewing of local beer, carpentry, mini-shops and selling of *bagia/burns.* The average area available to household for rainfed agriculture is 4 acres in Wasa and 8 acres in Kihanga (Table 1). The average sizes of *vinyungu* fields are 0.9 acre in Wasa and 1 acre in Kihanga. Although the sizes of *vinyungu* per household are small, when combined the area under *vinyungu* is extensively big to justify investment on improvements (Figure 2).

4.2.4. Wealth category

Results on wealth ranking using farmer's criteria (Table 3) are shown in Table 12. The results indicate that in Wasa village about 6% of farmers are considered to be of high income (rich), 76% medium income and 18% low income (poor). In case of Kihanga village 11% are considered to be rich, 61% medium and 28% of low income.

Almost all farmers in high and medium income categories are involved in *vinyungu* in this case. All farmers in low-income group are also involved in *vinyungu.* Further analysis of the field data revealed that, the few *vinyungu* farmers in low-income group have *vinyungu* of less than 0.25 acre and are not involved in any other activities to increase their income besides agriculture. This indicates that *vinyungu* alone cannot alleviate poverty but it can contribute significantly in moving up from lower to high wealth category.

4.2.5. Land tenure system

Inheritance and acquiring land through village government are major land tenure systems in the area (Table 6). In Wasa village, about two thirds have inherited land while two in five acquired from village government. For the Kihanga village, about 44% have inherited, 39% got from village government and 17% bought land. The percentage of farmers with private land (bought/rented) is lower than in low potential areas suggesting that probably almost all villagers are native to the area compared to Uhominyi which is close to main road and Ilula town-center.

4.2. 6. Vinyungu farming

Construction and sources of labour

Procedures and steps involved in *vinyungu* farming are the same as in low potential areas. Major sources of labour for *vinyungu* farming is family irrespective of sex. In few cases, families with few members use hired labor. *MgovQ* system is also used particularly in Kihanga village.

Source of water and its management

Unlike low agricultural potential areas, three different sources of water for irrigating *vinyungu* exist in medium potential agricultural areas. About 47% of *vinyungu* farmers in Wasa village use spring water, 41 % use river streams and 12% use shallow wells. In Kihanga village, 94% use river streams and 6% use spring water. Important valleys for *vinyungu* cultivation in Wasa are Mtemaa, Muhenzi and Muhepasi. These valleys are supplied with water by Muhepasi and Mbiluka streams. In case of Kihanga village five river streams are important for *vinyungu* irrigation, these are Kidilo, Kinyang'ama, Mkamila, Mpwapwa and Itemela.

Farmers who use spring water have no problem of water shortage and construction of furrows is for drainage purposes. *Vinyungu* fields in spring sources are smaller but many to allow for more drainage furrows. For those who use river streams, they divert water to *vinyungu* by earth channels, which have several wells for temporary storage and accumulation of water for irrigation. The channels are made during *vinyungu* construction and they have no intake structures and normally are not cleaned until next season. Water use efficiency is low because of loss through seepage.

Figure 2: *Vinyungu* fields in Uhominyi village

Tablel2: Wealth distribution *ofvinyungu* and *non-vinyungu* farmers in Medium potential areas

Village	Fanner category	Wealth group		
		High income	Medium income	Low income
Wasa	Vinyungu iamers (%)	6	76	18
	Non-vinyungu fanners (%)	0	0	0
	Total (%)	6	76	18
Kihanga	Vinyungu femers (%)	11	61	28
	Non-vinyungu farmers (%)	0	0	0
	Total (%)	11	61	28

Source: Field data November] 998

Where there is no river stream or spring but the water table is high, farmers dig wells and use them for irrigation. The water loss is minimum but there is additional labour of fetching water to irrigate *vinyungu* plots which are located far away. This work load can be reduced by introduction of simple irrigation means such as the use of watering cans and small pumps which will also minimize water losses and increase productivity.

The amount of water to irrigate or drain depends on experience in crop conditions and amount of water in furrows. Through experience some farmers have already established water requirements for various crops. For instance, few farmers in Kihanga reported that 2 litres per planting hole per day is enough for maize - bean inter-crop and in Wasa 15 litres per 3-5 planting holes was reported to be enough. These figures need to be verified by scientific research so that farmers can be advised accordingly so as to increase water use efficiency by minimizing unnecessary water application to crops.

Major crops and cropping system

Major crops grown in *vinyungu* in the medium potential areas are maize, beans, onion, sweet potatoes and tomatoes particularly in Kihanga. Different types of vegetables such as cabbage, *figiri* and spinach are also grown. Others are round potatoes and peas (Table 8). Maize bean inter-crop is the most common cropping system. As in low potential areas proper agronomic practices such as use of improved seeds and proper plant spacing are not followed.

Fertilizer and pesticides uses

Only about 38% of *vinyungu* farmers use inorganic fertilizers in Kihanga village and very few in Wasa village. Major reasons for limited use of inorganic fertilizers are high prices and their availability. The use of

farmyard manure is also very minimal. Only about 29% and 5% farmers use farmyard manure in Kihanga and Wasa respectively. Normally, farmyard manure is used in rainfed farms because of the problems of availability of enough manure and difficulty in transporting to the *vinyungu* fields. Use of improved wheelbarrow and mixing manure with vegetation to make compost are the possible solutions.

4.2.7. The role of vinyungu in alleviating poverty

The same roles explained in low potential areas (Tables 7 and 8) also apply to this area. In addition, *vinyungu* is the major source of maize for brewing of local beer during dry season particularly in Wasa village. A farmer who makes brew using maize from *vinyungu* is assured of market and higher income because of the scarcity of the commodity during that season. *Vinyungu* farming also provides employment to farmers during off-rain season and a source of seed for rainfed agriculture.

4.2.8. Major constraints to vinyungu

Major constraints to *vinyungu* farming are indicated in Table 9. Crop pests (Bean and maize pests) and diseases are the priority problems in Wasa, while in Kihanga water-shortage and high input costs (fertilizers) are the greatest problems. In both villages farmers apply the local pesticide known as *likowo* for control of maize stalkborers, but nothing is done for beans. There is a need for scientific identification and assessment of the effectiveness of the *Likowo*. Other areas which need technical assistance include: how to control crop pests, improved irrigation means and simple means of transporting farmyard manure to *vinyungu* fields. Although there is an extension staff serving each of the villages, they all admitted that in very few cases they offer technical assistance to *vinyungu* farmers.

The reasons being biased negative view of *vinyungu* to the environment and lack of irrigation knowledge among the extension staff. The study revealed that all the extension staff in the study area were either specialist in agriculture or livestock.

4.2.9. Vinyungu and the environment

Effects of *vinyungu* on environmental degradation are the same as in low potential areas (Table 10). The effects are due to clearing and burning of trees and. other vegetation, use of agro-chemicals, cultivating very near water sources and *vinyungu* plots layout and channel designs. Soil erosion, drying of water sources and deforestation are some of the evidences for such degradation. Misuse of fire which destroy catchment areas for rivers and streams is another cause and evidence for degradation caused by

vinyungu. Like the low potential agricultural area, there are several bylaws on *vinyungu* farming. The by-laws are: Restriction on tree cutting and cultivating very near water sources, prohibition of uncontrolled fire and planting water-conserving trees in water sources particularly in Kihanga village.

Unlike in low potential areas majority of farmers in Kihanga and Wasa are aware of the existence of the by laws and the corresponding fine for offender which range from TSh. 5,0007= to 7,000/=. However, the exact distance to cultivate from water source is not specified and thus each farmer mentioned different distances. Education on environmental degradation is still needed to supplement these by-laws. Introduction of appropriate agroforestry will help to conserve catchment areas, as farmers will get substitute sources for fuel wood and other uses.

4.2.10. Likely Impacts of restricting vinyungu

The likely impact of restricting *vinyungu* in medium potential areas are the same as those observed in low potentials areas (Table 11), the greatest impact being food shortage and decrease in income. Others include seed scarcity for rainfed crops and lack of vegetables. Areas used for *vinyungu* farms will be changed to grazing and spring areas will be turned to water swamps with limited uses by small scale farmers.

Downstream water users will get more water but with a threat of flood damages. The net impact will be increased poverty among small scale farmers and more environmental damage due to over-cultivation of upland areas.

4.3. High Agricultural Potential Areas

4.3.1. Lulanzi and Kising'a villages

Lulanzi and Kising'a represent the high agricultural potential area. Both villages are in Kilolo division, about 45 km from Iringa town center. Lulanzi village is accessible by mud road and has reliable transport throughout the year. The situation is opposite in Kising'a which is accessible only during dry season and there is no reliable means of transport.

4.3.2. Demographic aspects

Like low and medium potential areas, Wahehe and Wabena are the dominant tribes (Table 1). All the respondents in Kising'a were Wehehe while in Lulanzi the large majority were Wahehe and the rest Wabena. The average number per household is 6 which is the lowest compared to other

areas. Majority of farmers have primary school education. About 38% of the farmers in Lulanzi village are between 31 and 40 years old while in Kising'a, over 50% are in the same age bracket (Table 2).

4.3.3. Major economic activities

Major economic activities are rainfed agriculture, *viivungu* farming, livestock keeping and other minor activities like petty shops, fishery, carpentry, masonry, selling of *burn/bagia,* brewing of local beer and middlemen for crops (Table 3). Almost all farmers are involved in rainfed agriculture and the large majority in *vinyungu* farming. The average area available per household in Lulanzi is 1.8 acres for *vinyungu* and 4 acres for rainfed. In Kisinga a household has an average size of 1.5 and 4 acres of *vinyungu* and rainfed farms respectively (Table 1). The average size of *vinyungu* fields in this area is greater than in low and medium potential areas. This can be due to availability of large number of valley bottoms with enough water due to relief and higher rainfall characteristics of the area.

4.3.4. Wealth category

Results on wealth ranking using farmer's criteria (Table 4) are shown in Table 13. The results indicate that in Kisinga village about 18% of farmers are considered to be of high income (rich), 80% medium income and 2% low income (poor). In Lulanzi village, 12% are considered to be rich, 82% medium and 6% of low income.

Like the low and medium potential areas, not all farmers who are in high and medium income groups are involved in *vinyungu* but all poor farmers in Kisinga village are not involved in *vinyungu.*

4.3.5. Land tenure

Major land tenure systems in the two villages are as indicated in Table 6. Four out of five *vinyungu* farmers in Kising'a village have inherited the land and the rest have acquired by buying. Acquiring land from village government and renting is not common in this village. This may be due to availability of many valley bottoms. In case of Lulanzi, one out of five farmers have acquired *vinyungu* from village government, about four out of five through inheritance and very few have rented. (Table 6).

4.3.6. Vinyungu farming

Construction and labor sources

The stages involved in *vinyungu* construction in high agricultural potential

areas differ slightly from the low and medium potential areas. *Vinyungu* construction in these areas is mainly for drainage to remove the excess water. Unlike low and medium potential areas, *vinyungu* furrows in high potential areas are constructed before plowing so as to allow drainage of excess water.

Few farmers in this area do not burn the vegetation and residues but they plow under, a practice which improves soil fertility and minimizes environmental pollution due uncontrolled *vinyungu-fires*.

Like other areas, *vinyungu* farming involves all members of the family regardless of sex. Major source of labor for *vinyungu* farming is family labor and where the family labor is not enough hired labor is used. Few farmers use *mgove* system.

Sources of water and its management

Almost all farmers in Kising'a village use spring water in valley bottoms for growing their crops. Very few use river streams. About two thirds of *vinyungu* farmers in Lulanzi also use spring water and the rest use river streams. In spring water sources, farmers do not irrigate but drain water to meet crop growth conditions. Few farmers who use river streams divert water to *vinyungu* fields by earth channels and they irrigate the crops using buckets. Very few use watering cans.

Major crops and cropping system

Major crops grown in these high potential areas include maize, beans, round and sweet potatoes, cow peas and different vegetables. Kising'a village which has transport problem grows mainly beans and other non-perishable crops while in Lulanzi where transport is reliable cabbage is the leading vegetable crop in *vinyungu*.

The dominant cropping system is mono-crop of beans and cabbage in Kising'a and Lulanzi villages respectively.

Tablel3: _ Wealth distribution *of vinyungu* and *non-vinyungu* farmers in _____high agricultural potential areas

Village	Farmer Category	Wealth Group		
		High income	Medium income	Low income
Kising'a	*Vinyungu* Farmers (%)	16	76	0
	Non-vinyungu farmers (%)	2	4	2
	Total (%)	18	80	2
Lulanzi	*Vinyungu* Farmers (%)	10	81	2
	Non-vinyungu farmers (%)	2	1	4
	Total	12	82	6

Fertilizers and pesticide uses

None of the respondents from Kising'a village reported to be using inorganic fertilizers in *vinyungu* fields. Even farmyard manure which can be possible alternative to industrial fertilizers is not used. In Lulanzi only about 25% of *vinyungu* farmers use farmyard manure and very few use inorganic fertilizers. Reasons for non-use of fertilizers by the majority of *vinyungu* farmers is the difficult in transporting the fertilizer materials to *vinyungu* fields which are in valley bottoms of very steep slopes (>30%). Availability problems especially for inorganic fertilizers also contribute to non-uses of fertilizers by majority of farmers.

4.3.7The role of vinyungu in alleviating poverty

Vinyungu farming in high potential areas was found to play the following significant roles in alleviating poverty.

(i) Source of income: Majority of farmers depend on *vinyungu* for cash income through selling of beans particularly in Kising'a and cabbages in Lulanzi. Better bean prices and availability of enough water were also stated to encourage more farmers in *vinyungu* cultivation.

(ii) Supplement rainfed food: Like in low and medium potential areas food from rainfed is not enough to sustain farmers through out the year, therefore they have to get supplementary food from *vinyungu* (Table 7). The contribution of *vinyungu* to food security in high potential areas is more than in low and medium potential areas. This may be due to large *vinyungu* sizes and availability of water.

(iii) Vegetable production: Conditions of *vinyungu* in terms of soils and water are suitable for growth of different types of vegetables such as cabbage in Lulanzi. Besides cash generation, vegetables improve the nutritional status of the farmers

(iv) Employment during dry season: *Vinyungu* is a major employer to majority of farmers during the dry season (Table 3) thus ensuring food sufficiency and cash income.

4.3.8. Major constraints to vinyungu

Many constraints to *vinyungu* farming in high potential areas are same as those in low and medium potential areas (Table 9). Few problems which are particular for high potential areas are water-logging, labor shortage and unreliable market for cabbage.

4.3.9. Vinyungu and the environment

The effects of *vinyungu* on the environment are the same as in low and medium potential areas (Table 10) although the evidence of drying up water sources was not observed due to high annual rainfall in the area. By-laws on *vinyungu* farming which are restrictions on cultivating very near water sources, cutting water conserving trees and uncontrolled fire also exist. Majority of farmers are aware of these by-laws but face similar constraints as in other areas particularly on distance to cultivate from the water sources.

4.3.10. Likely impacts of restricting vinyungu.

The impacts of restricting *vinyungu* in high potential areas include food shortage, low income, lack of vitamins from vegetables and unemployment during dry season. Down-stream water users will be in danger of floods. Expansion of upland areas on steep slopes will be optional for majority of farmers as results there will be clearing of vegetation, soil erosion, loss of fertility and increasing environmental degradation.

5.0. Emerging Policy and Conclusions

1. *Vinyungu* farming plays a very significant role in ensuring year-round food production and cash income to farmers in Iringa rural district.
2. With current preparation and management practices *vinyungu* farming is detrimental to the environment.
3. The net impact of prohibiting *vinyungu* farming will be increased poverty among farmers and more environmental damage.
4. Slackness of village governments to enforce village by laws on environmental conservation and lack of extension advisory services are among the major causes of environment degradation in *vinyungu.*

   Appropriate agricultural technologies, policies and institutional set up are required to make *vinyungu* contribute significantly and sustainably to poverty alleviation among rural farmers.

6. Selling of green maize despite relializing more profit than dried maize grain, has great risk of not using the income to alleviate poverty.

6.0 Recommendations

6.1. Technical

1. There is an urgent need to develop and promote appropriate agronomic packages (crop rotation, varieties, control of pests and disease and fertilizers uses) for the *vinyungu* farming system.
2. More efficiency methods of water use need to be developed and promoted in order to improve water use efficiency and reduce pollution in *vinyungu* fields.
3. Low cost technologies on storage of perishable *vinyungu* crops are needed so that farmers can at least store their produce long enough to reach the market.
4. Management of water resources should be considered in terms of the whole catchment to ensure that the effects of upstream changes on downstream users and the overall regional development are considered.

6.2. Policy and institutional

1. There is a need of forming *vinyungu* farmer groups to enable them obtain credit for buying farm inputs and for easy advisory services. It is the role of the government to educate farmers on the requirements and procedures for forming these groups.
2. There is a need of clear definition of the environmental conservation by-laws and strengthening of the enforcement mechanisms.

7.0 Suggested Further Research Work

1. Research on the potential of local herb *(Likowo/lingatengate/ limwadada*) used as pesticides against maize stalkborers.
2. Assessment of the nature and extent of current water pollution levels in *vinyungu* fields.
3. Research on how to improve water use efficiency in *vinyungu* fields.
4. Research on the appropriate agronomic packages in *vinyungu* fields to minimize incidences of pests and increase, water pollution and realization of higher yields.

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