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The Role of Indigenous Knowledge in Combating Soil Infertility and Poverty in the Usambara Mountains, Tanzania

Juma M. Wickama
&
Stephen T. Mwihomeke

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ABBREVIATIONS:

AHI	African Highlands Initiative
ANOVA	Analysis of Variance
ARI	Agricultural Research Institute
ITK	Indigenous Technical Knowledge
MAFS	Ministry of Agriculture and Food Security
MPR	Minjingu Rock Phosphate
PRA	Participatory Rural Appraisal
REPOA	Research On Poverty Alleviation
SPSS	Statistical Programme for Social Sciences
TAFORI	Tanzania Forestry Research Institute

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Juma M. Wickama and Stephen T. Mwihomeke

ABSTRACT

This study was conducted in Kwalei Village, Lushoto District with the objective of determining if significant differences existed between farmers using the indigenous knowledge of applying a local shrub *Tughutu* (Venonia subligera) for soil enrichment in their fields against those not using it. The study compared livelihood standards, income levels, household nutrition and farm productivity of the two groups.

The study also sought to determine potential alternative uses of *Tughutu* which could be beneficial for household and community poverty alleviation efforts; advocate wider use of this innovation from Kwalei to the surrounding villages and develop policy recommendations for integrated natural resource management.

Results indicate that 67% of the farmers in the pilot village of Kwalei use the local shrub *Tughutu* as an organic fertilizer, especially for maize, beans, tomatoes and coffee. Women and old people were observed to practice the technology more than young and middle-aged men who can access other nutrient sources.

Significant differences (0.05 level, refer to Table 4) in terms of yields of maize, beans, tomatoes, coffee and farm income were established between users of *Tughutu* and non-users. The nutritional levels in terms of weight for age of children under-five, though slightly higher for the users of the technology, were however, not significantly different from the other group.

From these observations, this study advocates a wider use of this local innovation in other villages on these mountains, as this Indigenous Technical Knowledge (ITK) is not only effective in improving the soil's productivity, it is also a less costly intervention for the farmers to use. The village governments and Lushoto District Council have a role in this endeavour and their support is vital to ensure its increased use across the local communities in Lushoto.

1. INTRODUCTION

The Usambara Mountains are part of the Eastern Arc Mountains. These are a group of mountains that run in an arc formation from the Udzungwa Mountains in southern Tanzania to the Taita Hills in the Republic of Kenya. The Usambara Mountains are among the potentially richest areas for agriculture in Tanzania[1]. Several studies have indicated that, generally, the land area available for many households on these mountains is small and not adequate for meaningful agricultural production. Consequently soil fertility is generally declining because of overuse[2]. Reduced crop yields per unit area results in lowered income levels, poverty and food insecurity for many households. Most farmers are aware of the superior effects of industrial fertilizers, but complain of their high prices. Hence fertilizers are not applied to most crops.

In a recent Participatory Rural Appraisal (PRA) conducted in Kwalei village, Lushoto district, farmers were asked as to why despite obvious signs of declining soil fertility in their village and hence the poor crop yields they were not using chemical fertilizers. Most indicated that though inorganic fertilizers were available, they were expensive. Also there was limited availability of organic manure such as farmyard manure, due to low livestock population[3]. Some, however, reported that they coped with the situation by using a local shrub known in the local Kisambaa as *Tughutu (Venonia subligera)* as green manure. Leaves of this shrub were ploughed into the soil to improve the soil's fertility. Given this background, the African Highlands Initiative (AHI)[4] commissioned a study to investigate this shrub plus any other plant nutrient resources which had similar potential. During the study farmers identified six plants believed to improve soil fertility.

Photo 1. *Tughutu (Venonia subligera)* as found in the Kwalei Village area, Lushoto

[1] Pfeiffer (1990), Johansson (2001) and Tenge (2003),
[2] Lyamchai *et al.* 1998, Ngailo *et al.* 1998
[3] Lyamchai, *et al.* 1998
[4] African Highlands Initiative is an eco-regional programme under ASARECA which deals with technologies that deal with natural resource management in the East and Central African Highlands

These plants were collected, classified according to their botanical families, analyzed in a laboratory at the Agricultural Research Institute (ARI) – Mlingano Tanga for their chemical composition and incubated for their mineral release patterns. The shrub *(Tughutu)* was found to have exceptional quality over the others[5]. In further trials, this shrub was enriched with Minjingu Phosphate rock from Arusha for improving beans and vegetable production. Farmers were able to harvest twice their present yields[6].

Therefore the potential which this shrub holds in poverty alleviation and livelihood improvement for the people in Usambara Mountains is enormous. Its rich nutrient composition means a substantial saving in obtaining the same nutrients if they were otherwise purchased through a mineral fertilizer. It is easy to plant and grow, which implies that the shrub could be used as organic fertilizer in the hilly and inaccessible fields, where for which transportation of conventional farmyard manure has traditionally been difficult.

Before this could be done there was the need of establishing if significant differences in poverty indicators existed between those currently using this shrub for purposes already described against those who do not. The belief was that if this project could determine the extent those families using this shrub are better off in terms of farm productivity, fertility status of the fields, income levels, crop yields, family nutrition and related indicators compared to those not using *Tughutu,* then this knowledge would help policy makers. It would also encourage the dissemination of this Indigenous Technical Knowledge (ITK) to those unaware so as to reduce poverty and improve the livelihoods of people on the Usambara Mountains.

Photo 2. A farmer chopping *Tughutu* before placing it in a planting hole for tomatoes

Photo 3. A handful of *Tughutu* is placed in the planting hole, and then covered with a thin layer of soil before a tomato seedling is planted on top

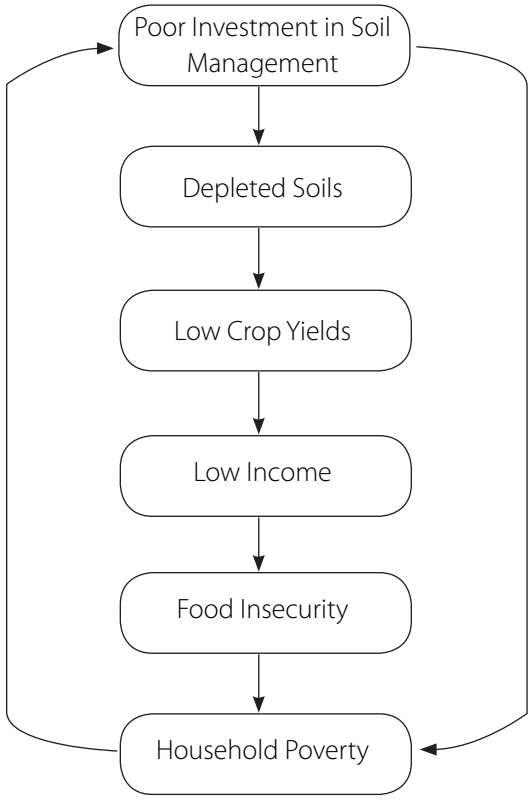
[5] Wickama and Mowo, 1999
[6] Wickama *et al.* 2000

2. BACKGROUND TO THE PROBLEM

According to Alexandratos (1988), some 780 million people in the developing world live in absolute poverty. Of these, 90% are in the rural areas with total or partial dependence on agriculture. In Africa it is reported that production per unit area of traditional crops such as sorghum, millets and maize have actually declined. Alexandratos estimates that, without proper land/soil husbandry measures on rain fed land, soil erosion and depletion of topsoil nutrients will lead to the daunting loss of 29% in terms of cropland productivity. Sanchez (1995) also reports that there is a close relationship between poor soils and poor farmers such that soil fertility depletion on small farms is now recognised as the key cause of declining food security, falling incomes and growing poverty in many sub-Saharan Africa.

In most parts of the East African highlands, the soils have already been exploited to their maximum natural potential for agricultural output. Farmlands are becoming fragmented into sizes, which make intensive agriculture difficult. Most farmers on these highlands are aware of the severe soil depletion, but they are just too impoverished to make any meaningful improvements to the soil's nutrient base. The majority found the inorganic fertilizers too expensive to afford. With such background there is a growing vicious cycle of poverty leading to low investment in soil management, leading to poor soils, which also leads to low crop productivity, low incomes, food insecurity and lastly increased poverty (Figure 1).

Figure 1. Schematic Relationship between Poor Soil Management and Poverty in Kwalei Village



Wickama and Mowo[7] reported on a local shrub called *Tughutu (Venonia subligera)* used by the Wasambaa of Kwalei village in Lushoto district for soil enrichment. This knowledge could help to break the above vicious cycle. Historically *Tughutu* is an indigenous plant that grows on the Usambara Mountains. Farmers in Kwalei village reported that the shrub's potential was recognised when the German colonial extension officers advocated its use in reinforcing ridges susceptible to erosion. The Germans had selected *Tughutu* probably because of its easy establishment (it is planted through stem cuttings like cassava) and it grows rather fast. Farmers noted that those areas with heavy populations of *Tughutu,* gave better maize yields once those pieces of land were cleared and cultivated. Farmers also believed that *Tughutu* helps the soils to retain moisture. Other uses of *Tughutu* include its fodder value - especially for goats during drought periods, firewood, as well as medicinal use for the treatment of wounds.

Only a few farmers reported that they used the shrub. It was not known, however, to what extent other people outside Kwalei village possessed this knowledge. Apart from awareness and use patterns, it was not clear whether those using it were shown to be better off in poverty and livelihood indicators than those not using it. It was also unclear as to why other people did not use this shrub despite its known potential for soil enrichment. This information was considered vital, because, once documented, it would encourage the organised dissemination of this ITK to more farmers living in other villages around Kwalei and beyond. This would help to boost the productivity of farmers, help alleviate their poverty by generating more income, and consequently improve their standards of living. In essence this was the broad scope of this project.

[7] 1999

3.0 STUDY OBJECTIVES

The general objective of this project was to assess the potential of this ITK observed at Kwalei village in Lushoto in alleviating poverty and improving the livelihoods of farmers through using integrated natural resource management. Specifically the project aimed to achieve the following:

1. Compare the differences in livelihood standards, income levels, health, household nutrition and farm productivity between those who use *Tughutu* for soil enrichment against those who do not.
2. Determine potential alternative uses of *Tughutu* that could be beneficial for household and community poverty alleviation.
3. Disseminate the observed ITK in Kwalei and the surrounding villages.
4. Develop policy recommendations for the district government aimed at integrating this knowledge for natural resource management.

4.0 LITERATURE REVIEW

The West Usambara Mountains, where Lushoto district is located, cover approximately 5,000 km-sq. The average population density in Lushoto district is 127-people/km sq[8]. The main ethnic group is the Wasambaa, who make up 78 % of the population. Other tribes are Pare (14 %), and the Mbugu (5 %) who had emigrated from the nearby Pare Mountains and settled mainly in the northwest and central parts of the West Usambara Mountains[9].

These mountains rise to 2,300 metres above sea level from the surrounding plains at approximately 600 metres. Due to their mountainous relief, the climate of these areas is characterised by extremely high rainfall variability. Pfeifer[10] reported that the mean annual precipitation in Lushoto decreases from the southwest to the north of the Usambara Mountains. It varies from 2,000 mm to 600 mm per annum with bimodal rainy seasons. The long rains occur during March to May *(masika)* while the short rains *(vuli)* occur during November to December. The average temperature oscillates between 18°Celsius and 23°C, with its maximum in March and minimum in July[11]. The West Usambara Mountains basically consist of two massifs of Precambrian metamorphic rocks. The major soil types in Lushoto are Acrisols, Phaeozems, Nitisols and Luvisols.

Ngailo *et al*[12] , in a study that covered four villages in Lushoto found that average land holdings were below 1.5 hectares per household. A later study by Lyamchai *et al*[13] in the Soni division (eastern part of Lushoto) found land holdings to be at 0.2-0.5 ha/household.

Mansoor *et al*[14]. reported that land holding in Kwalei, a village within Soni Division in Lushoto was a major factor that categorised farmers into different wealth categories. In their study, three wealth classes (A, B and C) were identified. Farmers in Category A were reported to own about 20 acres or more of land. Category B farmers owned 2-3 acres of land while Category C farmers owned much smaller pieces of land. Generally, all the groups were found to practise poor soil fertility management. Most of them do not apply inputs like fertilisers to crops due to their high cost. Consequently, crop yields in Kwalei and Lushoto are generally very low.

One area that has not been fully exploited is the potential of biomass transfer technologies in delivering cheap nutrients to the soil and consequently increasing crop yields. Experience from neighbouring Kenya shows that leguminous fallows of *Sesbania sesban, Tephrosia vogelii, Gliricidia sepium, Crotalaria grahamiana,* and *Cajanus cajan* are able to provide sufficient nitrogen for one to three subsequent maize crops. Most have helped double or quadruple maize yields at the farm scale[15]. According to Jama *et al*.[16], Kwesiga and Coe[17], Kwesiga *et al*.[18], in Kenya, a plant called *Tithonia diversifolia,* a common 'weed' introduced into Kenya during the 1920's, and presently used by many Kenyan farmers for fertilizing farmlands has shown great success. Thrupp[19] argues that for long term success at the farm level, the ITK systems must be taken on board. Thrupp states that the local ITK systems are an important source of information about the local farming systems, experiences, institutions,

[8] Bureau of Statistics, 1988
[9] Pfeiffer, 1990
[10] 1990
[11] Pfeifer, 1990
[12] 1998
[13] 1998
[14] 2001
[15] Palm *et al*., 1997; Nziguheba *et al*., 1998
[16] 1999
[17] 1994
[18] 1998
[19] 1987

culture etc. Earlier, Grandstaff & Grandstaff[20] had also argued that frequent examination of the local knowledge systems should reveal how local ITK can complement science. It is probably due to this fact McCall[21] and Vel *et al.*[22], reported that when farmers' local ITK is given its due recognition as a valid and important contribution, farmers eventually interact on an equal footing with scientists, and in doing so tend to bring their accumulated experiences and knowledge. For this project's purpose, all these add up to tools for alleviating poverty among farmers.

In the Kwalei village, Lushoto district, Tanzania, Wickama and Mowo[23] reported on the ITK among the local Wasambaa of shrubs which can be used for soil enrichment. In that study, farmers identified seven shrubs, namely: *Tughutu, Alizeti mwitu, Mhasha, Mshai, Mkuyu, Sopolwa, Tundashozi, and Boho.* These were analysed at ARI Mlingano Tanga and their selected characteristics are listed in Table 1.

Table 1: Nutrient Composition of Kwalei Shrubs

Shrub Type	Botanical Name	% Nitrogen	% Phosphorus	% Potassium
Mkuyu	*Ficus vallis-choudae*	3.0	0.23	4.4
Alizeti mwitu	*Tithonia diversifolia*	3.2	0.24	3.4
Mshai	*Albizia schiniperiana*	3.1	0.32	1.3
Mhasha	*Venonia amyridiantha*	3.4	0.23	4.5
Boho	*Bothriocline tementosa*	2.1	0.27	1.5
Sopolwa	*Kalanchoe crinata*	2.1	0.23	3.8
Tughutu	*Venonia subligera*	3.6	0.25	4.7
Tundashozi	*Justicia glabra*	2.0	0.27	2.1

Source: Wickama and Mowo (1999)

Most farmers preferred the shrub called *Tughutu*. For verification, this *Tughutu* was extensively tested at Mlingano[24] and later in Kwalei village itself where on application it gave maize and bean yields similar to kraal manure[25].

When combined with Minjingu Phosphate Rock (MPR) the resulting combination was able to more than double bean yields[26]. Despite this positive observation, it was not clear if actual use of *Tughutu* at household level could lead to the actual improvement on livelihoods, household incomes, food security, family health and nutritional status and other social economic parameters related to poverty. This study, therefore, wanted to find out if significant livelihood differences existed between farmers using *Tughutu* and those not using it. The intention of the study was, upon proof of such differences to disseminate the knowledge to those not using *Tughutu* and the policy makers in Lushoto so that more people could be encouraged to use and benefit from its potential and in doing so, reduce their poverty levels.

[20] 1986
[21] 1987
[22] 1989
[23] 1999
[24] Wickama and Mowo 1999
[25] Wickama *et al.* 2000
[26] Wickama *et al* 2000

5.0 RESEARCH METHODOLOGY

The study had the following research questions:

1. Are those using *Tughutu* the majority, or its use confined to a select few?
2. Why do some farmers not use *Tughutu?*
3. What are the major information pathways that have affected the spread of this indigenous knowledge of the benefits of *Tughutu?*
4. Are there significant differences in livelihoods (income, nutrition, education, housing) between those using *Tughutu* and those who do not?
5. What are the monetary savings and benefits accruing from using *Tughutu* against applying other inputs?
6. For those who do not use *Tughutu* how do they cope with soil infertility?

5.1 Hypotheses Tested

The test hypotheses were:

(a) Those using *Tughutu* for soil fertility improvement have a higher standard of livelihood.

(b) Farms/gardens belonging to those using *Tughutu* have higher crop yields.

(c) The majority of farmers do not use *Tughutu*.

5.2 Materials and Methods

5.2.1 The Study Area

Kwalei and the other four target villages are located 8 to 10 kilometers east of Soni town. The villages have average population densities ranging from 150 – 200 people/sq km[27]. The main ethnic group in these villages is the Wasambaa tribe, who make up 78-90 % of the population. Other tribes are Pare (10-12 %), and Mbugu (5 %). According to Pfeifer[28], the four villages fall in the "wet humid zone" which has a mean annual precipitation of 1,000-1,200mm with bimodal rainy seasons. Long rains occur during March to May (*masika*) and short rains (*vuli*) in November to December. The average temperature oscillates between 18°C and 23°C, with its maximum in March and minimum in July. The major soil types around these villages are Acrisols, Phaeozems, Nitisols and Luvisols.

5.2.2 Organisation of the Study

This study was conducted along the following steps:

- For data collection, the team developed questionnaires and a checklist of issues to be investigated with regard to the specific objectives. Questionnaires were pre-tested and the necessary corrections were done.
- A purposeful sampling technique was employed to allow all the eleven hamlets of the study village participate. The selection of respondents within the hamlets for this study was done on random basis.

[27] Village Executive data in Kwalei, 2003
[28] 1990

- Farmers were asked same questions, but were later divided into users of *Tughutu* and non-users. Each group was closely studied with respect to the specific objectives. A total of 100 households (25% of the village households) were interviewed for data collection.
- Village meetings, semi-structured interviews, structured questionnaires, farm surveys, rankings (pair wise & matrix), resource farmers, and other participatory techniques of collecting data were used to collect data.
- Secondary data sources were also used to gather data on the past interventions with regard to the technology being studied.
- Standard Health-Nutritional clinic cards were used to rate the nutritional state of the children aged under five. A weight-for-age criteria was used for rating. A child's weight (kgs) and age (months) was recorded and the appropriate point on the clinic card marked and rated. Malnourished children in the red curve (these had less than 60% of the standard weight for their age) were rated 1, those in the grey area (these had 60-80% of the standard weight for their age) were rated 2, while those in the green 3 (80-100% or above of standard weight for their age) were rated 4.
- Standard procedures of summarisation were used to process the data collected from the analogue questionnaires.
- A computer spreadsheet was used to gather and store data while for statistical analyses, the SPSS program was used. One way ANOVA tests were done to detect if groups differed significantly.
- Correlation analysis was done to determine the strength of relationship between different pairs of variables. There were no serious limitations to the study worth mentioning.

6.0 RESULTS AND DISCUSSIONS

6.1 Characteristics of the Studied Households and Influence on Use of *Tughutu* Technology

In this work, a total of 100 households were studied. Earlier work by Mansoor and Wickama[29] had established three wealth categories among farmers of Kwalei village:

- Farmers categorised as 'A' were observed to own 5-20 acres of land, at least 2 cows that are zero (not) grazed; good cement block houses, and could have an access to sufficient manure throughout the year. Farmers in this category use mostly manure (75%) for vegetable production in the valleys. The rest is applied to maize/beans fields and banana plantations. Category A farmers use small amounts of fertilizers, especially for the vegetable gardens. On average each household has two cows and 8-12 chickens. In this study there were 5 farmers belonging to this category.
- Category 'B' farmers own 2-3 acres of land. This group cultivates fewer types of crops. The smallness of their plots means that the farmers cannot produce enough maize and they have to import maize flour (a staple food) during most of the rainy season (3-4 months). This group has members who carry out intensive horticultural and vegetable production in the valleys. Category B farmers' fertilizer application is more than double to that of category A farmers and they apply more manure to their maize fields than their counterparts in group A. The category B farmers also have 3-4 other fields found elsewhere in the village. The higher levels of nutrient application by 'B farmers' is probably due to the fact that they have a smaller area for cultivation which means they are unable to leave land to lie fallow, unlike those in category A. Some 38 farmers (40%) interviewed belonged to this group.
- 'C' farmers own much smaller pieces of land. The majority own 1-2 acres of land and have fewer fields close to the village. Many do not cultivate any cash crop like tea and coffee. Nearly all the manure (90%) they obtain goes onto their vegetable gardens. Bananas are the crop which receives the remaining 10%. It was observed that their off–homestead fields are more distant (1-4 kilometres) compared to the other preceding groups. 'C farmers' do not use any fertilizers for all of their fields, most finding they cannot afford it given their per capita income. Category C farmers have to import maize during the rainy season and slightly beyond it (5-7 months). Nearly all the forage for their livestock is collected from elsewhere and sometimes cattle are grazed around the household. Category C represented 55% of the farmers in this study.

6.2 Summary of the Findings for the Categories

From the sample of 100 households, 67 (2 'A –farmers', 23 'B farmers' and 42 'C farmers') were found to be using *Tughutu* in their fields. Those not using it accounted for 60% of 'A farmers', 40% of 'B –farmers' and 30% of 'C –farmers'. The higher proportion of 'A –farmers' who do not use *Tughutu* is partly associated with the large areas they own. Their large land holdings mean they can afford to let some land lie fallow without disrupting their food security base.

Studies in Kwalei indicated that farmers belonging to category B follow most of the modern agricultural advice[30]. Most farmers in this group have better education levels but have only small to medium land

[29] 2001

[30] Mansoor and Wickama, 2001

holdings which they try to intensify through inorganic inputs like fertilizers and pesticides.

The majority of category C farmers use *Tughutu* because they can easily afford it as compared to fertilizers. All farmers using this indigenous knowledge reported that they preferred it because it was a cheap source of nutrients and it has a favourable effect on the soils. Those who have managed to plant the shrub in their homes also reported that its easy establishment was another advantage of this shrub.

Male-headed households formed 75% of the studied sample while female-headed formed the rest. Number and gender of household heads covered in data collection from the eleven hamlets of Kwalei village has been shown in Table 2 below.

Table 2. Distribution of Respondents Across Kwalei Village

Hamlet	Male	Female	Total
Kamajia	13	8	21
Kibaoni	9	3	12
Kingwele	11	3	14
Kweboma	8	2	10
Kwemse	5	1	7
Kwetongo	4	1	5
Mkunki	3	-	3
Mshewe	7	1	8
Muu	6	3	9
Shuleni	3	1	4
Ugange	6	1	7
TOTAL	**76**	**24**	**100**

Source: Field Study 2003

When these hamlets are examined in terms of *Tughutu* use, the emerging picture is as presented in Table 3 below. Several reasons can be given for the observed pattern in the use of this knowledge.

Table 3. Use of *Tughutu* Knowledge by Hamlets in Kwalei

Hamlet	Users of *Tughutu*	Non-users	Total
Kamajia	20 95%	1	21
Kibaoni	7 58%	5	12
Kingwele	3 21%	11	14
Kweboma	6 60%	4	10
Kwemse	4 67%	2	6
Kwetongo	4 80%	1	5
Mkunki	1 33%	2	3
Mshewe	7 88%	1	8
Muu	7 78%	2	9
Shuleni	3 75%	1	4
Ugange	4 57%	3	7
TOTAL	**67**	**33**	**100**

Source: Field Study 2003

Despite the fact that *Tughutu* knowledge is indigenous; the AHI through technical studies on this shrub[31] has been advocating its use across the hamlets as an organic fertilizer not only for staple crops like maize but also for a variety of other crops including vegetables. A close examination of the five topmost positioned hamlets that use this knowledge, that is Kamajia (95%), Mshewe (88%) and Kwetongo (80), Muu (78%) and Shuleni (75%) actually correlates with the effect the AHI has had on the respective hamlets in promoting *Tughutu* use[32]. This implies that advocacy for the use of *Tughutu* has a widespread influence.

The hamlet called Kibaoni deserves a special mention. This hamlet is the commercial center of Kwalei village and many people in Kibaoni tend to engage in trade and employment relating to the nearby tea factory. This could have contributed to their otherwise low score in the use of *Tughutu* as the majority of them can afford inorganic nutrient sources.

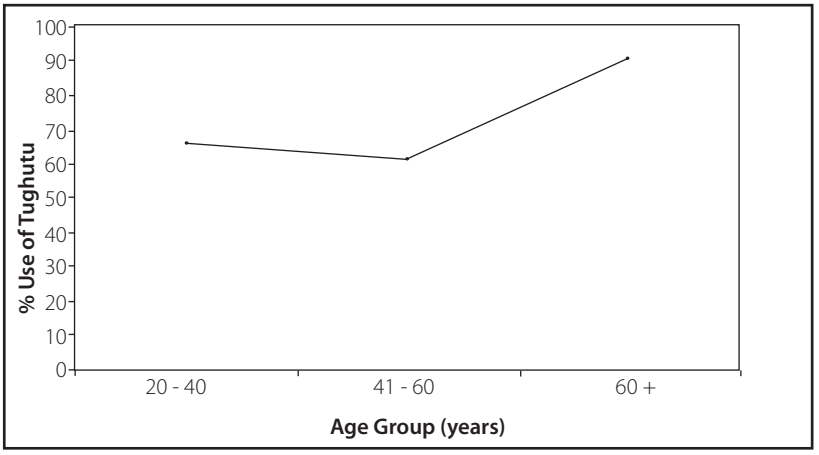
Of the 67% of farmers who use this ITK, women farmers form the majority. This correlates with the earlier observations made in Kwalei[33] that women were doing most of the farm work in the studied

[31] Wickama and Mowo 2001
[32] Wickama-personal experience
[33] Lyamchai *et al*. 1998

village. This can perhaps be explained that the women are traditionally more pre-occupied with the production of the food for their families to consume.

Several studies dealing with technology uptake in Kwalei have pointed out the influence of experience and knowledge on adoption[34]. Data collected during this study also supports this observation. To study a possible influence of experience of respondents to the use of *Tughutu*, respondents were grouped into three age groups: 20-40, 41-60 and 60+. Here we made the assumption that older members of the village were more experienced in the ITK than youngsters. The trend, which emanates from analysis, is as follows (Figure 2):

Figure 2. Influence of Experience on the Use of *Tughutu*



In principle, the difference in the use of *Tughutu* among farmers in the various age groups is not very significant. However, the group that uses *Tughutu* the most was found to be the 60+. This could be attributed to four reasons. Firstly in this group there are farmers who have more experience with the use of this shrub, drawing their experiences from as far back as the German colonial era[35]. Hence, such people need very little persuasion in using the shrub. Secondly this is a group which is economically the most disadvantaged when it comes to purchasing farm inputs like inorganic fertilizers, hence they are motivated to resort to whichever cheap sources of nutrients they can find. Thirdly, the application of inorganic fertilizers requires some technical skills, which most people belonging to this group tend to not possess. Fourthly, the majority of these have large land holdings[36] on which they cannot manage to apply inorganic fertilizers hence they resort to using *Tughutu*. These combined factors are most probably the cause for the observed trend.

The other groups have smaller land holdings, can fetch other nutrient sources like farmyard manure with much ease than the old people, and tend to be more conversant with application of inorganic fertilizers. Hence there are fewer of them using *Tughutu*. This observation implies therefore that experience of the target farmers should be considered in the future work on advocacy of the use of *Tughutu* in the other villages.

[34] Tenge, 2003
[35] Wickama and Mowo 1999
[36] Mansoor *et al* 2001

6.3 Differences between Users of *Tughutu* and Non-users on Poverty Indicators

For the purpose of this study, we chose household farm income, nutrition levels (weight for age indicators) especially for children aged under –five, and the productivity of the family agro-enterprises to be our criteria for assessing the importance of *Tughutu* in alleviating of poverty among the studied farmers. For the sake of reaching a judicious assessment of the family income, this study deliberately avoided including money flows from non-farm activities such as carpentry, traditional doctor fees, employment and remittances from relatives located elsewhere as household income. The intention was to assess family income on the basis of those enterprises for which *Tughutu* is applied or not applied so as to be able to effectively assess its contribution or opportunity cost from its omission.

6.3.1 Differences in Productivity

A combined summary of the crop produced and production levels between the two groups of users and non-users and an analysis of their differences is presented in Table 4.

Table 4. Productivity between Users of *Tughutu* and Non-users in Kwalei

Crop	Users (kg/acre)	Non-users (Kg/acre)	Significance Level
Maize	332.0	216.4	**
Bean	225.1	170.0	*
Tomatoes	8,502.9	4,327.3	**
Cabbage	2,104.5	2,163.6	ns
Sweet pepper (Hoho)	713.4	930.3	ns
Coffee	336.2	156.9	**
Tea	334.4	212.1	ns

Note: ***** significantly different at 0.05 level of significance
****** significantly different at 0.01 level of significance
ns no significant difference

Source: Field Study 2003

The differences in production for maize, the staple food in Kwalei and the other four villages, between farmers applying *Tughutu* in their fields against those who do not is shown in this table. The bulk of the non-users harvest between 200-300 kg/acre of maize, while those using *Tughutu* harvest up to 900 kg/acre of maize.

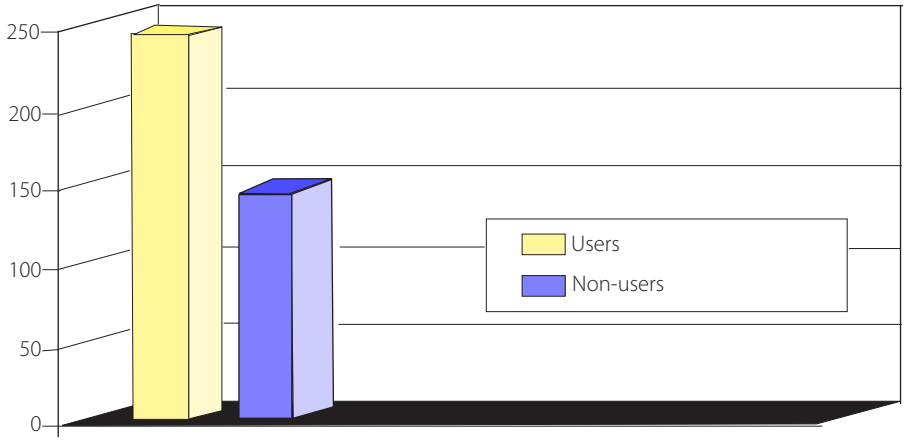
Generally the differences in the four crops (maize, beans, tomatoes and coffee) correlate well with earlier observations[37] in which it was reported that through AHI advocacy, farmers had actually extended the use of *Tughutu* from traditional maize and beans cultivation and eventually into the lucrative vegetable gardens. The non-significance in productivity of cabbages and sweet pepper between the two groups could be attributed to the fact that cabbages and sweet pepper take longer (4-5 months) to mature and sell at a lower price than tomatoes (3 months). Hence farmers tend to concentrate application of *Tughutu* to produce crops such as tomatoes, which take a shorter time to mature and bring a better return.

[37] Wickama *et al* 2000

6.3.2. Differences in Household Income from the Farm Produce

Users of *Tughutu* were observed to have more income from their farming than those not using it (Figure 3). To achieve this we transformed the harvested crops then multiplied by their highest market price as reported by farmers. On average, users of *Tughutu* had nearly double the income from their farms compared to non-users.

Figure 3. Differences in Household Possessions and Family Income



6.3.3 Differences in Family Nutrition Among the Under Fives

The study of nutritional status among the household under-fives was undertaken to detect if there existed differences in nutritional well being in either group and assess if the difference could be associated with the use or non-use of the *Tughutu* technology at the household level. Some 46 children (29 from users, 17 from non-users) were studied (Table 5).

Table 5. Differences in Nutritional Parameters Among Children

Parameter Studied	Children of Users (n=29)	Children of Non-users (n=17)	Significance (0.05 level)
Weight (kg)	12.78	12.47	ns
Height (cm)	82.24	83.82	ns
Weight/age Nutritional class	2.66	2.59	ns

Source: Field Study 2003

The non-significant difference in nutritional well being among children from users and non-users of *Tughutu* has several implications. One, we are of the opinion that the communities do not accord child nutrition the priority it deserves even when the family has better income levels. The trend can be attributed to ignorance on the repercussions of not investing in proper childhood nutrition. Two, lack of difference between these groups could also suggest that this community has more or less uniform practices and traditions when it comes to child nutrition such that even when the family has more income, there is little change in their approach to this matter.

7.0 EMERGING POLICY ISSUES

1) Despite the good intentions of the Tanzanian government in disseminating agricultural technologies through its Department of Agricultural Extensions Services, it seems that in the area of soil fertility management, emphasis is directed towards the use of inorganic resources such as mineral fertilizers and/or organic kraal manure. The potential of indigenous knowledge resources like *Tughutu* has never been accorded the recognition it deserves. Even when their potential is acknowledged, no formal framework exists to take them on board in a manner that could reach other communities in similar ecologies that are unaware of the potential of such resources. The Government can improve matters by putting in place policies that can address this gap.
2) Advocacy of agricultural technologies to farmers is basically a responsibility of extension agents. Yet these people are seldom exposed to tapping the potentials presented by indigenous resources such as *Tughutu*. In so doing they take it for granted whenever they come across it. Consequently an opportunity of such knowledge reaching other people is lost. The government can put in policy demands in which potential of the resources like *Tughutu* can be included in the technical curricula in the vocational education for extension officers so as to use opportunities currently missed.
3) Farmers are mostly the originators of ITKs. Yet the potential of farmers in disseminating such knowledge is often overlooked. For Lushoto, the Agricultural Services Extension Department could benefit by using farmers who use the *Tughutu* technology as resource farmers for farmer-to-farmer exchanges of knowledge.

8.0 CONCLUSIONS AND RECOMMENDATIONS

In view of the above we wish to conclude and recommend as follows:

1) Advocacy of technologies affects the speed with which some communities can access innovations. For policy, this implies that the authorities in Lushoto need to devise mechanisms for effective advocacy of this technology and put in place a framework by which practicing farmers can avail their knowledge to others.
2) *Tughutu* is mostly used in soil fertility improvement. Some alternative uses include medicinal purposes like enhancing blood clotting and the treatment of small wounds. For policy this calls for advocacy of domestication of this shrub and *Tughutu* being subject to traditional medicine research to verify its potential.
3) Households with commercial accesses tend to engage themselves in off-farm activities. For policy, this calls for selective targeting and identification of the beneficial target groups when advocating natural resource management technologies.
4) Women farmers appear more likely to use *Tughutu* shrubs for soil fertility improvement than men. For policy this calls for recognition of this role by introducing parallel technologies such as improving *Tughutu* with inorganic nutrient sources like MPR and fertilizers which can reduce the amount of *Tughutu* used. Also the Government can advocate domestication of *Tughutu* so as to reduce the time spent on fetching the shrub from forests. This will reduce the workload of women.
5) The experiences of farmers influence their use or non-use of *Tughutu*. For policy this calls for capacity building programmes for those without similar experiences to enable them benefit from the potentials of the shrub as well.
6) There are significant differences in the productivity of maize, beans, tomatoes and coffee between those using *Tughutu* and those who do not. Users of *Tughutu* realise higher returns from these crops. For policy there is a need for advocating for a judicious use and domestication of this shrub to continue getting its benefit. Furthermore, it is not only effective in improving the soil's productivity; it is also a less costly intervention for the poor farmers to use.
7) There is no difference in the nutritional well being among children from users of *Tughutu* and those not using it. This implies the two communities do not accord child nutrition the priority it deserves regardless of family income. For policy, this is a niche that needs to be addressed through capacity building programmes.
8) There is evidence from research that application of *Tughutu* when amended with phosphate fertilisers like MPR doubles the yields of beans compared to current farmers' practice. This implies that farmers have another cheap option for enriching their fields to realise better crop yields from the same area. For policy this niche calls for concerted efforts from the District Council in Lushoto and the Ministry of Agriculture and Food Security (MAFS) to incorporate this practice in their nutrient application recommendations to Lushoto and other places with a similar agro-ecological setting.
9) Research results indicate that application of *Tughutu* is comparable in terms of effectiveness to use of farmyard manure. *Tughutu* is easily established from stem cuttings and is fully grown within eighteen months. This provides a niche with which farmers can domesticate this shrub and then fertilise their fields located in hilly landscapes insitu. Presently such fields are difficult to treat with kraal manure owing to difficulties associated with transporting farmyard manure to such fields. For policy this calls for concerted efforts in sensitising communities to domesticate this shrub as part of current efforts of curbing soil erosion in the highlands.

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