The Neglect of Traditional Agro-Forestry (TAF) and its Effects on Soil Erosion and Crop Yield

The Case of the West Usambara Mountains

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1. Abstract

The paper aimes at investigating why Traditional Agro-Forestry practice (TAF) is diminishing, and studying the effects of its neglect on soil erosion and crop yield. The study was conducted between September and December 1996, in the West Usambara mountains.

The study was done in the tropical highlands of Northern Tanzania in Lushoto district between latitude 4 20'-5 10' S and longitude 38 10'- 38 40' E at an altitude between 500-2,000 m. Nine villages located in four Agro-ecological Zones (AEZ) were covered. The villages were Mwangoi, Mlesa, Majulai (Handei), Emao, Nywelo, Kivingo, Mng'aro, Dochi and Ubiri.

Intensive interviews, meetings and informal discussions were used to collect data from farmers. In addition, agricultural and forestry extension agents were also interviewed. A total of 180 farmers randomly selected and six extension staff were interviewed using standardized questionnaires which mostly contained closed questions. Data from standardized questionnaires were analyzed using descriptive statistics and chi-square analysis.

Results obtained indicate that the decline of TAF is caused by a complexity of factors. The major ones include drought, smallness of farmers' fields, inappropriate tree-crop combinations and a shift of preference from upland to valley bottom agriculture.

Important conclusion from this study is that TAF is still a viable farming system in the West Usambara Mountains. In order to revamp the existing declining trend, the problems associated to its decline should be tackled. In addition, research on the most appropriate tree-crop combination capable of solving multi-problems should be initiated. For instance, trees should be fast growing and able to carter for fuel wood and timber and also, should have minimum competition effect with intercropped crops particularly for moisture, light, nutrients etc.

2. Brief Literature Review

Agroforestry is a popular concept among agricultural development and environmental specialists and is often invoked by scientists and planners as a solution to rural development needs in Africa (Rocheleau, 1988). Young (1989) defines agroforestry as a collective name for land-use systems in which woody perennial (trees, shrubs etc.) are grown in association with herbaceous plants (crops, pastures) and or livestock in a spatial arrangement, a rotational or both, and in which there are both ecological and economic interactions between the tree and non-tree components of the system.

Related terms of agroforestry include alley cropping. Alley cropping is a well-known form of agroforestry, it is also called “hedgerow intercropping”. The practice is capable of maintaining soil fertility and crop yields under conditions where control plots under annual crops alone show soil degradation and declining yields (Young, 1989; Lal, 1988).

The ecological interactions between trees and crops, acting through the microclimate, and the sustaining of soil fertility, are the most distinctive features of agroforestry. Trees improve soil fertility by maintenance of organic matter (litter, prunings and root residue), nitrogen fixation, uptake and recycling of nutrients and other processes.

Certain trees may halt or reverse soil degradation by soil fertility enhancement properties, for example *Acacia senegal* and *Acacia albida* in semi-arid zone. *Proposis spp* also have a demonstrated capacity to improve soil fertility in semi-arid to dry savanna regions (Young, 1989).

Cover crops such as rubber, coconut and oil palm in Malaysia reduce weeding costs, decrease soil temperature, maintain soil structure, organic matter content and fertility. Disadvantages are twinning plants may damage the permanent crops, there is an increased risk of fire and there is a danger of harbouring diseases and insects (Bunting & Milsum, 1927) as quoted by Lal, 1977).

Agroforestry is frequently invoked as a solution to problems of land and water degradation as well as an answer to shortages of food, cash income, animal fodder and building materials in Sub-saharan Africa (Rocheleau, 1988). While experts may disagree on whether famines, drought and resource degradation are natural disasters or caused by misuse of the environment, there is a general consensus that future land use systems and technologies must give people more flexibility to respond to rapid shifts in economic and ecological conditions. In addition, new production systems must maintain, or in many cases restore, the soil and water resources upon which rural life depends.

In this context, several TAF systems have in fact sustained people for generations in a variety of African environments. The intercropping of *Acacia albida* with millet and sorghum in the West African Sahel, *Kibanja* system in Tanzania are among the best known examples of successful traditional agroforestry (TAF) practices. Less well-known but equally significant are the sylvopastoral systems developed by people who depend on managing livestock and their fodder source in African savanna lands.

At present, many of these TAF are literally loosing ground in the face of destructive changes and increasing pressure on the people and their natural resources. The

challenge is to maintain those agroforestry systems that are now under threat and to improve and adopt long-standing practices that must now be effective under changing conditions. Where TAF systems have not been used or can no longer be used because of changing conditions, new systems need be developed.

3. Hypotheses

1. There is no relationship between TAF and soil erosion
2. There is no relationship between erosion and crop yield

4. Methodology

4.1 Village selection criteria

Nine villages were selected in advance according to the following criteria; the four AEZ of the West Usambaras should be covered; TAF is a common/dominant practice in the area and the covered villages are adversely affected by soil erosion.

4.2 Organization and implementation of the field survey

The field study, which started in mid September 1996, took 52 days. The survey started by pretesting the standardized questionnaires; 15 farmers were involved. During the pretest, farmers interpretation of different questions were examined and necessary changes made.

4.3 Interviewees selection and instruments used

Twenty farmers, gender balanced were randomly selected from a list of villagers obtained from each respective village offices surveyed. For the extension staff, no sampling procedure was necessary. It was intended to interview the entire staff who was present.

Intensive farmers interviewing, village meetings and informal discussions were employed to collect data. The procedure was characterized by a three step: Firstly, 180 farmers were interviewed by the survey team of four people. The extension staff stationed in each of the surveyed villages was also interviewed. Secondly, meetings were held to discuss general problems facing farmers and TAF practice in particular and lastly, farmers informal discussions were also conducted. Six extension staff members were interviewed during the survey.

4.4 Processing of data, testing of hypotheses and analysis

Data resulted from the field survey were studied by the principal investigators in order to avoid selective interpretation. The data were then processed with the help of a spread sheet computer program (Quattro-Pro). The testing of the hypotheses was done by Chi-square analysis at 0.005 level of significance (Steel and Torrie, 1980; Hurbut and Blalock 1979).

5. Results and Discussions

5.1 Demographic and Social Structure of the Surveyed Sample

The demographic and social structure of the West Usambara mountains (Table 1) classified in four agro-ecological zones (AEZ) i.e. dry-warm, dry-cold, humid-warm and hot reveals the following:

Table 1. Demographic and social structure of the surveyed

Village	Div.	Land ownership (%)		AEZ	N	Sex (%)		Av. age	Ed. Level (%)		
		P	C			F	M		S	P	N
Mwangoi	Mlalo	100	0	D-W	20	50	50	52	-	87	13
Mlesa	Mlalo	100	0	D-W	20	40	50	49	-	70	30
Majulai (Handei)	Mlalo	100	0	D-W	20	36	64	38	-	86	14
Emao	Mtae	86	14	D-C	20	62	38	59	-	62	38
Nywelo	Mlalo	63	37	D-C	20	62	38	38	-	89	11
Kivingo	Umba	100	0	D-H	20	39	61	47	-	83	17
Mng'aro	Umba	32	68	D-H	20	47	53	39	-	84	16
Dochi	Lushoto	100	0	H-W	20	89	11	32	11	89	0
Ubiri	Lushoto	80	20	H-W	20	73	27	44	-	47	53
Mean		85	15		20	55	45	44	-	77	22

Village	Av. H/hd	Religion comp.		Ethnic compo.				Av. Farm size (ha)	Land-owner Ship
		Ch	Ms	Sa	Mb	Pa	Oth		
Mwangoi	9	5	95	95	0	0	5	5	5
Mlesa	7	10	90	95	0	0	5	2	
Majulai (Handei)	7		100	100	0	0	0	1.6	
Emao	9	52	48	10	10	71	9	2	
Nywelo	8	26	74	42	0	37	21	1.6	
Kivingo	7	11	89	89	0	6	5	2.4	
Mng'aro	6	5	95	63	0	16	21	2.4	
Dochi	6	22	78	89	0	0	11	0.8	
Ubiri	8	7	93	80	0	17	3	1.6	
Mean	7	15	85	74	2	16	8	1.8	

Source: Field data

Abbreviations
AEZ – groecological zone;
N – sample size;
S – secondary education;
P – primary education;
Ch – christian;
Ms – muslims;
P – private;
C – communal;
Sa – sambaa;
Mb – Mbungu;
Pa – pare;
Oth – others;
Div. – divisions;
F – female;
M – male;
D-W – dry warm;
D-C – dry cold;
D – H – dry hot;
H-W – humid warm

5.1.1 Dry warm AEZ

Mwangoi, Mlesa and Majulai (Handei) villages which fall in this zone lie about 1200-1800 m asl. receiving 500-800 mm rainfall /annum. Field data indicate the following:

Education level
Most farmers in the zone have primary education (81 %) and about 19 % have never attended school while secondary school leavers are non-existent. This scenario implies that most of the educated people in this zone do not stay in villages implying rural-urban migration of energetic youths after their secondary education. Normally the rural-urban migration of youths is associated with better prospects anticipated in towns such as employment and the diverse enterprises normally found in towns unlike in villages.

Average household and farm sizes

Results indicate that the average farm size, which is under private ownership, stands at 1.7 ha per household and on average one household has about eight people. This suggests that land available per person in this zone is only 0.21 ha which is quite a small area for meaningful food production. For instance, taking the average yield of maize (staple food) which stands at 500 kg of maize/ha in the district (Shelukindo,1992), then food available per person from these farms is only 15 kg of maize/year which is not sufficient to feed the people and make them concentrate on other agricultural activities.

5.1.2 Dry-cold AEZ

Emao and Nywelo villages fall under this zone. The zone receives annual rainfall of about 500-800 mm and lies between 1,200-1,800 m asl. Survey data reveals the following:

Education level

Unlike the dry-warm AEZ, this zone has a relatively low number of primary school leavers (76 %) and a higher number of farmers without formal education (24 %). The status of farmers with secondary education is like in the dry-warm AEZ.

Average household and farm sizes

The average household size in this zone stands at nine people per household and the average farm size at 1.8 ha/household. This indicates that land available for cultivation per person is about 0.2 ha/person which is too little for agricultural production. The farm size is lower in Nywelo due to existence of Government forest reserves aggravating the land pressure problem.

Land ownership

Land ownership in this zone is either private or communal, with most of the farms being private (75 %). In Nywelo village about 0.37 % of the arable land is forest reserves controlled by the Government agents (forest office). In these forest reserves people are restricted to cut trees. Cutting is done only under special permits.

5.1.3 Dry-hot AEZ

The AEZ, in which Kivingo and Mng'aro villages falls, experiences drought through out the year due to the rain shadow effect of the West Usambara mountains. The rainfall amount is usually below 500 mm per annum. Only drought resistant crops and some irrigated crops can thrive well in this zone. The altitude range is below 1000 m asl.

Education level

Field data shows that the dry-hot AEZ has in average a relatively low proportion of farmers without formal education (16 %) and those with primary education (84 %) when compared to the rest of the zones. This can probably be explained by the number of Government institutions in these villages and the number of primary schools in these villages. At present the Government institutions include the Kitivo irrigation project and Mng'aro prisons. In addition, there are three primary schools within the two villages.

Average household and farm sizes

The average household size in the zone is seven people/household a relatively low number when compared to the dry-warm and dry-cold AEZ's. The average farm size is the highest in the Usambaras with an average of 2.4 ha/household.

This suggests a relatively large piece of land (0.3 ha /person) for agriculture production though not sufficient for meaningful agriculture. The increase in farm size in the zone can be explained by the terrain of the area. Unlike in other zones which are mountainous, Mng'aro and Kivingo are situated in lowland with a maximum elevation of 1000 m.

Land ownership

The land tenure in this zone is either private or communal. In Kivingo, land is solely private while in Mng'aro a larger part is communally owned by the Government institutions in the village. This has led to critical land pressure among the poor farmers particularly in Mng'aro. Currently, the land under the Kitivo irrigation project which is in Mng'aro village is idle due to lack of funds but farmers are not allowed to use it. It is high time for the Government to give back the land to the village Government for re-allocation to farmers who are need of land.

5.1.4 Humid-warm AEZ

The AEZ encompassing Dochi, Ubiri and Bumba receives the highest rainfall in the West Usambaras. The annual rainfall ranges from 800-1.700 mm and its altitude range is between 1000-1,300 m. This suggests high agricultural potential far various crops.

Education level

Unlike other AEZ's, farmers in this zone have at least attained secondary education as evidenced by Dochi village with 11 %. The village is about 1 km from Lushoto town, the district headquarters. Being close to Lushoto town can probably explain why youths with secondary education have decided to settle there as most of the facilities obtained in towns can also be easily obtained in vicinity villages.

Field data also reveal a higher level of literacy when compared to other zones. This is indicated by the number of people with secondary education, which stands on average at 5 %. The average number of people without primary education stands at 27 % and those with primary education at 68 % which is the lowest when compared to other AEZ's. This can probably be explained by the involvement of the youths in petty business instead of attending schools. Petty business in interior villages is not very much pronounced like in villages near the district headquarters.

Average household size and farm sizes

The average household size is the same as in the dry-hot zone but with relatively low average farm size of about 1.2 ha/household. This reflects the high population density and severe land pressure in the zone.

Land ownership

Land tenure system in the zone is either private or communal. Most of the land is private except in Ubiri village. The location of Dochi (1 km from Lushoto) can explain why land in this village is privately owned. As a rule, in most cities and towns land demand for various developments becomes scarce as the population increases. In the long run the process extends to the vicinities of neighbouring villages or hamlets.

From the above observations the following general conclusions can be drawn:

- There is a serious land pressure in all zones and this has detrimental effect on agricultural production
- Rural-urban migration is evident in all AEZ's particularly by the literate youths, and where land is owned by private/Government institutions such as Mnga'aro (68 %), Nywelo (37 %) and Ubiri (20 %) the problem of land pressure is more severe.

5.2 Decline of TAF

The decline of traditional agroforestry in the West Usambara is attributed to many factors such as population pressure, drought, low crop prices and unreliable market, inappropriate tree-crop combination etc. as shown in Table 2.

Table 2. Causes of Traditional agroforestry decline

Reasons for abandonment	Villages mostly affected
Population pressure	Mlesa, Mwangoi, Nywelo, Dochi
Drought	Mlesa, Mwangoi, Nywelo
Low crop prices and unreliable market	Mlesa, Nywelo
Inappropriate tree-crop combination	Mlesa, Dochi
Introduction and enforcement of new conservation measures	Mlesa, Mwangoi, Nywelo, Mtae
Lowland agriculture	Mlesa, Mwangoi, Majulai
Lack of seedlings for traditional trees	Nywelo, Mwangoi, Mtae
Change of priority	Mlesa, Mwangoi, Majulai

Source: Field data

Population pressure

Population pressure is a serious problem in the West Usambara (Census, 1988) and this has recently drastically reduced the farm sizes. Farmers cultivate very small plots of about 0.3 ha (Table 1).

Population pressure was singled out by farmers as one of the factors leading to the decline of TAF particularly in three AEZ's namely dry-warm, dry-cold and in the humid-warm. Due to population pressure some farmers are now moving willingly to sparsely populated areas such as Handeni district.

The two scenarios i.e. population pressure and out migration of people to sparsely populated areas has negatively affected TAF development in the district. The smallness of the farms for instance, make farmers not to practice TAF because they are after short term benefits of seasonal crops rather than a mixture of annuals and perennial crops (TAF). The out-migration accelerates the abandonment of existing TAF plots which later leads to improper management and total collapse of the plots.

Because of population pressure which has resulted in land pressure farmers are now increasingly diversifying activities so as to earn extra income such as selling labour, running rental shops, selling firewood, charcoal and local brewing. As the number of farmers involved in agriculture is decreasing, TAF is also declining. Some of these activities such as selling of firewood and charcoal directly contribute to the decline of TAF as trees are cut without replacement.

There is no possibility that the land pressure problem can be solved so as to increase the size of TAF fields. However, appropriate tree crop combination and proper management in these small farm sizes will increase productivity and sustainability of agriculture in the district. Besides food crops, TAF will enable farmers to obtain fuel wood, fruits and timber in the same field.

Drought

Drought also is a factor contributing to the decline of TAF particularly in the dry-warm and dry-cold AEZ's. Characteristically these AEZ's receive rainfall amounts of about 500-800 mm/annum and rainfall is erratic in nature.

In recent years rain has been unreliable in its amount and distribution. As a result, some crops that were used in traditional agroforestry can no longer be grown or are grown at a smaller scale than before. An example of such crops is coffee and bananas in Mlesa village. Main reasons for drought problem in this area are deforestation and the unpredictable rains.

In our view drought can to a certain extent be checked through creating awareness among our people of the effects of deforestation on the microclimate and by urging people to plant trees. Campaigns like “once you cut a tree you need to replace it with trees” are of vital importance. Another counter acting measure is to look for cheap alternative sources of domestic energy instead of fuelwood that consumes a large part of tree crops. The use of improved/economic charcoal stoves, electricity, and kerosene can greatly reduce this environmental destruction for the benefit of the future generations.

Improper tree-crop combination

Improper tree-crop combination in a TAF farm is another reason for the decline of TAF in the dry- warm and humid-warm AEZ’s. Table 3 shows the common tree-crop combination in farmer’s TAF fields. The combination varies from village to village and even within the village it varies from one farmer to another.

Table 3. Tree-crop combination and its arrangements in traditional agroforestry farms in the surveyed villages

Village	Major crops	Trees	arrangement
Mwangoi Mlesa Majulai	Banana, Cassava, Maize, Beans, Coffee, Sweet potatoes, Yams, Pepper, Sugar-cane, Groundnuts	Msongoma, Mshai, Miwati, Mkindoli, Mkuyu, Muungu, Mikaratusi, Mvinje, Mvumo	Spatial mixed
Mtae	Maize, Beans, Potatoes, Banana, Sugar-cane, Cassava	Pears, Mikaratusi, Msongoma, Mshai, Muungu, Greveria, Mkindoli, Bokoboko	Spatial mixed
Nywelo	Maize, Beans, Irish potatoes, Banana, Cassava, Sugar-cane	Pears, Msongoma, Mshai, Mkaratusi, Pine cider	Spatial mixed
Kivingo Mng’aro	Maize, Rice, Banana, Sugar-cane, Beans, Kunde, Cassava, Sweet potatoes	Coconut, Mangoes, Mijoholo, Miarobaini	Spatial mixed
Dochi Ubiri	Banana, Cassava, Beans, Sugar-cane, Coffee, Potatoes	Eucalyptus Spp. Mishai, Agrocapus, Mitandala	Spatial mixed

Source: Field data

The variation depends on many factors such as plot size, farmers priority crops based on profitability, purpose of tree planting, farmers knowledge about tree-crop competition for moisture, light, nutrient and resistance of trees and crops against pests and diseases.

Some farmers have a crop tree combination that results in poor crop yields because of competition for moisture, nutrient and shade effects. Trees such as *Eucalyptus Spp. (Mikaratusi*) were identified by farmers to be causing low crop yield in their fields. This tree is known for its high water intake and as a result renders fields to have moisture deficit hence crop failures. This has built negative altitude towards TAF practice to some farmers.

In order to achieve a sustainable farming system (TAF) a research on the appropriate tree-crop combination is of vital importance. The combination should be

in such a way that minimizes effects of light, shade, moisture, nutrients etc. and at the same time ensuring good crop yields. The fact that farmers plant trees mainly for economic reasons should also be considered when designing a research project on the appropriate tree-crop combination. Multi-purpose trees for both fuelwood and timber should be incorporated.

Low crop prices and unreliable market

Low crop prices and an unreliable market for upland crops like coffee and bananas which are normally used in traditional agroforestry farms was mentioned as a handicap to the development of TAF particularly in the dry-warm and dry-cold zones. This has contributed to the abandonment of TAF. Many farmers are opting to plant trees for timber and construction because of market reliability and higher economic values than trees which are used in traditional agroforestry such as *Albizia gummifera* (*Mshai*), *Erythrina abyssinica* (*Muungu*), *Casuarina cunninghamiana* (*Mvinje)* etc. as shown in Table 3.

As a response to low prices of upland crops, many farmers are opting for valley bottom agriculture where they produce horticultural crops such as cabbages, tomatoes, spinach, sweet potatoes and beans by using traditional irrigation techniques. By using irrigation these farmers normally produce all year round.

Introduction and enforcement of new conservation measures

The introduction and enforcement of new conservation measures such as macro-contour and micro-contour lines, cut-off drains (*fanya juu/chini*), level terraces and contour grass strips by the Soil Erosion Control and Agroforestry Project (SECAP) in recent years (1985-todate), have contributed to the decline of TAF as an erosion control measure. The traditional soil conservation measures used to be vegetative strips of *Malaka* tree, *Donondo*, sugarcane, *Matugutu*; traditional agroforestry; crop residue strips; use of cover crops; ridges etc.

Lack of tree seedlings for traditional agroforesty

Once a traditional tree is cut or dies for any reason there is no replacement because seeds/seedlings for different traditional tree species such as *Mshai* (*Albizia gummifera*), *Muungu (Erythrina abyssinica*), *Mvinje* (*Casuarina cunninghamiana*), *Msongoma* (*Senna siamea*), *Mvumo* (*Ficus thonningii*) are not easily available. These trees have been identified by farmers to have the ability of conserving moisture and hence are beneficial to crops.

Change of priority

Survey data show that firewood and provision of timber for construction are the major reasons for growing trees in farmers' fields. This shows that the farmers' priority is more in economic benefits rather than erosion control. According to the field results tree planting for erosion control does not rank high. Only 14 % of the respondents plant trees for erosion control while the majority i.e. about 86 % (firewood 50 % and timber for construction 36 %) gave economic reasons.

5.3 Traditional Agroforestry and Soil Erosion

Table 4 shows the relationship between traditional agroforestry, soil erosion, crop yield and crop yield. About 63 % of all farmers without TAF are observing soil erosion in their field while only 38 % of the farmers with TAF observe soil erosion. These results show that a relation exists between traditional agroforestry and soil erosion. The test statistics indicate significant differences hence providing sufficient evidence that TAF can reduce soil erosion.

About 37 % of farmers without TAF do not observe soil erosion in their field, this can be explained as a result of the use of other conservation measures such as contour grass strips. About 38 % of farmers with TAF observe soil erosion in their field. This observation suggest that TAF alone may not completely halt soil erosion problem hence there is a need to take into account different conditions in trying to arrest soil erosion such as slope gradients, type of soil, climate, management practices etc.

Although soil erosion ranked third in purposes of tree planting, this scenario indicate that farmers are aware of soil erosion problem and its effects. However, this was not reflected at all in the major agricultural problems facing farmers. The major problems facing farmers in the order of priority include drought, land pressure, food shortage, pests, pasture stress, crop diseases, prices and availability of inputs. This suggests that probably a farmer conceives soil erosion differently from that of an expert. An in depth analysis of soil erosion on part of a farmer need to be studied.

Another explanation of this contradiction may be due to the fact that effects of soil eosin are not immediately noticeable and some time not at the site where it occurs. This calls for education and demonstrations to farmers on the quantitative effects of erosion on their crop yield and if possible on monetary terms. This will motivate them to invest in erosion control measures such as TAF

5.4 TAF and Crop Yield

Results in Table 4 also show that 40 % of farmers with TAF are observing high crop yield in their field while only 2 % of farmers without TAF are observing high crop yield in their field. Since other factors such as climate, soil management were the same for the two categories of farmers (agroforestry and non-agroforestry), the results support the conclusion that TAF increases crop yield.

Table 4. Relationship between Traditional Agro-Forestry, soil erosion, crop yield and yield trend

Farmers Category	Farmers Response									Total
	Erosion problem		Crop yield trends (1986-1996)			Crop yield comparisons (Agroforester Vs. non-agroforester)				
	Observed (%)	Not observed (%)	Increasing (%)	Decreasing (%)	Same (%)	High (%)	Low (%)	Same (%)	Don't know (%)	130
Agroforester **	38	62	13	84	3	40	36	20	4	50
Non-agroforester	63	37	10	90	--	2	33	12	53	
X2 critical	3.84		5.99			7.82				
X2 Calculated	9.30*		2.07			69.50*				

Source: Field data

* **Significant difference**
** **Farmer with tree-crop combination in his/her farm**

The increase in crop yield with TAF is due to its effectiveness in reducing soil erosion and hence conserving moisture and increasing organic matter and nutrients in the soil. About 2 % of all farmers without TAF field observed an increase in crop yield. This may be due to their ability to purchase artificial fertilizers or use of improved varieties and better crop management practices. About 36 % of the farmers with TAF observed low crop yields in their fields. This can probably be

explained by improper crop-tree combinations in these fields which results in competition for moisture and other nutrients.

5.5 Crop Yield Trends

Crop yield trends from 1986 to 1996 for farmers with and without TAF show a declining yield trend (Table 4). Field data indicate that about 84 % of the farmers with tree-crop combinations hereby referred as agroforesters observed decreasing crop yields in their farms. The same trend was observed for non-agroforesters of which about 90 % observed a declining yield trend.

The test statistics show no significant difference in crop yield trend between the two categories of farmers. This suggests that besides TAF there are other factors that contribute to yield decline.

5.6 Firewood Dilemma

Firewood is the major source of domestic energy in the study area though its availability is scarce. This has led to deforestation and decrease of traditional agroforestry practices as some trees, which are used in traditional agro-forestry, are cut down for firewood without replacement.

Results also indicate that about 1.5 to 5 hours are used daily in search of fuel wood. This not only overworks women and children who are responsible for firewood collection but also leads to wastage of precious time which would otherwise be used for other productive purposes including management of TAF fields. This calls for policy makers to mobilize farmers either in groups or individually to invest in alternative energy measures such as economical charcoal stoves, solar energy, cow dung energy, electricity etc.

6. Conclusions and Recommendations

It can be concluded that given the socio-economic and environmental setting of the area traditional agroforestry is still a viable and a sustainable farming system in the West Usambara mountains despite the problems associated with it. Traditional agroforestry under favourable conditions can ensure food security, soil fertility enhancement, soil erosion control and minimization of total crop failure in case of adverse climatic conditions such as drought.

In addition, research on the most appropriate tree-crop combination capable of solving multi-problems should be initiated. For instance, trees should be fast growing and able to carter for fuelwood and timber and also, should have minimum competition effect in terms of moisture, light, nutrients etc. with annual crops which are usually intercropped.

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