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*Full Length Research*

# Awareness and adoption of indigenous technical knowledge in agroforestry practices in Kenya's Maseno Region

**Nyando V.[1]*, Tsingalia H.M.[2] and Onyango C.A.[3]**

[1]Department of Sugar Technology, Masinde Muliro University of Science and Technology, Box 190-50100, Kakamega, Kenya.
[2]Department of Biological Sciences, Moi University, Box 3900-30100, Eldoret, Kenya.
[3]Egerton University, P.O. Box 536, Egerton, Kenya.

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**Agroforestry does not only provide tree products and services but more importantly has the potential to increase agricultural production. Despite these benefits, its adoption in developing countries, Kenya included, does not match the scientific significance, because, farmers continue to use indigenous technical knowledge (ITK). We examined the adoption of agroforestry technologies in the Maseno region of Kisumu County, Kenya where it has remained low despite the area being sufficiently served by agroforestry extension. The objective was to investigating the potential of integrating the existing indigenous technical knowledge into the current agroforestry technologies. Additionally, the study investigated the potential of indigenous technical knowledge in supplementing agroforestry extension. Purposive and proportional simple random sampling was used to select a sample of 150 household heads out of 4,070 farm households in the region. We collected primary data from household heads using a structured questionnaire. The results of the study showed that indigenous technical knowledge plays a significant role in the adoption of agroforestry technologies that help in management of fuel wood, fodder, soil and weeds. Gender significantly influenced the dissemination of indigenous technical knowledge related to agroforestry. The level of adoption of recommended agroforestry technologies in the study area was low. There is need to develop new farmer-centred agroforestry technologies that should not be seen by farmers as mere modifications of traditional farming systems. It is recommended that further studies on how effectively integrate modern agroforestry and indigenous technical knowledge for sustainability in improving agricultural production.**

**Key words:** Maseno, agroforestry, indigenous technical knowledge, farming.

## INTRODUCTION

Indigenous technical knowledge (ITK) is a body of knowledge built up through generations of by a group of people living in close contact with nature (Adam, 2009). Buresh and Cooper (1999), have defined indigenous technical knowledge as consisting of facts, experiences, practices, resource management strategies and production systems developed through trial-and-error during several millennia in a given community, nation or region. Indigenous technical knowledge therefore, is a key component of traditions and cultures of people (Darr et

*Corresponding author. Email:vnyando@gmail.com

al., 2009). It represents an intensely valuable data base that provides mankind with insights on how numerous communities have interacted with their changing environment and a genetic base for development of agriculture, medicine, energy and industry (Kwaje and Mwaura, 1994).

There are numerous applications for indigenous technical knowledge. These include, applications in fuelwood management (Franzel, Cooper and Denning, 2002), in fodder management (Barret, Place and Aboud, 2002) and in soil management (Majhi, 2008; Mutta *et al*. 2009).

Application of indigenous technical knowledge is currently on the decline due to the disappearing of the oral-based knowledge system of knowledge transfer (Johnson, 1992). It is imperative that the loss of indigenous technical knowledge be reversed through comprehensive documentation and appropriate conservation methods to ensure biodiversity conservation (Kwaje *et al*., 1994).

This study sought to: (i) describe the level of awareness and practice/adoption of agroforestry technologies in Maseno region, Kenya, (ii) to identify and document the existing indigenous technical knowledge practices in fuel, fodder, soil and weed management and to. We hypothesized that there are low levels of indigenous technical knowledge awareness making its application in sustainable agriculture difficult.

## STUDY AREA AND METHODS

We conducted the study in the Maseno region of Kisumu County. The Maseno region comprises four sub-regions namely: Sunga, East Karateng, Marera and West Karateng.

We obtained a comprehensive list of all the farm households in Maseno region from the local sub-county administrator. The four sub-regions had the following households: Sunga (680), East Karateng (768), Marera (1302) and West Karateng (1320). This gave an approximate ratio of 1: 1: 2: 2 of the sub-regions households in the sub-county respectively. We purposively selected the study area location because of the extensive research and extension works in the sub-county. We inventoried all households in the study area in consultation with the clan elders that were included sampling frame. There were a total of 4070 farm households in the study are that formed our sampling frame for the study (Kathuri and Pals, 1993). We used proportionate sampling to select 150 households using the ratio in which they occurred in each of the four sub-regions. Within each sub-region, we used simple random sampling to select the households. This ensured that each household in each sub-region had an equal opportunity of being included in the sample.

We used a structured questionnaire to collect primary data from the respondents. Both close-ended and open-ended questions were included in the interview schedule. We used close-ended questions to quantify the data obtained and open-ended questions to obtain views and opinions of the respondents. The questionnaire contained questions on personal details of the respondent (age, gender, and level of education), agroforestry (awareness and practice, importance of agroforestry), ITK (known ITKs and ITKs in current use in agroforestry), dissemination of ITKs and extension- (contacts and knowledge shared). In order to obtain information on these practices, we asked respondents to state past and present indigenous practices on fuel wood, soil, fodder and weed management practices. We considered these management practices important because they formed the major problem faced by farmers in the study area. The responses were recorded as “Yes” or “No” for each of the practices under fuel wood, fodder, soil and weed management.

Data collection involved home visits to administer the interview schedule face to face with the respondents. We collected primary data from the heads of the households or from representative of the household as per the cultural practices. We made a second visit to the same household if in the first visit we failed to obtain data from the respondent. In the event of failure in the second visit, we collected data from the immediate neighbour.

We obtained secondary data from the local Agriculture and Livestock offices and the Maseno International Centre for Research in Agroforestry (ICRAF) on the recommended agroforestry technologies being adopted by farmers. We used this information to cross check the information provided by farmers on agroforestry technologies in the study area.

We pre-tested the questionnaire in Mulundu sub-region of Vihiga district using a random sample of 20 respondents (Kathuri and Pals, 1993). We chose Mulundu because it is within the same agro-ecological zone and farmers’ circumstances were similar to what we expected of farmers in Maseno. We subjected the pre–test data to Cronbach’s Alpha coefficient tests to determine the reliability of the instrument. The instrument gave a reliability of 0.72 which is in agreement with the minimum acceptable reliability coefficient alpha of 0.7 in survey studies.

We analysed data collected using the Statistical Package for Social Science research (SPSS) (Version 11.5). We coded responses to each category of items in the instrument and assigned a score for purposes of data entry. The assigned scores were specified values for meaningful interpretation based on the scales of measurement of the data collected. We used both descriptive and inferential statistics to analyse the data.

The analysis included the use of frequency tables, percentages, as well as summary tables. We used inferential statistics to test the validity of the hypotheses.

## RESULTS AND DISCUSSION

### Existing indigenous technical knowledge practices

#### *Existing ITK in fuel wood management*

Results of indigenous technical knowledge in fuel wood management are shown in Table 1. According to respondents, the most known ITKs in fuel wood management are the use of shrubs (90.7%), establishment of woodlots (79.3%), use of less important parts of trees (79.3%), use of non-tree products (60.7%) and restricted tree cutting (50.0%). The least known ITKs are the use of dominant species in the environment (14.0%) and collecting firewood (7.3%).

#### *Existing ITK in fodder management*

Responses on current or past ITKs in fodder management are shown in Table 2. Eighty six (86.7) per cent of the respondents were aware of feeding animals along riverbanks, 81.3% of respondents were aware of communal grazing and 73.3% identified the use of crop residuals as a fodder. The least ITK practices known by farmers were the use of selected trees for grazing 9.3% and feeding leaf litter and pods to animals 10.0%.

#### *Existing ITK in soil management*

Table 3 shows responses of Farmers on existing ITK in soil. Results clearly show that the ITKs in soil management known to most farmers were composting (87.3%), use of crop residuals as manure (74.7%) and bush fallowing (62.7%). The ITKs least known to farmers were, adding termite moulds in soil (10.0%) and use of woodland litter (15.3%). Termite moulds were traditionally collected from the forests that have now been cleared and this may explain the disappearance of this practice. Likewise, lack of forests has also resulted in reduced amounts of woodland litter, which explains the low awareness levels.

#### *Existing ITK in weed management*

Results in Table 4 show that most farmers were aware that hand weeding/picking (64.7%) and use of ash (69.3%) were ways of controlling weeds/pests on the Farms. The ITK that was least known to farmers was the use of goat waste (12.0%) as a weed/pest control agent. The number of goats in the study area has significantly reduced, as farmers prefer to keep cattle instead of goats.

### Levels of adoption of agroforestry technologies

In order to understand the level of adoption of the ITKs, we consolidated the results in an aggregate index based on the responses “No” and “Yes” in the instrument. Using the coded values 1(No) and 2 (Yes) we developed an index range of 6-12 by multiplying the six technologies with the coded 1 and 2 scores for No and Yes respectively. We used the index range to divide the responses into three categories of low (6-8), moderate (9) and high (10-12) as shown in table 5. By way of aggregation and analysis 58% of farmers fell in the low adopters’ category, 20% were moderate adopters’ and 22% were high adopters’ of the recommended agroforestry technologies.

The low level of adoption of ITK can be attributed to low interaction with agricultural extension officers who provide the technical expertise of these new technologies. Much of information available to the farmers on the new agroforestry technologies is that shared amongst farmers themselves. Farmers appear not to gain much understanding of how the technology works, which explains the low adoption. Franzel (1999) and Place and Dewees (1999) concur that extension contacts are particularly important during the early stages of farmer experimentation with new technologies. This is the time when farmers need research support, technical advice and helping organisations to share with them their experiences. If this is lacking, adoption tends to remain low and sometimes it fails to pick up completely.

### Awareness and practice of promoted agroforestry technologies

A preliminary survey carried out in the study area by the researcher established that the agroforestry technologies currently being promoted in the study area include improved fallows (using *Tephrosa vogeli, Tephrosa candida* and C*ajans cajan*), biomass transfer (using *Tithonia diversifolia*), alley cropping (using C*allandria callothysus, Leucaena leucocephala)*, multipurpose woodlots (using *Grevillea robusta, Prunus africana,* C*. callothysus* and fruit trees e.g. mango tree), boundary planting (using *T. diversifolia*) and composting (using kitchen refuse, crop residues, livestock refuse). The level of adoption of agroforestry technologies was measured by the actual practice of the currently recommended

**Table 1.** Farmers' knowledge of existing ITK in fuel wood management.

| ITK in fuel wood management | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| Establishment of wood lots | 119 | 79.3 | 31 | 20.7 |
| Use of shrubs | 136 | 90.7 | 14 | 9.3 |
| Using dominant species in the environment | 21 | 14.0 | 129 | 86.0 |
| Reducing cooking frequency | 44 | 29.3 | 106 | 70.7 |
| Use of non-tree products | 91 | 60.7 | 59 | 39.3 |
| Using less important parts of trees | 119 | 79.3 | 31 | 20.7 |
| Restricted tree cutting | 75 | 50.0 | 75 | 50.0 |
| Collecting firewood | 11 | 7.3 | 139 | 92.7 |

N = 150

**Table 2.** Farmers' knowledge of existing ITK in fodder management.

| ITK in fodder management | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| Communal grazing | 122 | 81.3 | 28 | 18.3 |
| Use of crop residues | 110 | 73.3 | 40 | 26.7 |
| Feeding animals along rivers | 130 | 86.7 | 20 | 13.3 |
| Selected trees for grazing | 14 | 9.3 | 136 | 90.7 |
| Leaf litter and pod | 15 | 10.0 | 135 | 90.0 |
| Livestock pens | 81 | 54.0 | 69 | 46.0 |
| Disposing off animals | 56 | 37.3 | 94 | 62.7 |
| Movement during drought | 51 | 34.0 | 99 | 66.0 |

N = 150

**Table 3.** Farmers' knowledge of existing ITK in soil management

| Practices | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| Compost manure | 131 | 87.3 | 19 | 12.7 |
| Use of crop residues | 112 | 74.7 | 38 | 25.3 |
| Adding termite moulds | 15 | 10.0 | 135 | 90.0 |
| Hand weeding to maintain soil structure | 63 | 42.0 | 87 | 58.0 |
| Use of woodland litter | 23 | 15.3 | 127 | 84.7 |
| Bush fallow | 94 | 62.7 | 56 | 37.3 |
| Use of ash as fertilizer | 53 | 35.3 | 97 | 64.7 |
| Terraces | 54 | 36.0 | 96 | 64.0 |

N = 150

agroforestry technologies (Table 6). The general benefits associated with these technologies include improvement of soil fertility, provision of fodder for animals, provision of fuel wood, control of weeds, provision of medicine, fencing and the use of trees as windbreaks among others.

Data on awareness in Table 6 clearly show that farmers are aware of all the technologies being promoted. Eighty three (83.3) per cent of the respondents were aware of multipurpose woodlots, 72.0% were aware of biomass transfer and 70.7 % were aware of boundary planting. Farmers were least aware of compositing technology (5.3%). Most farmers were of the opinion that they have been composting for a long time and did not recognize it as a new technology.

On the actual practice of new technologies, 74.7% of

**Table 4.** Farmers' knowledge of existing ITK in weed management.

| Practices | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| Use of cow dung | 41 | 27.3 | 109 | 72.7 |
| Use of goat waste | 18 | 12.0 | 132 | 88.0 |
| Use of fire | 58 | 38.7 | 92 | 61.3 |
| Use of ash | 104 | 69.3 | 46 | 30.7 |
| Mulching | 63 | 42.0 | 87 | 58.0 |
| Hand weeding / hand pick | 97 | 64.7 | 53 | 35.3 |

N = 150

**Table 5.** Categorical practice/ adoption index.

| Level | F | (%) |
|---|---|---|
| Low (6-8) | 87 | 58.0 |
| Moderate (9) | 30 | 20.0 |
| High (10-12) | 33 | 22.0 |
| Total | 150 | 100.0 |

**Table 6.** Awareness and practice of promoted agroforestry technologies.

| Technologies in agroforestry | Awareness % | | Practice % | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| Improved fallows | 59.3 | 40.7 | 22.0 | 78.0 |
| Biomass transfer | 72.0 | 28.0 | 42.7 | 57.3 |
| Alley cropping | 52.0 | 48.0 | 42.0 | 58.0 |
| Multipurpose woodlots | 83.3 | 16.7 | 74.7 | 25.3 |
| Boundary planting | 70.7 | 29.3 | 64.7 | 35.3 |
| Composting | 5.3 | 94.7 | 5.3 | 94.7 |

N = 150

**Table 1.** Awareness and practice of promoted agroforestry technologies.

| Technologies in agroforestry | Awareness % | | Practice % | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| Improved fallows | 59.3 | 40.7 | 22.0 | 78.0 |
| Biomass transfer | 72.0 | 28.0 | 42.7 | 57.3 |
| Alley cropping | 52.0 | 48.0 | 42.0 | 58.0 |
| Multipurpose woodlots | 83.3 | 16.7 | 74.7 | 25.3 |
| Boundary planting | 70.7 | 29.3 | 64.7 | 35.3 |
| Composting | 5.3 | 94.7 | 5.3 | 94.7 |

farmers practice multipurpose woodlots, 64.7% practice boundary planting and 42.7% practice biomass transfer. The least practiced technology was composting (5.3%). This clearly demonstrates a liner relationship between awareness and the actual practice (Table 7). Most farmers practice multipurpose woodlots is because they provide multiple benefits.

Some of the cited benefits include improvement of soil fertility, provision of fodder, provision of food, provision of fuel wood and timber, shade, medicine, for aesthetic value and for commercial purposes. Improved fallows had 22% adoption level because as farmers noted, they

demand a lot of space and labour. The farmers also suggested that the seeds for planting the improved fallows.

## Conclusion and recommendations

This study aimed at investigating the awareness and application of indigenous technical knowledge in supplementing agroforestry adoption and extension in Maseno. The major findings of this study are that while farmers in Maseno region practise indigenous technical knowledge its adoption is still low. It has played a significant role in the adoption of the current agroforestry technologies that help in the management of fuel wood, fodder, soil and weeds. This was evident in the modified agroforestry systems that farmers engage in. Despite having limited conventional agroforestry extension, farmers learn from each other the new technologies in place. Through modification farmers have used their knowledge to ensure maximum benefits from these technologies. According to farmers these technologies when adopted according to recommendations, have one or more disadvantages to the land resource and its production. Besides, some technologies like biomass transfer are labour demanding if practiced according to extension recommendations.

Technologies adopted by farmers included improved fallows, biomass transfer, alley cropping, multi- purpose woodlots, boundary planting and compositing in varying degrees. The adoption of multi-purpose wood lots was prominent, because they provide multiple benefits including, provision of fuel wood, fodder, food, medicine and improving soil fertility. These findings are in agreement with studies in the Philippines where farmers adopted improved fallows because they provide multiple benefits (Gascon and Alibuyog, 2006).

It is evident that indigenous technical knowledge exists and is practised by farmers in their day to day activities, more so, in the adoption of the current agroforestry technologies that help in the management of fuel wood, fodder, fuel, soils and weeds. In fuel wood management for instance, respondents were aware that establishing woodlots, use of less important parts of trees and restricted tree cutting were important agroforestry practices. In fodder management the indigenous technical knowledge that is known to farmers includes communal grazing, feeding animals along river banks and the use of crop residuals. In soil management farmers were aware of compositing, use of crop residuals as manure and bush fallowing. Finally in weed management respondents knew of hand weeding/ picking and the use of ash to control weeds/ pests.

Indigenous technical knowledge still plays a statistically significant role in the adoption of the current agroforestry technologies that help in the management of fuel wood, fodder, soil and weeds. The fact that indigenous technical knowledge is still in existence in the study area strengthens the argument that it has potential to help solve problems facing farmers. Farmers use this knowledge to modify new technologies to suit their diverse needs. If indigenous technical knowledge is recognised by technology developers then it can help in forming a basis for technology generation and development.

Based on these findings, indigenous technical knowledge has the potential to supplement agroforestry adoption and extension since there are no hindrances from age, education or gender regarding dissemination. Agroforestry technology planners and developers should collaborate with farmers in a participatory manner, to develop, test and use appropriate channels to disseminate these technologies, which in turn will supplement their current work.

We recommend further studies to document which indigenous technical knowledge exists that is in the custody of the older generations. We also recommend the development of new agroforestry technologies that are farmer-friendly. There is need to evaluate the extension delivery system and to put more effort into disseminating agroforestry technologies to farmers. Since it is demand driven, farmers, need to be aware of other available alternatives as open air forums and closed door forums where they can share and exchange both modern and indigenous technical knowledge agroforestry knowledge. There is also need to design communication channels to disseminate new technologies.

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