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Agroforestry Contribution to the Improvement of Rural Community Livelihoods in Balaka, Malawi

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Abstract: *A cross-sectional study was conducted to identify the contribution of agroforestry on improvement of livelihoods of farmers in Balaka, Malawi with emphasis on (1) identifying the main forest products and services obtained from agroforestry trees, and (2) identifying the impact of agroforestry adoption on livelihoods of farmers. A total of 60 lead farmers from six villages; Joshua, Kapalamula, Malikula, Mpondabwino, Naliluwa and Sosola were used for the study. Data was collected using a standard structured questionnaire administered through face-to-face interviews. The results revealed that farmers identified the following as the main products obtained from agroforestry trees; fuelwood (48.3%), fruits (21.7%), medicine (15.0%) and fodder (15.0%). Fuelwood was ranked the most product obtained from the agroforestry trees indicating the reliance of farmers on the woody products as the main source of energy. The majority (68.3%) of the respondent indicated soil improvement as the main service obtained from agroforestry trees followed by water retention and conservation (20.0%), and then biodiversity conservation (11.7%). The major impact of agroforestry adoption to improvement of livelihoods of farmers identified were; increased income (51.7%), increased crop yield (33.3%) and improved health and nutrition (15.0%). Therefore, agroforestry is significant in improvement of rural community livelihoods. Hence, the present study recommends a strong need to intensify promotion of agroforestry and advocacy to policy makers.*

Keywords: *Forest products, Soil improvement, Water retention, Increased income, Improved health*.

1. INTRODUCTION

Achieving environmental sustainability in Malawi is an urgent concern as 84% of the population depends on natural resource-based livelihoods. The conservation of soil, water, and forest resources is essential to food security. Without proper management of the natural resources that support economic production, the country will be unable to sustain recent high growth rates and the progress it has made in poverty alleviation [1]. Practicing Agroforestry is one way of conserving both soil, water and forest resources whilst improving livelihoods [2, 3].

Agroforestry is the integration of multipurpose trees and shrubs with crops and livestock [4]. Agroforestry systems are designed and implemented to counteract soil erosion, degradation, and improve soil quality and health. Trees planted with crops fix nitrogen and produce large amounts of biomass that improve soil fertility [5]. The repeated application of tree biomass to the soil increases soil organic matter that leads to important increases in soil water retention capacity providing good environment for soil microbes and plant nutrients during its decomposition [4].

Traditionally, farmers have developed a wide range of agroforestry and soil conservation strategies. The strategies include the deliberate preservation of selected valuable trees and shrubs in cropped fields, the use of tree or shrub biomass (leaves and twigs)as mulch on crusted or compacted soils to improve organic matter input and soil structure, use of terracing and other physical structures for soil conservation and introducing livestock in the farm after crop harvest to restore soil fertility. Trees on farms provide shade, helps to maintain soil moisture so that less water is lost and crops can be grown [6].

The effects of agroforestry on water systems are numerous and include changes to hydrological cycles via changes in evapotranspiration rates and overland flow, modification of river flow and irrigation impacts. Permanent vegetation stabilizes stream or river banks. Proper allocation of woody vegetation along the river banks decreases water velocity and protects exposed soil from erosive forces of flowing water. The plants hold soil and rocks that are lining the river through their root systems [7]. Agroforestry trees located adjacent to water courses reduces surface runoff from fields, filtering surface and groundwater runoff, filtering stream water and reducing bank erosion [8].

Growing trees on farms reduces water consumption, help retain water for crops and provide protection to watersheds. The integration of agroforestry tree species into agricultural systems can capture a much larger amount of rainfall. The planting of indigenous or exotic deciduous species that produce high-value tree products (such as fruit or timber), while practicing root and shoot pruning, can increase the efficiency of water use while providing new economic opportunities [7].

Research has shown that some tree species grown on the upper levels of terraces have beneficial effects on evaporation and soil water content in adjacent cropping areas. Trees in forests, woodlands and elsewhere provides spring, stream and watershed protection [2]. A study by researchers from the World Agroforestry Centre has found that watersheds remain ecologically healthy for more than two decades due to agroforestry that covers much of its area [9].

The increased adoption of agroforestry practices in multi-functional landscapes can reduce pressure on forests and protected conservation areas [10]. Agroforestry provides a sustainable supply of tree products which were formerly harvested from the forest, as well as improving the sustainability and productivity of local agriculture. Agroforestry reduces encroachment and takes the pressure off from the existing forests as such the trees are being conserved [9]. Agroforestry practices maintains or increase diversity of species, it helps to substitute cultivated tree products for overharvested of fuelwood, fodder and other items from unique or fragile woodland. Agroforestry practices also help to improve conditions for natural regeneration of most desirable species [11]. This practice assists to re-establish bands of woody vegetation and grasses on the banks of rivers where natural vegetation has been removed or degraded. Trees ensures that moisture is available all the time, where moisture is abundant along waterways, most trees can be highly productive tolerating minor changes in surface or subsurface water levels better than agricultural crops hence observing tree abundance [12].

Despite these numerous advantages of agroforestry, relatively little is known about the contribution of agroforestry to improvement of rural community livelihoods in Balaka, Malawi who have been practicing the technology for more than two decades. Therefore, the objective of this study was to identify the contribution of agroforestry on improvement of livelihoods of farmers in the study area; with emphasis on identifying the main forest products and services obtained from agroforestry trees, and identifying the impact of agroforestry adoption on livelihoods of farmers.

2. MATERIALS AND METHODS

2.1. Study Site

The study was conducted in Malawi located in Southern Africa in the tropical savanna region in Traditional Authority Nsamala in Balaka district. Balaka is located 14°58'S, 34°57'E, and about 611 m above sea level. It receives 400 mm to 800 mm rainfall per annum, with annual temperature ranging from 14 ^{o}C to 34 ^{o}C. The soils are mopanosols and it is situated about 168 km southeast of Lilongwe the capital.

2.2. Data Collection and Analysis

Data was collected from August to October 2013 from six villages, Joshua, Kapalamula, Malikula, Mpondabwino, Naliluwa and Sosola. The villages had a total population of 100 lead farmers of which 60 were randomly sampled (10 lead farmers from each village). The data was collected using a standard structured questionnaire with multiple-choice and open-ended questions administered through face-to-face interviews. Targeted respondents were lead farmers (*A lead farmer is a local farmer who is trained by Extension Worker to guide fellow farmers in farming activities where Extension Workers are in short supply* [13]). The questionnaire was pre-tested on a few selected lead farmers in one of the study areas, and the easiness of completion of the questionnaire and ambiguity of questions were noted and subsequently revised before a large-scale interview of the lead farmers. Lead farmers were asked on socio-demographic characteristics, forest products and services obtained

from agroforestry trees, and the impact of agroforestry adoption on farmer's livelihoods. Data analysis was carried out using SPSS 17.0 for Windows and Microsoft Excel to generate descriptive statistics (frequencies/proportions).

3. RESULTS

3.1. Socio-Demographic Characteristics of Respondents

The mean age of the respondents was between 31 and 40 years. Most respondents were males (68.3%), and the majority of the respondents (73.3%) were married. Most of the respondents (96.7%) had undergone formal education, with the majority (45.1%) having completed primary education, few (8.3%) had some primary education and the remainder attaining higher levels of education. Most of the respondents (41.7%) became lead farmers after 2010 (Table 1).

Table1. *Socio-demographic characteristics of respondents*

Variable	Frequency (f)	Percentage (%)
Age of respondents (years)		
21 – 30	9	15.0
31 – 40	38	63.3
41 – 50	7	11.7
>50	6	10.0
Gender		
Male	41	68.3
Female	19	31.7
Marital Status		
Married	44	73.3
Single-never married	2	3.3
Single-divorced	4	6.7
Single-separated	3	5.0
Single-widowed	7	11.7
Education		
None	2	3.3
Some primary school	5	8.3
Completed primary school	27	45.1
Some secondary school	14	23.3
Completed secondary school	11	18.3
Tertiary	1	1.7
Year became lead farmer		
Before 2000	12	20.0
2001 - 2010	23	38.3
2011 to date	25	41.7

3.2. Contribution of Agroforestry to Improvement of Livelihoods of Farmers

Table2. *Contribution of agroforestry to improvement of livelihoods of farmers*

Variable	Frequency (f)	Percentage (%)
Products obtained from agroforestry trees		
Fodder	9	15.0
Fuelwood	29	48.3
Fruits	13	21.7
Medicine	9	15.0
Services obtained from agroforestry trees		
Soil improvement	41	68.3
Water retention and conservation	12	20.0
Biodiversity conservation	7	11.7
Impact of agroforestry adoption on livelihoods		
Increase in income	31	51.7
Improved health and nutrition	9	15.0
Increased crop yield	20	33.3

Summary of results on contribution of agroforestry to improvement of livelihoods are presented in Table 2. The results shows that farmers identified the following as the products obtained from agroforestry trees; fuel wood (48.3%), fruits (21.7%), medicine (15.0%) and fodder (15.0%). The

majority (68.3%) of the respondent indicated soil improvement as the main service obtained from agroforestry trees followed by water retention and conservation (20.0%), and then biodiversity conservation (11.7%). Furthermore, the respondent identified the following as the major impact of agroforestry adoption to improvement of livelihoods of farmers; increase in income (51.7%), increased crop yield (33.3%) and improved health and nutrition (15.0%).

4. DISCUSSION

4.1. Products Obtained From Agroforestry Trees

Fuelwood was ranked the most product obtained from the agroforestry trees indicating the reliance of farmers on the woody products as the main source of energy. This is consistence with results reported elsewhere [14 – 17]. Michael [15] reported that about 33% of the world's population uses wood and charcoal to produce at least 90% of the energy, while [16] reported that in development countries at least 70% of energy is supplied by fuelwood and charcoal. In Malawi fuelwood and charcoal contributes over 90% of total energy demand [17].

Fruits were also rated highly as one of the main products obtained from agroforestry trees. This is an evident that the fruits are important source of food for the households and form an essential part of nutrition and diet. Some of the trees that provide fruits in the study area includes: *Mangifera indica, Psidium guajava, Uapaca kirkiana, Carica papaya, Adansonia digitata.* The findings of the present study are in agreement with various studies [14, 18, 19] that have reported the importance of fruits as a dietary supplement. According to Akinnifesi et al. [20] fruits contribute on average about 42% of the natural food basket that rural households rely on in Southern Africa.

Agroforestry trees provide greatest part of rural people medicines and treatments of some ailments. Some of the trees that are used for medicinal purposes in the study area includes: *Uapaca kirkiana, Psidium guajava, Parinari curatellifolia.* The tree parts that are used are usually the bark, roots, leaves and flowers. The present findings are in line to those in literature [14, 18]. It has been further reported that about 80% of the world's population, mostly in developing countries, rely on traditional medicine for primary health care [21].

Fodder was also identified as one of the products obtained from the agroforestry trees. Tree fodders are the major source of livestock feeds in the study area. Some of the multi-purpose tree species that provide fodder in the study area include: *Leucaena leucocephala, Gliricidia sepium, Acacia angustissima.* The trees are grown in fodder banks and these helps to provide feeds to livestock during dry season when most pastures have dried up. The quality of fodder from these trees is high [22] and tree-fodder technology reduces cost of feed for livestock [23, 24].

4.2. Services Obtained from Agroforestry Trees

The results in Table 2 show that the farmers agree on the role that agroforestry play in adding nutrients to the soils hence assist in restoring and conserving soil fertility. Pinho et al. [5] reported that trees planted with crops fix nitrogen and produce large amounts of biomass that improve soil fertility. Furthermore, agroforestry trees leads to increase of soil organic matters through leaf litter hence replenishing soil fertility. Vegetation helps to stabilize the soil by retaining it to its original state. Incorporation of legumes into the farming systems through agroforestry also helps to fix the depleted nitrogen as they capture and use nitrogen from the air [22].

Water retention and conservation was also identified as one of the services obtained from agroforestry. According to Rocheleau et al. [12] agroforestry trees help to decrease water velocity and make rainwater to fully sink into the ground which is later retained to the surface for crops hence maintaining soil moisture. Agroforestry on upper levels of terraces have beneficial effect on soil water content in adjacent cropping areas. Kalaba et al. [2] also reported that agroforestry practices increases the infiltration and water holding capacity of the top soil and increases the ability of the soils to capture and use on-farm runoff. Combining woody plants and annual crops helps in conserving top soil and increase water availability below the soil surface and increases soil moisture. Agroforestry species helps to hold running waters such that they sink down. This helps to deepen the ground water table. This groundwater is then slowly released when the surface is dry (moisture retention). The successful water management for agricultural production is water storage. Water stored as groundwater in accessible aquifers can operate efficiently for longer periods [24].

Agroforestry practices helps in biodiversity conservation as indicated in Table 2. Agroforestry technology focus on the role of trees on farms and agricultural landscapes to meet economic, social and ecological needs [2]. Hence, these reduces the rate at which households visit their forested areas as most of the forest resources required are obtained from within their farmlands. Khanal [10] also reported that increased adoption of agroforestry reduces pressure on forests and protected conservation areas. Agroforestry has the potential to provide a sustainable supply of tree products which were formerly harvested from the forests.

4.3. Impact of Agroforestry Adoption on Livelihoods of Farmers

The sale products from agroforestry trees have a significant role in improving financial status of the households. Products from the agroforestry tree serves as a source of income and revenue to the households. Households are self-employed in local industry through processing of *Adansonia digitata* juices which is sold in super markets in urban areas. This is in agreement to the study by [2], who reported that income from agroforestry products can serve a safety net for the rural household and can also be significant source of prosperity if intensively produced and managed.

Fruits obtained from agroforestry trees form an essential part of nutrition and diet. Respondents assure that fruit trees are mostly served for food especially during difficult time of drought. In addition respondent indicated that most households depends on medicinal plants for most of their health needs. The results reported by [11] are agreement to the findings of the present study. Garrity [11] reported that at least 80% of rural communities in sub-Saharan Africa rely on medicinal plants for most of their health needs and income generation.

Increased crop yield was identified as one of the impact of agroforestry adoption. This was because of the soil improvement. The present results are inline to those in literature [20, 25, 26]. Akinnifesi et al. [20] and Saka et al. [25] reported an increase on crop yield ranging from 37-200% in different parts of Africa. According to Syampungani et al. [3] different researchers have attributed the increase in crop yield to different factors, which includes; improved micro-climate and soil physical-chemical properties [27]; increased nutrients inputs including biological nitrogen fixation [26]; and increased nutrient availability through enhanced soil biological activity and rates of nutrients turnover [20].

5. CONCLUSION

The study has revealed that agroforestry trees contribute several products such as fuelwood, fruits, medicine, fodder and services such as soil improvement, biodiversity conservation and water retention and conservation. The impact of agroforestry adoption on improvement of community livelihoods were increased income through sales of the products, increased crop yield and improved health and nutrition. Therefore, agroforestry is significant in improvement of rural community livelihoods. Hence, the present study recommends a strong need to intensify promotion of agroforestry and advocacy to policy makers.

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