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Review Article

Agroforestry Technologies Practiced by Women in Makindu and Nguumo Locations to Counteract the Effects of Climate Change and Variability, Makindu Sub Country, Makueni Country, Kenya

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Abstract

Climate change has become a global phenomenon that imposes economic, social, and ecological challenges to farmers, particularly in low-income countries who depend on agriculture for their livelihood. Agroforestry presents a promising option to sustainable agricultural productivity by providing a buffer to climate variability through permanent tree cover and varied ecological niches. This study therefore aimed to investigate women role in agroforestry technologies as an adaptation strategy to climate change in Makindu and Nguumo locations, which are in Makindu sub county, Makueni County. A sample size of 109 households were randomly selected from a sampling frame of, 11,571 households/residents in the two locations. In Nguumo location 54 households, in Makindu location 55 households were sampled. Using descriptive statistics, the study established that women use various technologies to counter the effects of climate change and variability. Highly practiced technology was agrisilviculture, silvipastoral, agrisilvipastoral. The study found out that women play a significant role in climate change adaptation through use of agroforestry technologies though their efforts were not recognised. Further it was found out that empowering women in the challenging areas can play a very critical role in ensuring that women adopt agroforestry technologies as an adaptation to climate change and variability.

Introduction

Climate Change increasingly affects the lives of many people, especially those of the poor in developing countries. In general, their livelihoods and food security, already endangered by HIV and other health or socio-economic problems, are even more endangered by climate change impacts. Therefore, adaptation to climate change has become an important issue. The vulnerability of women and men to the impacts of climate change is not even. Studies show that women are more vulnerable to climate impacts more than men because they lack the requisite to adapt to climate change and variability (Schalatek 2004:14). This may be because greater dependence on natural resources for livelihoods and their responsibility for obtaining food, water and fuel for the household. Climate change has become a major concern in Africa, where many climate models predict that it will cause among other things; decreasing rainfall especially in arid areas, warmer temperatures and increasing severity and frequency of extreme weather events (Alley et al., 2007). These changes pose serious threats to food security in an area that is already constrained by high population growth, diminishing family land and deteriorating soil fertility levels. Furthermore, issues relating to water availability are placing additional pressures on the region's ability to meet growing demands for food production. Efforts to adapt and mitigate these climate change and variability impacts and the associated competing interests are necessary in order to provide long term remedies to the effects of climate change which are likely to worsen.

In many rural smallholder-farming systems, women play significant roles in the food production activities. Unfortunately, it has been established that women farming communities are more vulnerable to climate change impacts to their male counterparts because they lack the knowledge to adapt to climate change (Schalatek, 2009:14). Kenya is strongly committed to intergraded natural resources management approaches out of the realization that more timber is already being harvested from farms and forests. This reinforces the practice of domestication and cultivation of trees and shrubs on farms making agroforestry an increasingly attractive option for the future. The Kenya constitution (2010) [1] has emphasized on the need for the country to work towards attaining and maintaining a 10% tree cover. According to the immediate former director of Kenya Forestry Service (Mbungua, Daily Nation of 14th November 2014), there is reliable data which confirms that as at 2010 Kenya's forestry cover was 6.99% of Kenya's land area [2]. Agroforestry has been widely acknowledged and proposed as a potential strategy for helping subsistence farmers reduce their vulnerability to climate change. Since, agroforestry technologies are not gender-specific, their success in climate change adaptation calls for active participation of women farming communities. The concept of gender in this study was not about women alone but both men and women participation in agroforestry technologies in the society in order to come up with strategies that challenge gender imbalance in agroforestry practices.

It laid more emphasis on women and examined their participation relative to men while highlighting gender discrepancies so that strategies to challenge gender imbalances are addressed. This aimed to encourage that women be given opportunities to be able to make decisions, access resources equitably, hold positions and benefit from development initiatives such as agroforestry by educating them. Particular emphasis was laid on women who despite farming and willing to participate in agroforestry remain disadvantaged in the agricultural sector due to cultural, social-economic and sociological factors. The study sought to establish the agroforestry technologies practiced by women in Makindu, to examine the influence of women empowerment in and access to adoption of agroforestry technologies to counter climate change and to determine the role played by agroforestry technologies to the livelihoods of women and environment. The rest of the paper is divided into sections. Section 2 presents existing literature

on the work, Section 3 presents the methodology, Section 4 presents the results, Section 5 presents conclusions and recommendations.

Literature Review

Agroforestry is a global practice. Tyler and Miller (1996) reports that in the United State of America farmers have been reducing soil losses through a combination of conservation tillage [3]. These include agroforestry or alley cropping, a form of intercropping where several crops are planted together in strips or alleys between trees and shrubs, which can provide fruit or fuel wood. Trees provide shade which reduce water loss through evaporation. Trees and shrubs also act as wind breaks; alley crops protect livestock from temperature extremes and a source of timber and poles. In UK, Hammer (2012) reports that despite the fact that farmers are enthusiastic about the practice of agroforestry; there are still a handful of farms deliberately practicing it [4]. In Australia, Nuberg et al. (2009) reports that agroforestry represents a significant proportion of Australia's native forest.

Scroth and Sinclair (2003) reports that farmers in southern Africa practice agroforestry by planting legume trees along with crops to generate their soils and substitute for mineral nitrogen fertilizers which are needed by plants but which are too expensive for them [5]. According to Asare (2004), agroforestry has been practiced in Ghana for many years to enhance sustainable development through the national agroforestry policy of 1986, which initiated national programs to support agroforestry through research, training and extension [6]. In Uganda Musukwe and Mbalule (2001) reports that agroforestry is widely practiced. It has been identified as a land use approach, which ensures the sustainability of the production base. According to Kaboggoza and Eilu (2009) the University of Makerere offers a Master of Science Degree in agro- forestry where the link between agriculture and forestry is strongly built with agroforestry entrepreneurship and environmental conservation for sustainable agriculture being emphasized. There is substantial evidence that especially in recent years those smallholder/subsistence farmers are turning to agroforestry as a means of adapting to the impacts of climate change [4-6]. Since the 1995 women's conference in Beijing, donors, policy makers and development practitioners have pointed out the critical role of gender in development programs [7-13]. The uptake of new technologies is often influenced by farmers' contact with extension services. Several studies have shown that women have lower access to agricultural extension than men.

In Malawi for instance, 19% of women had access to extension compared to 81% of men [14]. In Ethiopia, women had 20% contacts with extension services compared to men who had 27% [15]. UNEP/GRID-Arendal (2008) reports that 70% of agricultural work in Benin and Zimbabwe is carried out by women, but there is less than 10% female extension staff [16]. In addition, most of the extension services are focused on cash crops (men's crops) rather than food and subsistence crops, which are considered to be women's domain. A study carried out by CIMMYT (1998): Morris and Doss (1999) on how gender affects the adoption of innovations in Ghana, reported fewer contacts of women with extension agents and a large proportion of women reported no extension contacts at all [17, 18].

Methodology

Location of study

The study area lies in Makueni County, which covers an area of 8034.7km^2.The county boarders Kajiado to the west, Taita Taveta to the south, Kitui to the east and Machakos to the north. The county is currently divided into nine sub counties namely Makueni, Mukaa, Kilungu, Kibwezi, Kathozweni, Makindu, Mbooni (East, West) and Nzaui. Makindu Sub County is the target study area. It has three divisions Makindu, Tsavo West National Park, Chyulu Game Rerseve), four locations and fifteen sub-locations. The study sites are Makindu and Nguumo locations in Makindu Sub County which covers four locations and fifteen sub- locations. Nguumo location has four sub locations namely Syumile, Muuni, Ndovoini, Kaunguni. Makindu location has five sub locations, which are: Kiu, Manyatta, Kisingo, Kamboo, and Kai.

Population and Economy

Nguumo and Makindu locations have total population of 11571 households. Nguumo location has 5774 households while Makindu location has 5797 households (Census survey, 2009). 90% of the population is rural based (Table 1). Livestock production and crop farming are the back bone of the people's economy in the area contributing to nearly three quarters of household earnings (Republic of Kenya, 2002). Main food crops include maize, beans, sorghum, pigeon peas, cowpeas, cassava, and green grams, sweet potatoes. Commonly grown vegetables are kales, cabbages, spinaches brirrinals, okra, tomatoes, millet and finger millet. Fruits grown are mangoes, bananas, melons, passion fruits, papaws, oranges, lemons. Farmers intercrop crops, vegetables and fruits, this typical crop mix raised by a household varies substantially between, one zones to another, between households, between local landscapes. Mixed farming result to higher resource-use efficiency [19].

Climatic Conditions

Makindu Sub County is located on the Nairobi Mombasa High-way, in Makueni County in the South eastern part of Kenya (Figure 3.1). It lies approximately 135 kilometres by road, southeast by Machakos, and approximately 356 kilometres by road, North West of coastal city of Mombasa. The geographic coordinates are 2 16'30, 00"S,'3749.12.00." E (latitude; 2.2275000; 37' 49'12.00"E (Latitude: -2, 275000: 37, 820000). The climate of the area is semi-arid with very erratic and unreliable rainfall [20]. The area is hot and dry throughout the year with temperatures ranging from a minimum of 15-22° centigrade to a maximum of 25-32° centigrade.

Sample size

According to Nassiuma (2000), for most surveys, a coefficient of variation range of 21% to 30%, standard error of 2% to 5% is acceptable [21]. Therefore, a 21% coefficient of variation and a standard error of 2% will be used in the study. The lower limits were selected in order to reduce sample variability and minimize degree of error. The formula given by Nassiuma (2000) was applied in this case as shown below [21].

$$n = \frac{NC^2}{C^2 + (N-1)e}$$

Where

n=sample size=x

N=population=11571

C=coefficient of variation=21%

E=standard error=2%

The sample size for Makindu division (Nguumo and Makindu Locations) will be;

$$\frac{11571 \times 21^2}{(21\%)^2 + (11571-1)(0.02)^2}$$

$$\frac{11571 \times 441/10000 = 11571 \times 0.0441 = 510.281}{441/10000 + (11571 - 1(0.0004)) = 0.0441 + (11570 \times 0.0004) = 4.625}$$

$$510.281 / 4.628 = 109 \text{ respondents.}$$

Data Collection and Analysis

Primary data was collected using various qualitative and quantitative methods. Primary data included information gathered directly from respondents/inhabitants of the area through semi- structured questionnaires which had some fixed/closed and open-ended questions. Answers for these questions were gathered through in-depth interviews with respondents, visiting various focused groups and obtaining their views through discussions and also observations on various farms.

Results and Discussion

Agroforestry technologies employed by women in Makindu and Nguumo locations to counteract the effect of climate change and variability

Under this section, proportions of households employing agro forestry practices are presented under size of land under agro forestry and the types of agro forestry practices and technologies are also presented.

Proportions of households practicing agro forestry in Nguumo and Makindu Locations

The study sought to investigate whether the respondents practiced agroforestry. Out of those who practiced agro forestry in the selected study sites majority were females. Nguumo location led in number of females, 59% practicing agroforestry followed by

Table 1: Sample Size for the two Locations of study within Makindu and Nguumo Locations.

Location	Households	Proportion by Percentage	Sample Size
Nguumo	5774	49.901	54
Makindu	5797	50.099	55
Total	11571	100	109

Table 2: Proportions of Household Practicing Agro forestry (%) by Gender in Nguumo and Makindu Locations.

Location	Yes		No	
	Males	Females	Males	Females
Nguumo	41	59	63.6	36.4
Makindu	47.1	52.9	63.6	36.4
Overall Average	44	55.95	63.6	36.4

Table 3: Agroforestry Technologies adopted in Nguumo and Makindu locations by Gender (%).

Technology	Nguumo		Makindu	
	Males	Females	Males	Females
Agrisilviculture	54.5	45.5	66.7	33.3
Silvipastoral	53.8	46.2	55.3	44.7
Agrisilvipastoral	58.7	41.3	54	46
Agrihortisilviculture	54.3	45.7	53.7	46.3
Silvihorticulture	52.8	47.2	54.5	45.5
Agrihorticulture	51.7	48.3	54.8	45.2
Hortisilvipastoral	46.9	53.1	56.1	43.9
Hortipastoral	48.4	51.6	56.8	43.2
Agripasture	57.1	42.9	56.2	43.8
Silviapiculture	54.5	45.5	55.4	44.6
Overall Average	53.27	46.73	56.35	43.65

Makindu location. On average 44% of the males practice agro forestry and 55.95% practice agroforestry. This clearly indicates that women are involved in agro forestry practices than men in the two sub locations as indicated in (Table 2) below.

Type of Agroforestry technologies adopted in Nguumo and Makindu Locations

(Table 3) presents the different types of agroforestry technologies practiced by smallholders' farmers in Nguumo and Makindu locations. The results revealed that in Makindu location males were leading with 56.35% in the various agro forestry technologies adopted followed by males in Nguumo location with 53.27%. In females, category Nguumo was leading with 46.73% in the various technologies adopted and Makindu followed with 43.65%.

Conclusion and Recommendations

Data presented in (Table 3) shows proportions of respondents who had adopted various agro forestry technologies. Analysis of these results showed that generally both locations had adopted various forms of agro forestry technologies as an adaptation to climate change and variability. These findings were supported by Bishaw et al. (2013) who stated that various agro forestry practices suitable for enhancing the adaptation of agro ecosystems to climate change have been developed, tested, and popularized in Kenya and Ethiopia [22]. However, the results also indicated that the percentage of adoption in women was higher in female headed households compared to male headed household in both locations. Findings of (Carr & Thompson 2014) indicated that women have limited control over land and property rights. For instance in Sub-Saharan Africa (SSA), women only have rights to use and access land through men, especially in customary land tenure systems (Farnworth et al. 2013:76), while only 3 percent of women own a title deed in Kenya (Go K 2008), hence positioning women at the periphery of farm production decisions [24-26]. Unequal rights to land not only limit women's ability to access credit, but also restrict their decisions on land use as shown by the present study that are necessary to adapt to climate change. Gender inequality also persists in livestock ownership and control of income where men own and control income from large livestock like cattle and draft livestock, whereas women own small livestock such goats, sheep and poultry [27-29].

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