

Influence of Women Empowerment on Adoption of Agroforestry Technologies to Counter Climate Change and Variability in Semi-Arid Makueni County, Kenya



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Abstract

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. Subsistence farmers in developing world are unable to cope with such climate variability since they do not have the capital to invest in new adaptive practices. They are also especially sensitive to climate change since they rely almost entirely on rain-fed agriculture. This study was carried out at Nguumo and Makindu locations in Makindu sub-county, Makueni County. The main objective of the study was to examine the role of women in agroforestry technologies as an adaptation strategy to climate change and variability in Makindu and Nguumo locations, Makindu sub county, Makueni County, Kenya. Information was gathered using 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. Information was generally gathered from both men and women without necessary targeting the women alone to avoid biased answers. For example women may feel that they carry most of household chores, therefore ignore the participation of men. Linear regression analysis done to investigate the degree to which women empowerment in and access to agroforestry technologies help in adapting to climate change and variability was fitted for both locations. Results obtained indicated that there was a positive and a significant relationship between women empowerment and agroforestry technologies ($p < 0.05$) in Makindu Location and Nguumo Location. For the empowerment coefficient in Women for Makindu location and increment in women empowerment by one unit increases the adoption rate by 0.432 units. For the coefficient in Nguumo location an increment of women empowerment by one unit increases the adoption of agroforestry by 0.232 units. The study recommended enhancement of women capacity to make decisions, access resources equitably and benefit from development initiatives like agroforestry. The Study concluded that empowering women in their challenges is very critical in women adoption of agroforestry technologies.

Keywords: Women empowerment; Agroforestry technologies; Climate change

Introduction

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 [1-7]. There is a general consensus that gender inequalities in areas such as ownership and access to resources, land tenure systems, education, extension and social-cultural factors have contributed to lower agricultural productivity and higher poverty levels [8]. However, due to their generally weak position in society and family, women are usually not included in discussions and decision-making processes related to climate change or any other issue. Their limited access

to information and resources such as land and credit further prevents them from developing their capacities in agriculture although they play a crucial role in food security and agroforestry. In addition, there is a gender-related bias regarding the value and usefulness of local knowledge. Women often feel ignored, overlooked and not taken seriously when they try to make their contributions and share their knowledge [9]. They are seen as 'farmwives' rather than true farmers, and as such as not capable of producing and sharing valuable knowledge about farming. Society ignores the value of indigenous knowledge by continuing to view

the knowledge and practices of women as ‘primitive’, unscientific and as a hindrance to development. The male members of the families think that if they use this unscientific knowledge promoted by the women, they cannot get more crops from the land. Men only believe in the usefulness of local knowledge if it is confirmed by a scientist or agricultural officer. Only then will they accept it as environmentally and socially appropriate and hence more sustainable.

African women play an important role in production as portrayed by Esther Boserup (Agricultural economist) in her book on Women’s Role in Economic Development [10]. Boserup used research data from Africa, Asia, and America to highlight women’s central positions in economic life of their communities. Together with [5,6,11-15] reports important prepositions which highlight the importance of focus on agroforestry and women as women play a key role in most production systems, women contribution to food security is made in the face of great obstacles, women contribute substantially in production but there is systemic exclusion from benefits associated with technological change, given access to same resources as men (education, farm inputs, labour) food production will be increased from 10-20%,and finally though women play a key role their contribution to agriculture is largely ignored by policy makers [16].

Although men and women are both involved in management of trees planted on farms, earlier literature confirms the fact that women do most of the work, especially at the initial stages of tree establishment [17]. For example studies conducted by [18] in Tanzania and [19] in Zimbabwe, established that over 60% of Tanzania women are responsible for managing tree species planted

on farms while over 80% of Zimbabwean women are responsible for watering young seedlings. This findings were confirmed in a study by [20] that determined the adoption of fodder in the central highlands of Kenya. Despite the fact that 91% of household respondents were male headed, 89% of these households females were responsible for managing fodder. A similar scenario was observed in Uganda [21] whereby over 80% of households with calliandra, women were involved in management. The present study therefore examines the influence of women empowerment in and access to adoption of Agroforestry technologies to counter climate change and variability in Makindu and Nguumo locations.

Methodology

Study area, location and settlement history

The study area lies in Makueni County which covers an area of 8034.7km². The county borders 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 Reserve), four locations and fifteen sub-locations Figure 1 show maps of the two locations and their 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 [22]. This is because the other two division are game reserves and no agricultural activity takes place.

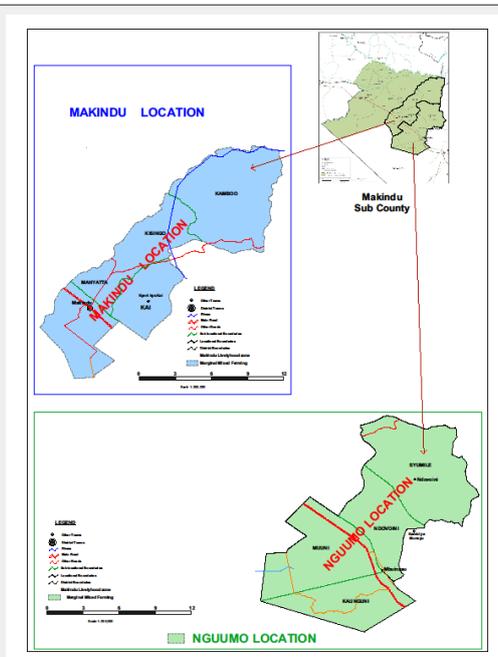


Figure 1: Map showing Nguumo and Makindu locations. Source: Chief’s offices Nguumo and Makindu locations.

The choice of these two locations (Nguumo and Makindu) was influenced by the evident severe effects of climate change and the active participation of locals in agroforestry practices as an effort to adapt and cope with climate change. Also, there is reliable little rainfall in the area coupled with some reliable sources of water like boreholes, wells and dams which can provide some water for irrigation purposes more so; records from [23] showed that these two locations were active in crop and livestock farming despite the challenges of climate change and variability.

Nguumo and Makindu locations have total population of 11571 households. Nguumo location has 5774 households while Makindu location has 5797 households [24]. 90% of the population is rural based. Livestock production and crop farming are the backbone of the people's economy in the area contributing to nearly three quarters of household earnings [25]. Livestock species kept include Cattle, sheep and goats are the most important animals in the area [26]. Crops such as maize, beans, sorghum, pigeon peas, millet and cassava are cultivated mainly for subsistence while green grams, sweet potatoes, vegetables and fruits (like mangoes, melons and bananas) are grown for sale [26]. Makindu Sub County was first settled in the early 20th century by railway construction workers. It acted as a base for railway construction workers on the Mombasa Kampala railway project by that time. With time, many people have settled in the area from different parts of the country like Machakos, Kitui, Makueni and others [23]. The Sikh temple in Makindu built at that time, still bears reminiscence to the railway building days. The temple was a place of worship and social centre for many of the workers from India. The temple is well preserved and is managed as a free lodge for any traveller who knocks on its door. Makindu division is also served by Makindu airport [27].

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. Information was generally gathered from both men and women without necessary targeting the women alone to avoid biased answers. For example women may feel that they carry most of household chores, therefore ignore the participation of men.

This method was used to access women participation in agroforestry technologies as an adaptation measures to climate change and variability in the area. Secondary data was obtained from published material and internal sources; journals, books, annual reports, workshop proceedings and periodicals,

relevant literature from libraries and internet and Ministry of Agriculture. 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. Information was generally gathered from both men and women without necessary targeting the women alone to avoid biased answers. For example women may feel that they carry most of household chores, therefore ignore the participation of men.

Study generated qualitative and quantitative data from the administered questionnaires. Qualitative data was subjected to in-depth analysis and used to compliment discussion of the analysed quantitative data. The Quantitative data was cleaned, sorted, summarized and stored using Ms Excel and statistical package for social sciences (SPSS). Quantitative and qualitative data were summarized and presented in forms of charts, tables, frequencies, graphs and percentages where necessary. Both descriptive and inferential statistics were used to analyse the qualitative and quantitative data. In inferential statistics, correlation analysis and linear regression analysis were used. In descriptive statistics charts, graphs, mean, percentages and frequencies were used.

Results and Discussion

Proportions of households practicing agroforestry in Nguumo and Makindu Locations

The study sought to investigate whether the respondents practiced agroforestry. Out of those who practiced agroforestry in the selected study sites majority were females. Nguumo location led in number of females, 40.35% practicing agroforestry followed by Makindu location with 28.07% females. Males in Nguumo and Makindu were 32.0%, 18.0% respectively. This clearly indicated that more women are involved in agroforestry practices than men in the two locations. (Figure 2) The current trend of the results is in agreement with the findings by [28] who argued that female headed households were more likely to take up climate change adaptation options when they are exposed to information than male headed because they have more access to land.

From the results in figure 2, it can also be deduced that majority of the women in the two locations were aware of most of the agroforestry technologies practiced in several parts of the world as an adaptation to climate change and variability and were practicing them. These results are in agreement with the findings by [29] who indicated that agroforestry is a long-established farming practice in many parts of the world for livelihood diversification and climate change adaptation.

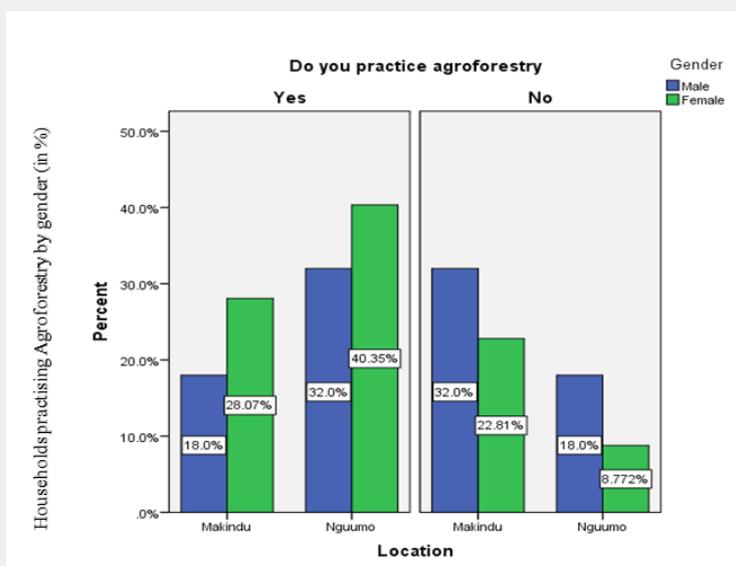


Figure 2 Proportions of household practicing agroforestry (%) by gender in Nguumo and Makindu locations.

Proportions of households practicing tree planting and livestock keeping in Nguumo and Makindu locations

Table 1: Proportions of households by gender planting trees and keeping livestock (%) in Nguumo and Makindu locations.

Sub-location	Tree planting		Livestock keeping	
	Male %	Female in charge %	Male %	Female in charge %
Nguumo	42.3	57.7	42.4	57.6
Makindu	28.2	71.8	47.1	52.9
Overall mean	35.25	64.75	44.75	55.25

The agroforestry technologies practiced by women in Makindu and Nguumo locations included whether the farmers plant trees, whether they grow crops, pastures and fodder crops and whether they kept livestock. Results presented in Table 1 indicated that in Makindu location, 28.2% of males, 71.8% females planted trees and 47.1% males, 52.9% females kept livestock. In Nguumo location, 42.3% males, 57.7% females planted trees while 42.4% males and 57.6% females kept livestock. Majority of the respondents who planted trees and kept livestock in both locations were females (Table 1).

A chi-square test of independence was calculated comparing the frequencies of households planting trees and gender in Nguumo and Makindu locations. A significant interaction was found ($\chi^2 (1) = 49.05, p < 0.05$). Women were more involved in planting trees in both Nguumo and Makindu locations.

A chi-square test of independence was also calculated comparing the frequencies of households keeping livestock and gender in Nguumo and Makindu locations. A significant interaction was found ($\chi^2 (1) = 38.97, p < 0.05$). Women were more involved in keeping livestock in both Nguumo and Makindu locations.

Combination of these activities on the same piece of land maximizes the returns from the land with or without the use of sophisticated technology [30]. This intercropping solved the problem of food, fuel wood, timber shortage and conserved soil moisture contents, also ameliorated the harsh climatic condition. This collaborates with the findings of [31] who indicated that agroforestry contributes to soil and water conservation besides improving fertility. The multipurpose woody perennials provide livestock fodder or function as living fences around the grazing land or provide shade /browse and also provide fruits. [32] added that silvipastoral as asset of land system involves the deliberate combination of woody perennials, animals, crops on the same management unit. Under this technology, improved pasture species are grown along with tree species. Fodder and pastures were grown for livestock feeding purposes.

This was also confirmed by the findings of [33] who indicated that in Tanzania the Chagga farmers were self-sufficient in fodder produced primarily from the trees and shrubs grown in home gardens. In addition, [34] confirmed this by indicating that in Nambale division of Busia district (Kenya) farmers had planted *Sesbania sesban* on terraces to control soil erosion, females were

provided with fuel wood, green manure and fodder.

Role of gender in Agroforestry adoption and its adaption to climate change

As indicated in the Table 2 majority of females in both

locations indicated that gender plays a big role in agroforestry adoption in Makindu location, overall average was 30.5% males, 69.5% females and Nguumo 32.8% males, 67.2% females stated that gender plays a critical role in agroforestry adoption and adaptation to climate change and variability.

Table 2: Gender role in Agroforestry adoption and adaption to climate change.

Location		Makindu		Nguumo	
		Male%	Female%	Male%	Female%
Role played	Planting	30.5	69.5	39.1	60.9
	Cultivating the land	44.4	55.6	47	53
	Watering young seedlings	34.6	65.4	30.6	69.4
	Harvesting	12.5	87.5	14.5	85.5
Overall average		30.5	69.5	32.8	67.2

The results revealed that men and women play different roles in dealing with climate change where women are the major actors in several areas of adaptation (agents of change). Therefore, the role of women in agroforestry technologies as adaptation measures to climate change effects should not be under-estimated [35]. [36] concurs with the findings who indicated that women is one of the most vulnerable part to the impacts of climate change and are actually the one who have a lot of roles and initiatives to play in various crises and the negative impact of climate change. Women are more involved in agroforestry technologies/ activities as an adaptation strategy as confirmed by the findings of [37]. In Makindu and Nguumo locations the study established that women have taken part in almost all production activities related to agricultural production like land preparation, planting,

weeding, watering, harvesting but men are the ones who decide on whether to sell the product or not (dominate the marketing of the product). These results are in consonance with the findings of [38] who indicated that women contribute more hours of labour to cultivation, livestock raising and tree management and highly involved in activities like nursery tending and seed preparation.

Ability of women to manage agroforestry in Makindu and Nguumo locations.

As indicated in Figure 3 in Makindu location 47.2% females, 52.8% males and in Nguumo location, 46% females, and 54% males indicated that women were able to manage agroforestry. The results confirmed that women had the ability to manage agroforestry given the opportunity.

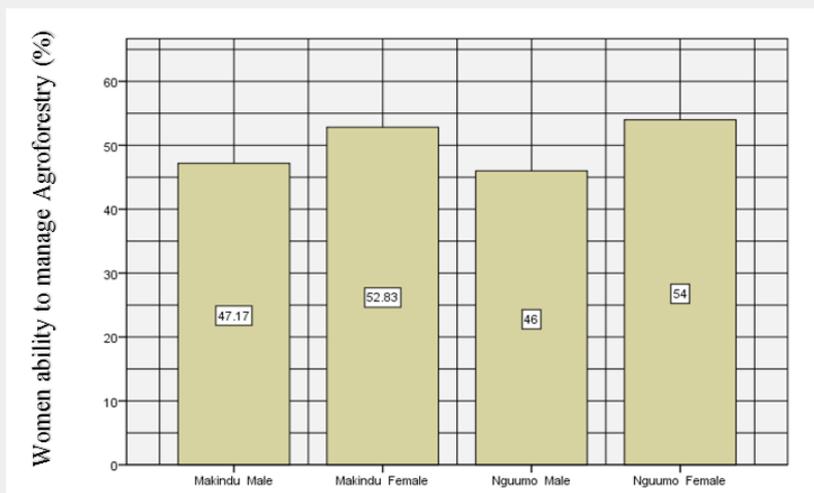


Figure 3: Ability of women to manage agroforestry in Makindu and Nguumo locations.

The results from figure 3 confirmed that women had the ability to manage agroforestry despite the barriers they face.

This concurs with the findings of [39] who indicated that women farmers form an integral part of agroforestry, as they were often responsible for managing trees especially at the early stages of establishment because men consider this feminine work. Also women are known to be principal holders of knowledge and managers of traditional home gardens, and make up about 60% of the practitioners of innovative agroforestry practices such as domestication of indigenous fruit trees and production of dairy fodder.

The current study revealed that an overwhelming majority of women in both Makindu and Nguumo locations were able to manage agroforestry technology in response to climate change effects. The results concurs with findings from a similar study by [16] which indicated that women play important roles in all agriculture and forestry activities, including management and utilization of natural resources and their protection, as was also confirmed by [40].

Also the results revealed that women in Nguumo and Makindu locations were highly involved in agroforestry technologies because they were usually responsible for providing the family with its food and also helped add the family income by farming because they could sell minor products like fruits, milk, vegetables from agroforestry and get income (called farmer women). This was in line with the findings of [36] who established that women (farmer women/rural women) had greater burden of climate change impacts than men because they had primary responsibility of collecting water or firewood as well as providing food for their families

Need for women empowerment, areas of women empowerment and women empowered in Makindu and Nguumo locations

The study sought to establish whether women need to be empowered in the areas where they are disadvantaged (challenges) in order to be able to easily access and adopt agroforestry technologies.

From the table 3 below, 83.3%, Nguumo 87.3% of women suggested that they needed to be empowered in agroforestry technologies.

The study sought to establish whether women need to be empowered in the areas where they were disadvantaged (challenges) in order to be able to easily access and adopt agroforestry technologies. They suggested that the empowerment could be done through county government, non-governmental institutions and ministry of agriculture (MoA) providing them with loans, provision of more extension workers, training through workshop, shows, visits and seminars, provision of inputs like seeds, pesticides, insecticides, fertilizers and tools.

83.3% women in Makindu and 87.3% women in Nguumo suggested that they needed to be empowered in agroforestry technologies (Table 3). In Nguumo location, 67.92%, of women needed to be empowered in land tenure, 75.47% involvement in decision making, 88.89% access to resources, and 71.70% access to extension information. In Makindu location 64.8% needed empowerment in access to resources, 53.70% in land tenure, 59.26% in decision making, and 74.07% in access to extension information. Only small percentages of women were empowered in the two locations, Nguumo 12.7%, Makindu 16.7%.

Table 3: Need for women empowerment, areas of Women empowerment and women empowered in Makindu and Nguumo locations.

Location		Nguumo (%)	Makindu (%)
In need of empowerment		87.3	83.3
Areas	Access to resources	88.89	64.81
	Owning land	67.92	53.7
	Decision making	75.47	59.26
	Access to extension information	71.7	74.07
Empowered	12.7	16.7	

Results in table 3 indicated that only as small percentage of women had been empowered in the two location hence a deficiency in women empowerment (Nguumo 12.7%, Makindu 16.7%). 87.3%, of women in Nguumo location, 83.3% of women in Makindu, needed empowerment in agroforestry technologies in various areas such as, socio- cultural factors, decision making and access to basic education in order for them to participate fully in agroforestry technologies as an adaptation to climate change. This was confirmed by the findings of [41], [42] who indicated that

there were gender-specific risk perceptions and worries about climate change that influence adaptive behaviour which were due to prevailing social inequality and varying susceptibilities.

From the findings of the current study (Table 3) it was clearly indicated that access to information, owning land, decision making and access to resources affect adoption of agroforestry technologies. Lack of access to these services burdens the woman for it is not only the role of woman to produce food for

the family but also feed livestock and oversee family's nutrition status, thus raising higher worries about declining agricultural productivity and higher incidences of food insecurity. This means that Women's roles in food production are affected when the food production deteriorates due to drought and erratic rainfall exposing households to food security risks as was confirmed by [43].

Also from results of table 3 it is clearly indicated that, insecure land rights, limited access to capital and productive inputs (resources) hindered women of both locations from taking up climate-smart practices such as agroforestry and conservation agriculture [44].

Relationship between Factors influencing adoption of agroforestry technologies by women and women empowerment

The study sought to establish the strength of the relationship

between Agroforestry practices by women, empowering women towards adoption of agroforestry, access and implementation of agroforestry information and adoption of agroforestry technologies by women. To achieve this Pearson's correlation coefficient was performed since both the independent and dependent variables are in a ratio scale. There was a positive linear relationship between adoption of agroforestry technologies and empowering women towards adoption of agroforestry ($\rho = 0.501$, $p\text{-value} < 0.05$). This indicates that a unit change in women empowerment towards adoption of agroforestry increases the adoption of agroforestry by women by 50.1%. Thirdly, there was a significant positive relationship between adoption of agroforestry and access and implementation of agroforestry information by women ($\rho = 0.630$, $p\text{-value} < 0.05$). This implies that a unit increase on how women access and implement agroforestry information increases the adoption of agroforestry technologies by women by 63% [28-36] (Table 4).

Table 4: Correlation Analysis on factors influencing of adoption of agroforestry technologies by women and various independent variables in Makindu and Nguumo locations.

		Adoption of Agroforestry Technologies	Agroforestry Practices by Women	Empowering Women towards Adoption of Agroforestry	Access and Implementation of Agroforestry Information
Y	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	70			
X1	Pearson Correlation	.627**	1		
	Sig. (2-tailed)	0			
	N	70	70		
X2	Pearson Correlation	.501**	.370**	1	
	Sig. (2-tailed)	0	0.002		
	N	70	70	70	
X3	Pearson Correlation	.630**	.703**	.350**	1
	Sig. (2-tailed)	0	0	0.003	
	N	70	70	70	70

** . Correlation is significant at the 0.01 level (2-tailed).

Conclusion and Recommendation

Findings showed that more women participated in agroforestry more than men. In addition more women planted trees and kept livestock compared to men and thus women plays a critical role in agroforestry adoption and adaptation to climate change and variability. The study concluded that residents of Makindu and Nguumo locations had adopted various agroforestry technologies which helped them to adapt to climate change and variability effects.

Women in the area played a critical role in adoption of agroforestry technologies as an adaption strategy to climate change and variability (were able to manage agroforestry technologies) women needed empowerment in various areas which hinder their full participation in agroforestry technologies. Further, study concluded that in Makindu and Nguumo locations agroforestry benefited women in various ways like provision of food, source of various products like fruits, firewood provision, pasture and fodder for livestock, income, and employment.

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