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Women's Participation in On-farm Tree/Shrub Management and Fuel Wood Availability in Rural Households of Densely Populated Vihiga and Kirinyaga Highlands of Kenya

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ABSTRACT

Fuel wood provides 89% of cooking energy for rural households in Kenya. Generally, women are responsible for the supply of the resource but households experience high levels of scarcity estimated at 57%. This study quantified the degree to which women were allowed by their husbands to participate in tree/shrub decision-making, planting, harvesting and marketing, and the effect of their participation on household fuelwood availability in the highly populated Vihiga and Kirinyaga Counties of Kenya. A total of 180 randomly sampled households were interviewed using a semi-structured questionnaire in 1998 and repeated in 2012. The results show that, in Vihiga, over 63% and 76% of the women in 1998 and 2012 respectively were allowed to make tree/shrub resource decisions. In Kirinyaga, the proportion was 54% and 84% for 1998 and 2012 respectively. However, for technical, economic, and cultural reasons, very few women participate in harvesting and marketing of the same. The limited scale of both men's and women's actual participation in tree/shrub planting, ignorance as regards optimal tree/shrub management practices, and the limited comprehension of the high quantities of fuel wood required for household cooking and heating were responsible for the unsustainable household supply of fuel wood. Awareness for both women and men on the required household fuel wood quantities, training on tree/shrub management for fuel wood supply and actual planting of trees and shrubs can contribute to sustainable rural household fuel wood supply.

Key words: *Women, Trees, Shrubs, Fuel wood, Vihiga, Kirinyaga, Rural households, Kenya*

1.0 INTRODUCTION

Ninety percent of Africa's population depends on wood energy for cooking and heating (ICARF, 1994). It is generally agreed that wood fuel will remain the main, and in some cases the only, source of energy in developing countries for many years to come, yet traditional sources of supply continue to dwindle (O'Keefe et al., 1984; Republic of Kenya, 1994; Mugo, 1989; Mugo, 1997). One of the reasons given for this situation is the limited participation of women in on-farm tree/shrub decision-making process and the management of

wood resources despite the fact that they are the principle providers of fuelwood for their households (Chavangi, 1984; Place, 1995; Mugo, 1997). In most rural households, natural resource's use decision-making and utilization is done by men. In Kakamega County of Kenya, Bradley et al., (undated) found that although women were responsible for provision of fuelwood, they had no rights of access to the trees on their husbands' land. Other studies (e.g, Hoskins, 1982; Barnard and Scherr, 1994; Scherr, 1995) found that each individual in the household sets priorities directly reflecting their responsibilities and objectives.

Participation in tree/shrub production and control of their utilization by women, therefore, has major implications for the satisfaction of women related tree/shrub needs. While men can plant trees for construction and cash income, women cannot plant trees for fuelwood because of not having primary decision-making powers over land and tree/shrub use. Even where women are able to plant trees, they are often not allowed to harvest them for fuelwood (Mugo, 1997). Men on the other hand do not want to plant fuelwood trees for women because it is culturally degrading (Chavangi, 1984; Mugo, 1997). This study examined and quantified the participation of women in household tree/shrub resource decision-making, planting, harvesting, marketing, and utilization of the wood products in the highly populated high agricultural potential Counties of Vihiga and Kirinyaga in Kenya. The effects of the level of women's participation on household on-farm tree/shrub population and fuelwood availability were also examined. This is an ongoing longitudinal study that started in 1998. It was repeated in 2012 and will also be done in August 2019. The study was guided by the hypothesis that households with women empowered to participate in tree/shrub decisions, management and utilization had more trees/shrubs per capita and more fuelwood for household use than those where women were not empowered to do the same.

2.0 STUDY AREA

The study was done in two high agricultural potential and population density areas that have freehold land tenure regime to rule out climatic and communal land tenure constraints to tree planting and also to ensure high demand for fuel wood from the high population. The two sites were also selected to contrast areas with a strong (Vihiga) and a weak (Kirinyaga) cultural barrier to tree planting by women. Due to the high population that characterizes both Vihiga and Kirinyaga Counties, one administrative division was selected from each of the Counties for detailed investigations. Luanda and Gichugu divisions were purposefully selected from Vihiga and Kirinyaga Counties respectively. Within the sites, the land use systems, (i.e., maize/beans for Vihiga and coffee/tea for Kirinyaga) were also considered.

Vihiga County lies between longitude 340 30' East and 350 0'East and between latitude 00 and 00 15' North. Luanda Division is located approximately 30 km north of Kisumu City. This division was identified by the County Home Economics Officer as the one with the highest fuelwood scarcity problem. It is generally flat and at an altitude of about 1300 m to 1500 m above sea level. It has a warm and semi-humid climate with a bimodal rainfall distribution that can support fast growth of trees and shrubs. Luanda receives between 1800 and 2000 mm of rainfall annually. Rainfall peaks in April to June for the long rains and September to November for the short rains. Mean temperatures range from 14 to 32^{o}C. Luanda has well drained, dark red friable soils partly covered with humid top soil derived from both volcanic and basement complex rocks and the yellow red loamy sands derived from both sedimentary and basement rocks. The County's average size of a household farm holding was 1.4 acres (0.6 ha) in 1997 and 0.99 acres (0.4 ha.) in 2009. Luanda had one of the highest population density in the country estimated at 1,090 persons/km^2 in 1997 (Republic of Kenya, 1997) and 1,298 persons/sq. km in 2009. This has implications on land availability for on-farm tree/shrub planting.

Kirinyaga County is located between Longitudes 3701' and 380 East and latitudes 00 1' South 00 40' South. Gichugu Division forms the eastern part of Kirinyaga County and most of it extends into the Mt. Kenya Forest. The division has a tropical type of climate and is interspersed with open 'U' shaped valleys and ridges.

It is at an altitude of between 1310 and 2130 metres above sea level. Since the County is within the highlands of Kenya near the equator, the pattern of rainfall is typically equatorial. It has two rainfall seasons. Long rains occur from March to May and short rains occur from October to November. Gichugu division falls within the high potential part of the County. It has three dominant cropping zones, which include tea, coffee, and maize/beans. The main tea zones receive 1,700 to 2,150 mm of rainfall annually while the coffee and maize/beans zones receive between 1,220 and 1,500 mm. The area has low annual mean temperatures of 14.5 to 20.6°C. Gichugu has rich fertile red clay soils. Livestock are raised in all the three zones with the dominant domestic animals being cattle. In 1997, the study areas average size of household farm was 2.4 acres (0.97 ha) and the population density was estimated to be 635 persons/km^2 in 1997 and 653persons/ km^2 in 2009. This was almost double the County's population density of 343persons/km^2 and half of that in Luanda. In both Luanda and Gichugu, numerous tree and shrub species grow well. Climatic and soil factors, therefore, are not a constraint to tree/shrub planting.

3.0 MATERIALS AND METHODS

One hundred and eighty households were randomly selected from Vihiga and Kirinyanga Counties. In Vihiga, 90 households were selected from six villages, three of which were from Ebukanga Sub-location and three others from Esaba Sub-location in Central Bunyore Location. The list of households from each village was used as the sampling frame. Systematic random sampling technique was used to select 15 households from each village. In Kirinyaga, the interest was in the coffee and tea zones. Thumaita sub-location in Karumande Location was selected to represent the tea zone while three villages, two in Rwambiti (Kagaa and Mucungwa) sub-location and one in Raimu sub-location (Muthegi) were selected from the coffee zone. As for the case of Vihiga, 15 households were selected from each village using systematic random sampling technique. For the tea zone, 15 households each were sampled from Kibaro, Kamweti, and Gaturi villages. The head and/or spouse of each household were interviewed using a semi-structured questionnaire. The interviews were conducted between January and March 1998 in Vihiga and March and April 1998 in Kirinyaga. In 2012, the interviews were conducted in the same villages in August for Vihiga and October for Kirinyaga. The information gathered covered the general household characteristics, fuelwood consumption and supply, and the role of women in the various aspects of the tree/shrub resource decision-making, management and utilization. Direct observation of the type of tree/shrub species on the farm, the planting niches, numbers, spacing, the type and number of stoves used, and the type and quantity of fuelwood in storage were made. Physical counting of trees and selected species of shrubs was done on the sampled farms. Information was also gathered from previous studies done on wood fuel, household gender roles, and agroforestry in general. Vital information was also obtained from government documents, particularly the development plans of the two Counties.

4.0 RESULTS AND DISCUSSION

4.1 Participation of women in tree/shrub resource decision-making and management

Contrary to expectation, as outlined in the results in Section A of Table 1, in Vihiga, most women (over 63% (1998) and 76% (2012) were allowed to participate in tree/shrub resource decision-making. In Kirinyaga, the proportion was 54% (1998) and 84% (2012). The change in the proportion allowed over the 14 year period was +13% for Vihiga and +30% for Kirinyaga. In Vihiga, the activity to fell trees was the least allowed for women (56%) while in Kirinyaga, making decisions to fell shrubs was the activity that very few women (29%) were allowed to participate in. This could be because there are very few shrub related activities in Kirinyaga when compared to Vihiga. In addition, shrubs are used for marking farm boundaries and generally, many women do not participate in farm boundary issues. For Vihiga, most of the trees planted are eucalyptus, which tend to be a man's cash crop while in Kirinyaga the main tree is grevillea. The hypothesis that very few women in Vihiga and Kirinyaga participate in tree/shrub resource decision making was not supported. Also,

the hypothesis that fewer women in Vihiga when compared to Kirinyaga participate in tree/shrub decision-making was not supported.

Overall, the change in participation over a period of 14 years is positive for both Vihiga and Kirinyaga in all the aspects of women's participation in tree/shrub related decision making, management, marketing and utilization. This implies that the strategies employed to increase participation of women in tree/shrub planting for multiple purposes are bearing fruit and should be maintained and or enhanced. This should encourage counties and countries that are still struggling with women's participation in tree/shrub decision making, management, marketing and utilization to press ahead since it is possible to attain full participation.

Table 1: Women's participation in tree/shrub decision making and management

Tree/shrub related responsibility	Proportion of the women who were allowed by their husbands to participate (%)					
Section A - Decision making	Vihiga			Kirinyaga		
Year of survey	**1998**	**2012**	**Change**	**1998**	**2012**	**Change**
Decide to plant trees	63	89	+26	66	92	+26
Decide to plant shrubs	64	90	+26	41	92	+51
Decide to prune/pollard/coppice trees	67	65	-2	72	91	+19
Decide to prune/pollard/coppice shrubs	68	75	+7	72	91	+19
Decide to fell trees	56	61	+5	42	68	+26
Decide to fell shrubs	62	73	+11	29	68	+39
Average – Decision making	**63**	**76**	**+13**	**54**	**84**	**+30**
Section B – Actual planting						
Direct sow tree seeds	55	94	+39	53	96	+43
Direct sow shrub seeds	52	93	+41	39	96	+57
Get or raise tree seedlings	55	93	+38	67	94	+37
Get or raise shrub seedlings	49	93	+44	37	94	+57
Tend wildlings	78	92	+14	93	96	+3
Plant tree seedlings	56	92	+36	86	92	+6
Plant trees on farm boundary	41	78	+37	55	86	+31
Plant shrubs on farm boundaries	41	81	+40	36	88	+52
Average – Actual planting	**53**	**90**	**+37**	**58**	**93**	**+35**
Section C - Harvesting						
Prune/pollard/coppice trees	22	74	+52	24	91	+67
Prune/pollard/coppice shrubs	35	74	+39	44	91	+47
Fell trees	23	63	+40	30	68	+38
Fell shrubs	36	72	+36	26	68	+42
Average – Harvesting	**29**	**71**	**+42**	**31**	**80**	**+49**
Section D – Marketing						
Sell surplus prunings	72	56	+16	37	63	+26
Keep prunings revenue	67	59	-8	42	64	+22
Sell fuelwood	78	61	-17	37	67	+30
Sell poles	35	68	+33	25	71	+46
Sell sawn timber	25	72	+47	21	79	+58
Average – Marketing	55	63	+8	32	69	+37
Section E – Transportation and Utilization of fuelwood						
Transport the wood home	91	89	-2	88	96	+8
Use the wood in the home	99	83	-16	94	96	+2
Give some wood to friends	95	63	-32	92	68	-24
Average – Transportation and utilization of fuelwood	**95**	**78**	**-17**	**91**	**87**	**-4**

4.2 Women's participation in tree/shrub planting

The proportion of women allowed to participate in tree/shrub planting and tending of wildlings were 53% (1998) and 90% (2012) for Vihiga. The proportion for Kirinyaga was 54% (1998) and 93% (2012). This reflects a change of +37 and +35 for Vihiga and Kirinyaga respectively over the 14 year period. The similarities in the proportion of women allowed in the two Counties imply that the negative effects from cultural beliefs observed in earlier studies in Vihiga could have faded over time. The hypotheses that few women in both Vihiga and Kirinyaga participate in the actual tree and shrub planting and that the proportion of women participating in Vihiga is lower than that of Kirinyaga were not supported.

4.3 Women's participation in tree/shrub harvesting

In Vihiga 29% (1998) and 71% (2012) of the women were allowed to harvest trees and shrubs while in Kirinyaga, the proportion was 31% (1998) and 80% (2012) (Table 1). The 1998 proportion of 29% and 31% were quite low compared to the 2012 proportions. The change, however over the 14 years was highest in this component of tree management registering +42 and +49 for Vihiga and Kirinyaga respectively. As mentioned earlier, trees are generally felled for poles and timber in Vihiga and Kirinyaga, respectively. In both Counties, traditionally, it was the responsibility of men to undertake or oversee tree felling or timber sawing. There was therefore very little involvement by women. In addition, trees in both Counties were felled for selling. Again, although women could also sell, it was generally men who did the selling of trees. A factor that could also have contributed to the limited participation of women in tree harvesting was the size (height and width) of trees grown. The eucalyptus and grevillea trees grown are tall and wide. This makes it difficult for women to climb them since they generally have not developed the skills for climbing trees or even just cutting them from below.

However, if this argument was true, then there should be more harvesting of shrubs by women. This does not appear to be the case since only 36% and 26% of the women in Vihiga and Kirinyaga, respectively, were allowed to fell shrubs in 1998. In 2012 the proportion was 72% and 68% in Vihiga and Kirinyaga respectively. This suggests that there could be other reasons for the limited participation of women in tree/shrub harvesting activities, the most probable being the control of household economic resources by men. These results support the hypothesis that very few women in both Vihiga and Kirinyaga participate in tree and shrub harvesting for the 1998 survey but not the 2012 survey. However, the hypothesis that due to cultural constraints fewer women in Vihiga participate in tree/shrub harvesting compared to Kirinyaga was not supported in both the 1998 and 2012 surveys. Both counties were at the same level on this aspect of women participation in tree/shrub management.

4.4 Women's participation in marketing of wood products

Results in Table 1 show that in Vihiga, more women (55%) were allowed to participate in the marketing of wood products when compared to those of Kirinyaga (32%) in 1998. In both counties, sawn timber was the product least acceptable for women to sell. Only 25% and 21% of the women in Vihiga and Kirinyaga respectively, were allowed to sell timber. A similar lower proportion 35% and 25% for Vihiga and Kirinyaga respectively were allowed to sell poles. Seventy eight percent of women in Vihiga were allowed to market fuel wood as compared to 60% of Kirinyaga. There was a higher scarcity of fuelwood in Vihiga than in Kirinyaga and generally, women were involved in fuelwood trade just as they would do with any other commodity. The wood was not necessarily harvested from their farms. In Kirinyaga, there was very little wood buying and selling and when it occurred it was in large quantities (e.g., ox-cart load [Ksh. 300], pick-up load [Ksh. 2,000], or lorry load [Ksh. 6,000]. In Vihiga, split fuelwood was sold in small bundles of three to four one-meter long and five-centimeter wide pieces of air-dry wood at Ksh. 10 per bundle. The hypothesis that few women in both Vihiga and Kirinyaga participate in the marketing of wood products was supported for timber and poles but not for fuel wood. In addition, the hypothesis that fewer women in Vihiga than

Kirinyaga participate in the marketing of wood products was not supported. Infact the situation is the opposite of the stated hypothesis i.e. more women in Vihiga than Kirinyaga participate in marketing of wood products. The practice appears to be related more to economics than culture.

5. WOMEN'S PARTICIPATION AND HOUSEHOLD FUELWOOD AVAILABILITY

The study hypothesized that households in which women were involved in tree/shrub decision-making, actual planting, harvesting and marketing had significantly more fuelwood than those where they were not involved. Comparisons of fuelwood availability for households in which women were allowed/not allowed to make tree/shrub-related decisions, plant, harvest, and market the wood products were made and the results were as indicated below.

5.1 Women's participation in decision making

Results in Table 2 show that only two out of the 24 variables tested had a significant effect on fuelwood availability. In Vihiga, the households in which women were allowed to make decisions to prune/coppice/pollard shrubs had significantly more fuelwood ($p=0.05$) than those in which they were not allowed to make such decisions. When trees are felled, the wood can be used by the owner for construction, fuelwood, or fencing. Alternatively, the wood could be sold as poles and sawn timber for construction, or sold directly for fuelwood. Being unsuitable for other wood needs like construction and sawn timber, shrubs were generally harvested for fuel wood. It is, therefore not surprising that in Vihiga, households in which women were allowed to make decisions to harvest shrubs had significantly ($p=0.10$) more fuelwood.

There was, however, no significant difference in fuelwood availability between households in which women had, since marriage, made decisions to harvest shrubs and those in which such decisions had not been made. This occurrence could probably be due to the timing of the study. It is possible that the shrubs could have been harvested earlier and utilized such that at the time of the study there were none in storage. In addition, it could be because the households had just a few which were harvested and none remained for harvesting on a continuous basis. In Kirinyaga, the women who had made decisions to harvest shrubs since marriage had significantly more fuelwood ($p=0.10$) than those who had not done so. For both the Vihiga and Kirinyaga Counties, these findings imply that planting tree/shrub species whose wood has fewer alternative uses could be used more for fuelwood than those tree/shrub species that have many alternative uses. This, however, does not disqualify the species that can be managed for multiple products. This also suggests that trees and shrubs should be planted specifically for fuelwood instead of depending on leftovers from other products like timber or poles.

5.2 Women's participation in actual tree/shrub planting

It was hypothesized that households in which women were allowed to plant trees/shrubs had significantly more fuelwood than those in which they were not allowed. Out of the 11 variables tested for Kirinyaga (Table 3), only one, felling of trees was found to be significant in 1998. In Vihiga however, two variables were significant at 10% probability level and four significant at 5% probability level. In 2012, all the variables tested were significant except the one of planting shrubs on farm boundaries. As mentioned earlier, shrub planting in Kirinyaga has a lot to do with farm boundary marking and very few women participate in it and it does not generate fuel wood.

In Vihiga, it emerged that the households where women were allowed to plant tree seedlings, direct sow tree seeds, and plant trees on farm boundaries had significantly more fuelwood ($p=0.05$, 0.10, 0.10 respectively) than those in which the women were not allowed to do the same. In addition, the Vihiga households in which women had raised tree/shrub seedlings (e.g., tree nursery) had significantly more fuelwood ($p=0.10$) than the households where such activities had not been under-taken. It is possible that women who had raised seedlings had also planted them.

Considering comparisons between Counties, the fact that Kirinyaga women were planting grevillea (man's tree) and Vihiga women planted shrubs (have access to them and takes 1 year to harvest) could be responsible for the difference in fuelwood availability. The length of time (3-5 years) it takes to start harvesting grevillea could also be a contributing factor to the little fuelwood observed in the Kirinyaga homes.

Table 3: T-test comparisons of the fuelwood availability between households in which women were allowed/not allowed to participate in tree/shrub decision making, actual planting, harvesting and marketing in 1998 and 2012

Tree/Shrub activity	Vihiga		Kirinyaga	
	1998	2012	1998	2012
Decision-making				
Make decision to plant trees		ns		ns
Make decision to plant shrubs		ns		ns
Decide when to prune, pollard or coppice trees		ns		*
Decide when to prune, pollard or coppice shrubs	**	ns	ns	*
Decide when to fell trees		ns		ns
Decide when to fell shrubs	ns	ns	ns	ns
Actual planting				
Direct sow shrub seeds	*	ns	ns	*
Direct sow tree seeds		ns		*
Get or raise tree seedlings	ns	ns	ns	**
Get or raise shrub seedlings		ns		**
Plant tree seedlings	**	ns	ns	**
Plant trees on farm boundaries	*	ns	ns	*
Plant shrubs on farm boundaries		ns		
Tend wildlings		*		*
Harvesting				
Fell trees	**	ns	*	ns
Fell shrubs	**	ns	ns	ns
Prune, coppice, pollard trees		ns		
Prune, coppice, pollard shrubs		ns		*
Marketing				
Sell surplus prunings	ns	ns	ns	ns
Keep prunings revenue	**	ns	ns	ns
Sell fuelwood	ns	ns	ns	ns
Sell sawn timber		ns		ns
Sell poles		ns		ns
Transport fuelwood home		ns		*
Use the wood in the home		ns		ns
Give some wood to friends		ns		ns
Attend extension demonstration		ns		**

*, **, ***, significant at 10%, 5%, and 1% level of probability: ns = not significant

5.3 Women's participation in harvesting trees and shrubs

It was hypothesized that households in which women were allowed to harvest trees/shrubs had significantly more fuelwood than those in which they were not allowed to harvest them. The results show that in Vihiga, the households in which women were allowed to harvest trees (p=0.05) and shrubs (p=0.05) had significantly more fuelwood than the households in which women were not allowed to do the same. In Kirinyaga, the households in which women were allowed to fell trees had significantly (p=0.10) more fuelwood than those in

which they were not allowed. The other 25 variables tested did not show significant differences in fuelwood availability between the two groups of households. This suggests that to increase household fuelwood availability, women should be allowed to participate in harvesting of trees and shrubs.

5.4 Women's participation in marketing wood products

It was hypothesized that households in which women were allowed to market wood products had significantly more fuelwood than those in which women were not allowed to market the same. Results (Table 3) show that Vihiga households in which women were allowed to keep prunings revenue had significantly more fuelwood (p=0.05) than those in which they were not allowed to do the same. In Kirinyaga, a significant difference was found between households in which women were allowed to sell surplus tree prunings (p=0.10), keep prunings revenue (p=0.05), and sell poles (p=0.05) and the households in which women were not allowed to do the same. Although not always the case, it is possible that households in which women were allowed to sell prunings had more trees/shrubs than those in which they were not allowed. In both counties, generally, it is the responsibility of the men to provide income for their households.

Due to poverty, however, in some homes, the male head of households may not allow their wives to keep revenue from wood sales. Where a wife was allowed to keep such revenues, it could be possible that either the household is financially well off or the husbands had alternative sources of income, such as, off-farm employment. In Kirinyaga, the households where women had kept prunings' revenue and those who had sold fuelwood since marriage had higher positive effects on fuelwood availability than households in which women had only sold surplus prunings. Generally, there was little fuelwood selling in Kirinyaga. Households where fuelwood was sold could be those that had relatively large quantities of surplus wood. As for the case of Vihiga, households where women had kept prunings' revenue could be those where husbands had alternative sources of income which could include off-farm employment. This suggestion was found not to be a clear "yes", because, of the 33 households in Kirinyaga in which wives were allowed to sell fuelwood, only 13 (39%) had husbands with off-farm employment. The other 20 (61%) were living on the farms helping with farm work. It is therefore possible that these were households in which wives and husbands decide and work together. This is an attribute that should be promoted for optimal management and utilization of farm forestry resources.

6.0 OTHER WOMEN-RELATED VARIABLES TO THE DURATION OF FUELWOOD IN STORAGE

In societies like Kenya where generally, men are responsible for tree planting and women assume the responsibility for collecting fuelwood, it should be expected that a higher number of females in a household should result in higher levels of fuelwood availability. This, it could be argued, is because female members of the family provide the labor for collecting fuel wood. This is also expected to work negatively for the tree population on the farm because there is no incentive for the male members of the household to plant trees for fuelwood. Of the relationships considered, only four were found to be significant (Table 4). In Vihiga, the number of trees per capita had a strong negative correlation (r = - 0.3048) with the number of females in the household. Although these results concur with the expectation, considering other factors examined, the negative relationship could also be due to the household size rather than the number of females in the household. A case could be made for the households that live near the forest since women collect fuelwood from the forest everyday. However, this may also not be true because, the limited planting of trees in the tea zone had more to do with the tea growing policy than household gender composition.

In Kirinyiga, education of the mother correlated positively (r = +0.2634) and significantly (p = 0.05) with the per capita number of trees and negatively (r = -0.2099, p = 0.10) with the quantity of fuelwood in storage (Table 4). High education tends to lead to better employment, hence higher incomes. Apparently, only one

household out of the 90 interviewed had the wife in off-farm formal employment. All the other 89 women were farmers. For the later, having little fuelwood in storage could imply that the household uses alternative energy sources or they buy fuelwood when they need it, or still they could just be suffering from the scarcity like all the other households that have shortages. The age of the mother had no significant effect on the per capita number of trees and the level of fuelwood in storage.

Table 4: Correlation of number of trees per capita and fuelwood availability with various women related variables

Female variable	Trees/capita		Days fuelwood in storage will last	
	Vihiga	Kirinyaga	Vihiga	Kirinyaga
Number of females in the household	- 0.3048***	- 0.1566	- 0.0461	- 0.0611
Age of mother (years)	- 0.0975	- 0.1559	- 0.0755	0.1062
Education of mother (years)	0.1341	0.2634**	- 0.2099*	0.1016

*, **, ***, significant at 10%, 5%, and 1% level of probability

Considering the gender of the household head and residence of the male household head, there was no significant difference in the per capita means of trees between households headed by males (19 trees) and those headed by females (17 trees). The households in which male heads reside at the home had 19 trees per capita while those in which they live away from the home or have died had a mean of 17 trees per capita. The similarity in the per capita number of trees between male headed and widow headed households could be attributed to the fact that most of the trees on the farm had been planted before the male heads of the households died. Most trees were over 15 years old.

Factors contributing to greater participation of women in tree/shrub decision making and management

Various household land, and land use factors were used to predict the likelihood of women's participation in tree/shrub decision making and management. Results show that of the 12 factors considered in Vihiga (Table 5a), none was found to contribute significantly to women's participation in tree/shrub issues. In Kirinyaga, only higher age of the women (Table 5b) was found to be a positive significant contributor (p=0.01). Negative significant contributors were; higher age of the male household head (p=0.01), the male household head residing home (p=0.05) and ownership of land title deeds (0.05). This implies that women from households where male heads of the households are elderly, reside at home, and have land title deeds, participate least in tree/shrub decision making and management. The issue of land title ownership may not be a direct relationship because there is a strong association between age of male head and ownership of titles. The main negative factors, therefore, may be the age of the male head and his continuous presence at home.

Table 5a: Regression coefficients of predictor variables of women's participation in tree resources decision-making and management in Vihiga District

Variable name	Un-Standardized Coefficients	T-value
Age of household head	0.0622	0.352
Age of mother	-0.0141	-0.092
Education of household head	0.0451	0.089
Education of mother	0.0405	0.086
Family size	-0.2690	-0.392

Number of females in household	0.0629	0.050
Male head residing home	0.8650	0.230
Household land size	0.2830	0.339
Land inherited (acquisition)	-1.4960	-0.444
Household head employed	-0.5660	-0.161
Ownership of land title deed	2.0890	0.791
Number of trees per capita	0.0088	0.153
Constant	12.1090	1.559
R – squared	9.3%	-
R – squared adjusted	-23%	-

*, **, significant at 10%, 5%, levels of probability respectively

Table 5b: Regression coefficients of predictor variables of women's participation in tree resources decision-making and management in Kirinyaga District

Variable name	Un-standardized Coefficients	T-value
Age of household head	-0.396***	-2.753
Age of mother	+0.442***	+2.651
Education of head	-0.200	-0.757
Education of mother	+2.918	+0.108
Family size	-0.139	-0.289
Number of females	+1.169	+0.021
Male head residing home	-5.192**	-2.092
Land size	+0.441	+0.949
Closeness to a public forest	-0.405	-0.242
Land inheritated	-1.247	-0.491
Household head employed	+3.564	+1.594
Ownership of land title deed	-3.886**	-2.214
Days fuelwood in storage will last	+7.847	+1.076
Number of trees per capita	+2.536	+0.627
Constant	+21.761***	+2.631
R – squared adjusted	47% (34%)	-

*, **, ***significant at 10%, 5%, 1% levels of probability respectively

7.0 CONCLUSIONS

a. Contrary to previous reports that women were not allowed by their husbands to participate in tree/shrub issues, a significantly higher proportion of women in Vihiga and Kirinyaga were allowed to participate in tree/shrub decision making and planting but very few allowed to harvest and market the wood. However, the scale of participation could be very low (e.g., planting 5 trees/shrubs as opposed to planting 500 trees/shrubs).

b. Permission for women to participate in tree/shrub related activities in Vihiga and Kirinyaga was almost the same. But there was more participation in shrub activities in Vihiga when compared to Kirinyaga. The reason however, appeared to be more on the type of technology (tree/shrub species) and practices in a given area than cultural beliefs.

c. Women's participation in tree/shrub decision-making does not automatically contribute to increased tree/shrub population and fuelwood availability at the household level probably because of other constraints, particularly the land resource (hence scale of participation) and limited knowledge on optimal management of tree/shrubs.

d. Generally in both Vihiga and Kirinyaga, the women who participate in marketing of wood had significantly more trees/shrubs per capita than those who did not participate. The reason could be either because the households had more trees per capita hence women could be allowed to sell some or because women were allowed to market the wood products hence are motivated to plant more.

e. In Vihiga, women who participate in shrub related activities had significantly more fuelwood than those who were not participating. This could probably be due to the fact that unlike trees, shrubs were specifically harvested for fuelwood.

f. No factor in Vihiga and only higher age of women in Kirinyaga was likely to lead to women's greater participation in tree/shrub decision-making and management. This could be due to access to land by older women than younger women.

Overall, there is no simple way to summarize gender roles and farm forestry within rural households and communities. Gender roles and responsibilities are dynamic. They change with new economic and technological circumstances as it has been observed in this study.

8.0 RECOMMENDATIONS FOR INCREASING FUELWOOD SUPPLY

a. Trees and shrubs which women can plant and harvest easily are already known and are available. They should therefore be actively promoted and women should be allowed to plant and harvest them for their various wood needs.

b. Land size constraints to women's participation in tree/shrub planting should be sorted out by identifying other tree planting niches like farm boundaries, borders and contours.

c. Men should be sensitized about fuel wood supply/demand quantities and other related issues so that they can support their wives in planting and harvesting the necessary trees/shrubs or procuring fuelwood for household use.

d. Since men have the overall decision-making authority in most homes. There is a possibility that they can, make tree-related decisions that suit their roles exclusively. As long as tree-related gender-based household roles remain, women's fuelwood needs should be deliberately targeted.

e. It is beneficial to involve women in the tree resource decision-making and management, but as Cashman (1985) argues, it is much better if the household is treated as one unit where married women and men are involved in all the household decision-making and implementation processes jointly.

9.0 AREAS FOR FURTHER RESEARCH

From direct observation, women in both study areas appeared to be overloaded with many activities but denied access to the required resources. Gender maps on resource use (who uses what), labor (who does what), and decision-making (who decides what) at the household level should be generated for the rural areas. This will help highlight needs for shifting gender roles to relieve women of some household and farm cores and or increase access to resources required for them to accomplish their culturally assigned roles.

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Biography

Fridah Wilumila Mugo, holds a Doctorate and Master of Science Degree in Natural Resources Policy and Management from Cornell University, New York State in USA; She also has a Master of Arts Degree in Land Use Planning and a Bachelor of Science Degree in Agriculture from the University of Nairobi in Kenya (the PhD and two Masters Projects were on on-farm forestry). Fridah's areas of specialization are: Land use planning; farm forestry, environment, Research methods Gender Studies. She has over 36 cumulative years of experience with various institutions/organizations in 11 African Countries. She has spent over 36 years working in the field of agriculture, environment, agroforestry, energy, gender and natural resources management. For 18 of the 36 years, she worked with the Ministry of Energy, Government of Kenya, 3 years with the International Centre for Research in Agroforestry (ICRAF) and 8 years as a Private Consultant. Currently, she teaches as a Senior Lecturer in the Department of Urban and Regional Planning at the University of Nairobi in Kenya.