Socioeconomic Determinants of Adoption of Eco-Friendly Farming Practices in Agroecosystems of Embu County, Kenya

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Abstract

Agriculture is one of the economic activities that not only depends on and influences a number of environmental resources including water, land and biodiversity as well as production technologies and management skills. Given the vast global area under agriculture, the influence of agriculture on overall environmental sustainability cannot be overlooked. Environmental challenges such as pollution, soil erosion, soil acidification, low agricultural production and unsustainability of the agricultural ecosystems, have been associated with conventional farming practices. To address these environmental challenges, environmentalists have mooted Eco-friendly Farming Practices (EFFPs) as possible alternatives to the conventional farming approaches that have been greatly associated with the aforementioned challenges. This study was conducted among households of Embu County in Kenya to determine the socio-economic factors that influenced adoption of EFFPs. Earlier studies had indicated clearly that Embu County was experiencing soil erosion, pollution and soil acidification, yet EFFPs had been introduced to counter these environmental challenges. Therefore, the study sought to find out the influence of socioeconomic factors on adoption of the EFFPs. Ex post facto research design was used. Through multi-stage random sampling 402 household heads were selected and all the 32 extension officers in the area were interviewed. Average income from agriculture, gender, farming experience, level of education, size of the farm and age were statistically significant (at 5% significance levels) in influencing adoption of EFFPs among households of Embu County. The study concluded that the socioeconomic factors were significant in influencing adoption of EFFPs among households of Embu County. This implies that the household socioeconomic characteristics must be considered in designing effective environmental sustainability programmes in the County.

Keywords: Adoption, Eco-Friendly farming Practices, Socioeconomic factors, Households, Embe County

Introduction

The environment and its resources form the basis for human livelihood, sustenance of economies and agricultural development in the world (Mutuku, *et al.*, 2017). Use of environmental resources for agriculture is central in the global economy accounting for over 24% of the global Gross Domestic Product (Smith, *et al*., 2007). One of the key roles of agriculture is food production. To meet the food requirements for the ever growing human global population (expected to rise to 11billion by 2100), ther is need to remodel conventional agriculture to keep up with the growing lobal food demands Conventional agriculture involves intensified mechanization, intensified use of pesticides and excess inorganic fertilizers, expansion of irrigated land, specialization and breeding of high yielding crops. Notably, conventional farming practices lead to a sudden increase in farm production. However, the increase in production is not sustainable. Additionally, the intensified conventional agriculture stretches environmental resources to limits thus weakening their natural processes (United Nations Environment Programme [UNEP], 2008). For instance, these conventional agricultural practices have been associated with acute soil degradation (Ngetich, *et al.,* 2012), environmental pollution, soil acidification, biodiversity loss and salinization (Hurni, 2000; Rasul and Thapa, 2004; Roling, 2005).

To address the environmental challenges associated with agriculture, and simultaneously provide agroecosystem services, environmentalists have supported a paradigm shift in farming practices by encouraging adoption of Eco-Friendly Farming Practices (EFFPs). EFFPs constitute a set of farming practices that sustainably support

provision of agroecosystem services and simultaneously, mitigate environmental challenges associated with agriculture Mozzato, *et al.,* (2018). These farming practices broadly consider tillage practices, cropping systems, choice of farm seeds, farms feeds, soil fertility practices, farm biodiversity; pests and diseases management, soil conservation, water conservation and marketing of the farm produce as well as cross cutting management practices. They are considered environmental friendly because these practices are based on similar tenets (tripod dimensions of ecological, social and economic aspects) as environmental sustainability. These practices are geared towards food production or meeting such other market requirements, and are carried out without incurring any negative environmental impacts Mozzato, *et al*., 2018).

EFFPs through their multi-dimensional approach have been associated with benefits such as increased farm production, increased biodiversity, sustained soil fertility, reduced soil erosion, increased soil moisture, reduced environmental pollution improved food security and income stability to farming households (Njeru, 2015).

To realise the benefits of EFFPs including overall environmental sustainability, farmers have to accept and adopt these practices. Success stories and benefits of EFFPs have been recorded in South Africa, Zimbabwe and Zambia (Yadate, 2007). Despite the environmental benefits associated with EFFPs, their adoption rates in many African countries remain low (Giller, *et al.,* 2009; International Assessment of Agricultural Knowledge, Science and Technology for Development [IAASTD], 2009).

Agriculture being the backbone of Kenya's economy and a great user of environmental resources, adoption of EFFPs should be prioritised. In Kenya, very low (0-6%) adoption rates of EFFPs among farming households have been reported (Njeru, 2015; Chomba, 2016). However, despite the low adoption in some regions, some households have been reported to have high adoption intensity of EFFPs (Olwande et al 2009, Suri, 2011). This

study sought to examine the influence of socioeconomic factors on adoption of EFFPs in Embu County. The socioeconomic determinants and their influence were examined against adoption of EFFPs covering soil fertility techniques, tillage practices, cropping systems, agroforestry, soil and water conservation practices.

Materials and Methods

The study was carried out in Embu County in Eastern part of Kenya. Embu County borders Kirinyaga County to the West, Kitui County to the east, Tharaka Nithi County to the North and Machakos County to the South. The County is located between $37^{0}3'$ and $37^{0}9'$ east. Embu County rises from about 515m above sea level at the Tana basin in the east to over 4870m on top of Mt. Kenya in the North West. The human settlement in the county is mainly rural. The County's agroecology has influenced the settlement pattern. The county lying averagely at an altitude of about 1,700m above sea level, experiences bimodal type of rainfall with long rains falling from March to June while the short rains start at around October to February (Jaetzold, *et al.*, 2007a). A great majority of the farmers are small scale holders whose major cropping enterprises are coffee, tea, maize, beans, potatoes, macadamia. The households rear cattle, goats, sheep, poultry and bees. The combination and intensity of these enterprises vary across the upper midlands (UM1 and UM 2) and lower midlands (LM) of the County.

Ex post facto research design was used to determine the influence of socioeconomic factors on adoption of EFFPs among the farming households in Embu County. All the 80,138 farming households and the 32 agricultural extension officers in the Embu West, Embu East and Embu North sub-counties were targeted for the study. These extension officers represented the informed specialists, and the 80,138 farming household heads being the users of the EFFPs. The sample used in the study was selected through a multistage sampling technique. The first stage involved purposive selection of the block of the three sub-counties where EFFPs were intensively introduced. Twenty four out of

the 70 sub-locations were a sample size of 402 household heads was proportionately and randomly chosen for the study.

The sampling unit was the household head because of their influence on decisions regarding farming practices. Questionnaires were administered on house to house basis. In cases where the household head was not present, a spouse was interviewed and if the spouse was absent any adult of the household was interviewed. Where none of these was present, the interview was postponed. Before the actual use of the questionnaire, it was pretested in a neighbouring county and its reliability established. An observation, schedule which is relatively free of bias, was also used to supplement information collected on various observable field practices.

Sixteen EFFPs that were relevant in the study area were considered in the study. These EFFPs considered specific attributes on cover cropping, weed management, cropping systems, soil fertility techniques, use of integrated pest management, minimum tillage, retaining plant residues/mulching, use of inorganic pesticides, soil testing, soil fertility techniques and agroforestry.

The socioeconomic attributes examined were gender of the household head, level of income from agriculture, highest education level attained by the household head, household's farm size holding, farming experience and age of the household head. Data was cleaned and analysed using Statistical Package for Social Sciences (SPSS) version 22 for windows. The relationship between adoption of EFFPs and selected socioeconomic factors was determined using of chi-square statistics at 5% significance level. The computed p value was compared with 0.05 at 5% significance level. If the p value less than 0.05, signified a significant relationship between adoption of EFFPs and the

socioeconomic attributes. A p value more than 0.05, sigified that a statistically significant relationship did not exist.

Results and Discussions

Influence of Socioeconomic Factors on Adoption of EFFPs

The p value obtained for the correlation between socioeconomic factors and adoption of EFFPs was less than 0.05 and therefore socioeconomic factors significantly influenced adoption of EFFPs among households in Embu County.

Table 1: Regression Coefficients for Socio-economic Factors influence on Adoption of Eco-Friendly Farming Practices

Independent Variables	B	Std. Error	t	Chi-square value	p value
Constant	2.886				
Gender of Respondent	0.059	0.022	2.619	12.798	0.005
Age of Respondents	-0.109	0.025	-4.437	15.798	0.0001
Farming Experience	0.136	0.021	-6.575	34.064	0.0001
Size of Farm	0.070	0.023	-3.008	35.459	0.0001
Highest Level of Education Attained	0.214	0.016	-13.349	62.060	0.0001
Annual income from Agriculture	0.092	0.014	6.430	73.692	0.0001

Gender of the Respondents

A chi-square test on the relationship between gender of the respondents and the adoption of EFFPs yielded a p value of 0.005 which is less than 0.05. This implied a significant relationship between the gender and adoption of EFFPs (Table 1). Women were more likely to adopt EFFPs than men. This observation is in tandem with the findings of (Njeru, 2015). However, this finding contradicts the observations by Akama, *et al*, 1995, Fiallo

and Jacobson 1995, De Boer and Baquete 1998, and Infield (1998); reported that gender had no influence towards adoption of environmental conservation practices.

Level of Income from Agriculture

Less than 1% of the respondents earned either Kshs 20,000 or less from agriculture, while 2.7% earned between Kshs 21,000 to Kshs 40,000; 11.7% earned between Kshs 41,000 to Kshs 60,000, and more than half (57%) of the respondents earned above Kshs 80,000 in a year (Table 2).

Table 2: Household's Annual Income from Agricultural Activities

Range of income (Kshs)	Frequency	Percent
1-20,000	2	0.5
21,000-40,000	11	2.7
41,000-60,000	47	11.7
61,000-80,000	113	28.1
Over 80,000	229	57.0
Total	402	100.0

Further tests on relationship between annual income and adoption of EFFPs using chi-square was carried out. A chi square value of 73.692 was obtained with a corresponding p value of 0.0001 at 5% significance level (Table 1). The obtained p value of 0.0001 was less than 0.05; thus there was a statistically significant and positive relationship between households' levels of income from agriculture and adoption of EFFPs. This implies that those who earned more from agriculture adopted more of EFFPs while those who earned little from agricultural activities adopted less of the EFFPs. This positive relationship between farm income and adoption of EFFPs is in agreement with the findings reported elsewhere of Shields et al (1993) who averred that high income levels positively influences adoption of technologies while low farm income inhibits adoption of EFFPs.

Higher levels of income from whichever source to the farm widen the financial base of a farmer and this hastens the adoption of technologies. However, the study's finding on the positive influence of income on adoption contradicts the opinion of Mengstie (2009) who reported that income levels do not influence adoption of EFFPs.

Where households realised more income from agriculture, then there was a high likelihood that they ploughed back part of the income into improving the agricultural enterprises. This included adopting more EFFPs because they support the production that gives higher income. With higher levels of income from agriculture, putting up structures like gabions, terraces (for soil and water conservation measures), engaging hired labour for the more labour-engaging EFFPS (composting and mulching) is made easier if households have more income. Lower income levels mean that more competing needs will be addressed before addressing farm related expenses. This low income is bound to be lower in the next season because fewer inputs (investment) went into the EFFPs. This lack of investment in EFFPs leads to low production and then less income. That sets in motion the cycle of less investment and low production and subsequently low income.

Educational Level of the Household Head

Slightly more than half (54%) of respondents had a minimum of secondary level of education, a third (33.8%) had attained up to primary level of education while 11.9% had no formal education (Table 3). The results were further tested to establish if a significant relationship exists between the highest level of formal education attained by the household head and adoption of EFFPs using the chi-square statistic. A chi square value of 62.060 with a corresponding p value of (0.0001) was obtained (Table 3). The p value obtained is less than 0.05 which implied a significant relationship between the highest level of formal education attained by the household and the adoption of EFFPs.

Table 3: Highest Educational Level Attained by the Household Head

Educational Level	Frequency	Percent
Post-secondary	84	20.9
Secondary	134	33.3
Primary	136	33.8
No formal education	48	11.9
Total	402	100.0

This finding is consistent with observations by Asrat, *et al.,* (2004, Tenge, *et al.,* 2004, Bodnár, *et al.,* 2006, and Anley, *et al.,* 2007) who associated higher level of education with higher adoption rates. This positive relation can be attributed to the fact that higher education levels do infer a greater capacity for adopters to learn and decide about new technologies. This implies that environmental education and higher conservation efforts would be successful among highly educated people because they are more open to new ideas. Higher education levels also increases famers' creative and innovative capacity. With higher levels of education, a farmer is expected to appreciate and understand the influences and relationship between environment and agricultural practices and thereof adopt more of the EFFPs. This findin however contradicts earlier observations by other studies (Tesfaye, 2003; Rahmeto, 2007; Tigist, 2010. In his study on soil and water conservation measures in Konso Wolaita and Wello, areas of Ethiopia; Tesfaye (2003) observed that no significant relationship existed between higher adoption rates of soil and water conservation measures and higher education levels. This study acknowledges the importance of formal education in enhancing environmental conservation. The higher the advancement in education level, the higher the likelihood that they are

exposed to the intricate interactions of the environment and agriculture. Some of the household heads could have been trained in agriculture or even related disciplines.

Household's Farm Size

Four fifths of the respondents had their farm's sizes ranging between one to five acres, 12.4% of the households had land sizes between six to ten acres while 7.5% of the respondents owned over 10 acres of land (Table 4). Essentially majority of the households in the study area are small holder farmers.

Table 4: Farm Size Holdings by Households

Farm Size (Acres)	Frequency	Percent
1-5	322	80.1
6-10	50	12.4
Over 10	30	7.5
Total	402	100.0

Chi square test was conducted to test the relationship between farm size holding by households and adoption of EFFPs. A chi square value of 35.459 with a corresponding p value of 0.0001 was realised. Since the obtained p value was less than 0.05 (Table 1), a statistically significant relationship was deemed to exist between farm size and adoption of EFFPs. This indicated a tendency of households on relatively bigger farm sizes to adopt more EFFPs than households on smaller farm sizes. These findings are consistent with earlier observations by Kasenge (1998, Uaiene, *et al*., 2009) and Mignouna, *et al*, (2011. Melesse 2018) too, avers that adoption of new agricultural technologies correlates positively with land size. Those in support of the positive relationship between farm size and adoption advance two reasons: first, return on investment is faster and stable in

larger farm sizes. Second, is that larger farm sizes have the advantage of more land to carry out more trials (Carlisle, 2016).

Other scholars however have differed with the positive relationship between farm size and adoption of agricultural technologies. Carlisle (2016) argues that small holder farmers can identify a problem of soil degradation faster than large holder farmers, therefore small holder farmers adopt more than farmers with large sizes of land.

Age of the Household Heads

About half (51%) of the respondents were aged between 41-50 years. Forty percent of the respondents were over 50 years of age while the youthful and energetic segment (31-40 years) constituted a paltry 8% of the respondents. A negligible 1% of the respondents were the youngest respondents aged between 20-30 years (Figure 1). These were the youthful farmers who had ventured into farming.

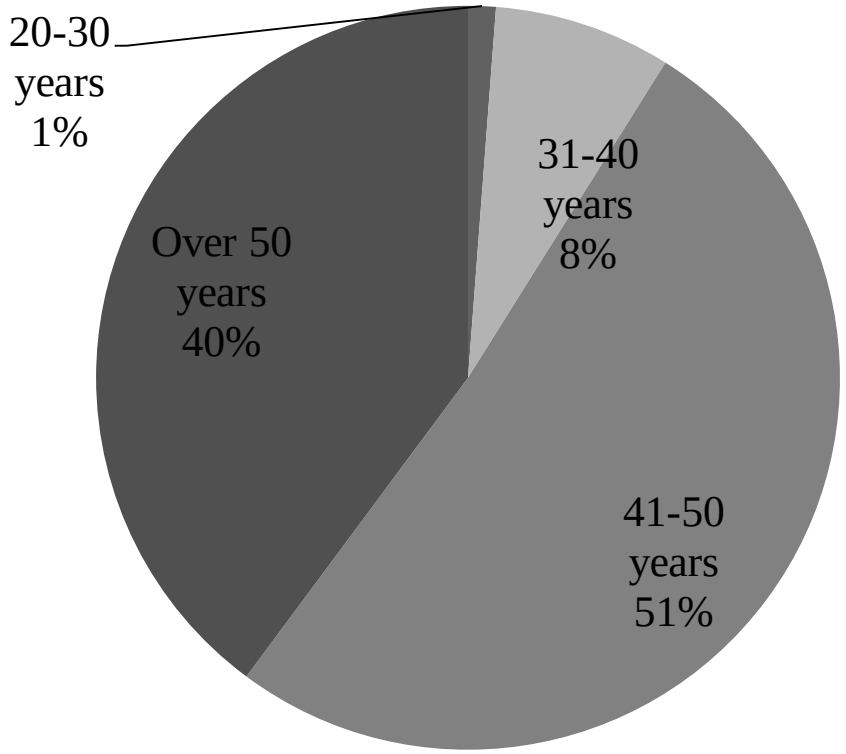

Figure 1. Age of the Household Heads

The age of the household heads was examined against the adoption status of EFFPs (adopted once, adopted more than once and those who have never). The greatest proportion of the adopters as found among household heads aged between 41-50 years. The least of the adopters were aged over 50 years (Table 5).

Table 5: Adoption Status of Eco-Friendly Farming Practices by Age

Age of the Respondents	N	Status of adoption (%)		
		Never	Adopted once	More than once
20-30 Years	5	0 (0)	1 (20%)	4 (80%)
31- 40 Years	31	0 (0)	4 (13.0%)	27 (87.0%)
41-50 Years	206	0(0)	18 (8.7%)	188 (91.3%)
Over 50 Years	160	7 (4.4%)	94 (58.8%)	59 (36.9%)
Total	402	7		

To test on the relationship between the age of the household head and adoption of EFFPs, chi square test was run. A chi square value of 15.798 with a corresponding value of 0.0001 was obtained.

The p value obtained was less than 0.05 (Table 1), therefore a statistically significant but negative relationship exists between age of the household head and adoption of EFFPs in Embu County.

This corroborates observations by Bijesh, *et al*., (2018) who found out that age of the farmer had a significant, but negative, effect on conservation practices. However, the findings contrast the findings by Tigist (2010) who found a positive relationship between age of the farmer and adoption of conservation practices. The study avers that more adoption of EFFPs is likely to be found among younger and energetic household heads while the elderly were not likely to adopt more EFFPs. The younger household heads

(also likely to be educated) were more receptive to new technologies hence their higher adoption of EFFPs.

Farming Experience of the Household Head

A fifth (20.6%) of the respondents had a farming experience spanning between one to 10 years; slightly more than half (51.7%) of the respondents had between 11 to 20 years of farming experience. More than a quarter (27.6%) had over 20 years of farming experience (Table 6). Therefore, more than three quarters (79.3%) of the households had over ten years in farming. This is substantially a long period of time for a household to have learnt and evaluated new technologies. Farming experience is a household characteristic representing the time spent in undertaking farming activities. The household heads over time can evaluate the success and failure in crop production.

Table 6: Farming Experience of the Household Head

Farming experience (Years)	Frequency	Percent
1-10	83	20.6
11-20	208	51.7
Over 20	111	27.6
Total	402	100.0

To test whether a significant relationship existed between farming experience and adoption of EFFPs, chi-square test was carried out. A chi square value of 34.064 with a corresponding p value of 0.0001 was realised (Table 1). Since the p value obtained was less than 0.05 at 5% significance level, the study showed a statistically significant but negative relationship between adoption rates and farming experience

This contrasts what Kidane (2001), Melaku (2005, Yishak 2005) had earlier observed that households with longer farming experience had accumulated knowledge and skills in farming which enabled them to adopt EFFPs faster. Similarly, Mahdi (2005) observed a statistically significant mean difference in the farming experience between adopters and non-adopters of improved sorghum varieties in Ethiopia.

The study found out that the more experienced households adopted more EFFPs than households with fewer years of farming experience. The length of time a household is involved in farming activities serves as a learning forum. The more experienced households over time can evaluate success and failures of technologies and practices. This made the more experienced households to adopt more. For example, a household that has long adopted composting, in realising the high yields might be willing to adopt other EFFPs.

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