INFLUENCE OF LAND TENURE AND FARMER INCOME ON ADOPTION OF INDIGENOUS AGRICULTURAL PRACTICES IN CHUKA SUB-COUNTY, KENYA

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ABSTRACT
Indigenous agricultural practices (IAPs) are environmentally and agriculturally sustainable. Among the widely applied IAPs include crop rotation, agroforestry, intercropping, organic manure application, and minimum tillage. A lot of research has been conducted to reveal the determinants of adoption levels of modern technologies among smallholder farmers. However, little literature exists on factors that contribute to improved adoption of IAPs in Kenya. The research was aimed at determining the influence of land tenure and level of farm income on the adoption levels of IAPs in Chuka Sub-County. A descriptive correlational design was utilized to guide data collection and analysis. The study targeted a population of 22,400 smallholder farmers involving a sample of 100 participants selected through stratified sampling from Mugwe, Karingani, and Magumoni Wards. A semi-structured questionnaire was utilized as a data collection tool. A pilot study was conducted in Muthambi Ward to aid in the checking and improvement of validity of the research instrument. Hypothesis testing involved use of ANOVA and t-tests. The results indicated that land tenure had a significant large effect on the adoption of IAPs, $F(2, 97) = 6.59$, $p = 0.002$, $\omega^2 = 0.10$. Farm income had a significantly moderate effect on the adoption of IAPs $t(97.00) = 4.57$, $p < .05$. The adoption level of IAPs was still moderate given the low frequency of application by many smallholder farmers. The County Government and Ministry of Agriculture should give sufficient support to farmers, strengthen land tenure systems, and sensitize farmers on the importance of IAPs so as to increase the adoption.
Keywords: Agricultural extension, Farm income, Land tenure, Sustainable adoption

INTRODUCTION

Many of the agriculturists around the world have recognized that modern farming systems are unsustainable. Hence, farmers have largely embraced indigenous agriculture that is organic in nature and comprise practices that endure thousands of years (El-Siddig and El-Tohami, 2017). Indigenous agriculture is more apt for developing countries as it requires low technical skills and investment. Agriculture in sub-Saharan Africa is primarily rainfed (Harris and Orr, 2014). This form of agricultural production is highly vulnerable to climate change impacts (Valverde et al., 2015). This is coupled with land degradation and loss of soil fertility (Mongi et al., 2010). Indigenous agriculture is crucial to preserving biodiversity and mitigating climate change (Sharma et al., 2020).

Indigenous agriculture is crucial to preserving biodiversity and mitigating climate change (Sharma et al., 2020). The indigenous agricultural practices (IAPs) will not only strengthen sustainability index in agriculture, but also protect the environment, reduce land degradation, and mitigate soil fertility deterioration (Lal, 2015). Among the IAPs widely applied include crop rotation, intercropping, agroforestry, organic manure, and minimum tillage (Baudron et al., 2015). Indigenous agricultural practices are thought to be of low cost and have higher efficiency in the sense of more returns for a lower input level hence, suitable for a broad group of farmers (Pittelkow et al., 2015). The adoption of IAPs also leads to the improvement of soil health and productivity through organic matter increase, in-soil water conservation, and soil structure (Lal, 2015).

There is increasing evidence that land tenure regimes and farm income play a fundamental role in the use of natural resources such as land (Mulimbi et al., 2019). Environmental degradation crises arise from poorly organized land tenurial arrangements and low income (Clover and Eriksen, 2009; Shahzadi et al., 2019). Where property rights are non-existent, the environment is likely to be overexploited as climate vulnerability impact is borne by the community as a whole while the benefits accrue to the individual (Mulimbi et al, 2019). Low income earners are predisposed to adopting modern practices which are faster in boosting crop yield however, the practices are destructive to the soils (Richardson, 2015). For sustainable crop yield, there is need for farmers to adopt IAPs which are able to ensure a balance between soil nutrient input and output (Nkomoki et al., 2018). Studies on land tenure systems and adoption of technologies are few (Ngotho and Kangu, 2016). Even though a lot of studies have been conducted to indicate the socio-economic determinants of adoption levels of modern technologies in Kenya, up to date there is little or no empirical evidence relating land tenure and farm income to the adoption of IAPs. The study determined if the said factors enhance or hinder the adoption of IAPs in Chuka Sub-County, Kenya.

Purpose of the Study

The study was aimed at examining the contribution of land tenure and farmer income towards adoption of IAPs among farmers.

Research Objectives

The specific research objectives were to:

1) Determine the effect of farmers' level of income on adoption of IAPs
2) Examine the influence of land tenure on adoption of IAPs among smallholder farmers

Research Hypotheses

$H0_1$: Low and middle annual income earning farmers do not differ significantly based on adoption of IAPs

$H0_2$: Farmers producing crops on leased, land owned with, and without title deed did not differ significantly based on adoption levels of IAPs

METHODOLOGY

Study Population

The study was undertaken in Chuka sub-county, Kenya. The sub-county is located in Tharaka-Nithi County with a longitude of 37.6546°E and latitude of 0.3229^0S (Okeyo et al., 2014). The area is located on upper midland agro-ecological zone with an altitude of about 1,500 meters above sea level. The area experiences a mean temperature of approximately 20°C and rainfall ranging from 1,200 millimeters to 1,400 millimeters per year. Rain falls in two seasons; the long rains occur from March to June whereas short rains fall between October and December. The soils are humic nitisols, deep, and fertile (Mucheru-Muna et al., 2007). The area is characterized by smallholder farmers rearing livestock; cattle, goats, sheep, and poultry while crops include; coffee, maize, beans, tea, bananas, sunflower, tobacco, and vegetables. Agriculture is the mainstay for the livelihood in the sub-county. In this area, adoption of IAPs is still low despite years of promotion, economic, and environmental benefits. However, there is little empirical evidence relating farm characteristics, land tenure and farm income to adoption of IAPs.

Data Collection

The study employed a questionnaire to collect data from the farmers applying IAPs. Content validity was determined by cross-checking the research instrument items against the study objectives. Results from the pilot study also helped in identifying errors and ambiguities in the questionnaire items. Cronbach alpha coefficient of between 0.68 and 0.84 for the instrument items were realized indicating that the instrument was internally consistent. Land tenure and farm income had a higher coefficient ($\alpha = 0.84$) while adoption of IAPs had a coefficient of 0.68. Table 1 shows the reliability coefficients of instrument items.

Table 1. Reliability coefficients of research instrument items (N =18)

Items	No. of items	Cronbach's Alpha
Farm income[a]	6	0.84
Land tenure[b]	4	0.84
Adoption of IAPs[c]	5	0.68

Note. [a], [and b] = Independent variables, c = Dependent variable; a, and b = 1= strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = strongly agree; [c] = 1 = Not at all, 2 = Very low, 3 = Low, 4 = High, 5 = Very high.

Data Analysis

Independent samples t-test was conducted to find out if low income earning farmers differed significantly with middle income earning farmers on the adoption of IAPs. The t-test, the assumption of homogeneity of variance was checked using Levene's test. The Levene's test statistic was significant, $F = 6.72$, $p = 0.01$ suggesting that the assumption was violated; therefore, the results of equal variances not assumed were utilized. A one-way analysis of variance was conducted to determine if farmers with leased, owned with title deed and without a title deed differed significantly on adoption of IAPs. The assumptions of normality and homogeneity of variance were checked. The Levene's test statistic showed that the assumption of homogeneity of variance had been met, Levene's statistic $(2, 97) = 1.86$, $p = 0.16$.

RESULTS AND DISCUSSION

The research involved 100 farmers where 60 (60%) were male and 40 (40%) were female. This showed that a majority of farmers in the area were men. The farmers' ages ranged from 24 to 80 years ($M = 47.11$ $SD = 13.71$). Most of the farmers had secondary education ($n = 50$, 50%) although a few had no formal education ($n = 9$, 9%). The mean annual income ranged from Kshs 10,000 to 400,000 (M = Kshs 62,820, SD = 58176.16). This implied that many of the farmers were low income earners.

Adoption of IAPs

Various IAPs have been shown to be common among smallholder farmers owing to the fact that the practices are locally developed and less expensive compared to modern technologies. The most commonly practices include crop rotation, mulching, intercropping, application of organic manure, and minimum tillage. The adoption of IAPs was assessed through regularity of application. A five-point Likert-type scale covering frequencies; 1 = not at all, 2 = very low, 3 = low, 4 = high, 5 = very high, was utilized. Table 2 shows the descriptive statistics for adoption of IAPs in Chuka.

Table 2. Descriptive Statistics for Adoption of IAPs[a] (N =100)

Practice	M	SD
Crop rotation	4.01	0.88
Intercropping	3.92	0.75
Agroforestry	3.73	0.76
Organic manure application	3.41	0.88
Minimum tillage	2.69	0.81

Note: [a] = 1= Not at all, 2 = Very low, 3 = Low, 4 = High, 5 = Very high

As presented in Table 2, Crop rotation was the most common applied practice (M = 4.01, SD = 0.88). This may have resulted from the benefits associated with the practice as opposed to sole cropping (Lundy et al., 2015). Many farmers intercropped staple cereals and legumes on the same piece of land (M = 3.92, SD = 0.75). Intercropping contributed to the maintenance of soil fertility resulting in better crop yield. Farmers stated that intercropping was an ancient practice that helped to meet environmental and economic sustainability (Duchene et al., 2017). Although, agroforestry promoted interactive benefits of combining trees, shrubs, crops, and livestock, it was occasionally practiced (M = 3.73, SD = 0.76). Farmers practicing agroforestry stated that the practice was profitable, healthy, and a productive land use system (Thorlakson and Nuefeldt, 2012).

The strong winds that had damaged crops such as bananas enticed farmers to establish agroforestry trees to act as windbreaks, promote organic matter formation, and prevent soil erosion (Jose and Bardhan, 2012). Organic manuring (M = 3.41, SD = 0.88) and minimum tillage (M = 2.69, SD = 0.81) were rarely practiced even though the farmers rearing goats, chicken, and cattle (Adesope et al., 2012). This may have been occasioned by the perception that animal manures contain less nutrients and slow release of nutrients as compared to inorganic fertilizers. A few of the farmers who used organic manure reported to have applied it alongside synthetic fertilizers. Minimum tillage involved the application of herbicides to kill weeds, mulching, crop rotation, slashing, burning, and early planting (Marenya et al., 2017).

However, farmers stressed that reduced tillage operations had promoted soil organic matter formation, reduced costs of production, maintained soil structure, and improved soil fertility (Grabowski et al., 2016; Rochecouste et al., 2015).Table 3 indicates adoption scores computed based upon the summated Likert-type items of the five IAPs. The adoption scores ranged from 12 to 26 (M = 17.76, SD = 2.72). The results indicated that about half of the farmers moderately (n = 42, 42%) applied the IAPs. This indicated that the IAPs were not being utilized by many farmers (n = 58, 58%) even though the practices are less expensive and largely depend on indigenous knowledge.

Level of Income and Adoption of IAPs

Objective one sought to determine the effect of farmers' level of annual income on adoption of IAPs. The level of annual income was measured using two values; 1= low income and 2 = middle income while adoption was assessed by scoring frequency of application of IAPs. Table 4 indicates the farmers' annual income in Kenyan shillings.

Table 3. Distribution of farmers by the adoption scores (N = 100)

Adoption Scores	Freq. (f)	Percent (%)
12 – 14	14	14
15 – 17	29	29
18 – 20	42	42
21 – 23	14	14
24 – 26	1	1

Note. M = 17.76, SD = 2.72

Table 4. Distribution of farmers by the annual income (N = 100)

Annual Income	Freq. (f)	Percent (%)
18000 – 154400	83	83
154401 -290800	10	10
290801 – 427200	3	3
427201 – 563600	2	2
563601 – 700000	2	2

Note: M = Kshs. 112,610, SD = 115903.56.

A majority of farmers were low income earners (n = 83, 83%) and this may have affected the adoption of IAPs as demonstrated by previous studies (Njeru, 2016; Briggs and Moyo, 2012; Mlenga and Maseko, 2015). Based on the finding, it can be taken to mean that a majority of the farmers in the Sub-county are poor. Descriptive statistics for income and adoption are indicated in Table 5.

The results in Table 5 indicate that IAPs took long to generate income thus a discouragement to farmers to apply the practices (M = 4.36, SD = 0.99). In addition, the income ensued from the utilization of IAPs was low (M = 4.22, SD = 0.55). Farmers observed that the adoption of the IAPs was largely dependent on the income (M = 3.98, SD =1.21) and its source (M = 3.84, SD = 1.11). Most of farmers had low disposable income and this dissuaded the drive to apply the practices (M = 3.21, SD =1.22).

An independent samples t-test was performed to test the hypothesis one and results were as shown in Table 6.

Table 5. Descriptive statistics for income and adoption of IAPs (N =100)

Statement[a]	M	SD
Agricultural indigenous practices take long to generate income	4.36	0.99
Level of income influences the type of agricultural indigenous practices to adopt	4.22	0.52
Usually, agricultural indigenous practices generate low income	3.98	1.21
Adoption of agricultural indigenous practices is influenced by the type of source of income	3.84	1.11
I lack an incentive to adopt agricultural indigenous practices due to low disposable income	3.21	1.22

Note. [a] = 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Table 6. Descriptive and t-test statistics for level of income by adoption scores[a] (N = 100)

Variable	N	M	SD	T	P
Low income earners	98	17.73	2.74	4.57	<0.05
Middle income earner	2	19.00	0.00		

Note: [a] = 1- 20; p = 0.05.

As shown in Table 6, middle income earning farmers applied IAPs (n = 2, M = 17.73, SD = 2.74) more than low income earners (n = 98, M = 19.00, SD = 0.00). This difference, -1.27, 95% CI [1.81, -0.72], was significant t (97.00) = 4.57, $p < 0.05$. The level of farmer income had a medium effect on adoption of IAPs, d = 0.46 (Cohen, 1992). This may have affected the adoption of IAPs since income has been found to correlate with the uptake of farming technologies (Njeru, 2016; Briggs and Moyo, 2012).

Land Tenure and Adoption of IAPs

Objective two sought to examine the influence of land tenure on adoption of IAPs among smallholder farmers. Land tenure is the act, right period of holding land. It was classified into three groups namely leased, owned with a title, and owned without a tittle deed as shown in Table 7. Almost half (n = 48, 48%) of the farmers involved in the study owned land with title deeds. Land ownership is necessary for effective adoption of IAPs (Rao et al., 2016). This showed that many of the farmers would implement long-term investment in the farm and also grow perennial crops as a result of land tenure security. Few farmers farmed on the plots under leasehold (n = 4, 4%). Farmer used a particular piece of land for a given period of time at a rent fee while land owners without title deed often operated on communal land. In some cases, farmers would allocate a part of the piece of land to the sons for farming, this would be described as ownership without a title deed. Table 8 shows descriptive statistics for land tenure and adoption of IAPs.

As presented in Table 8, many of the farmers disputed the claim that there was no need to adopt IAPs since the benefits are long term IAPs (M = 2.76, SD =1.45) and on leased land (M = 1.78, SD = 0.85). Most of the respondents disagreed with the statement that land ownership insecurity compelled farmers to use chemical fertilizers to maintain soil fertility, hence low adoption of IAPs (M = 2.48, SD = 1.36). The farmers doubted the assertion that lack of title deed discouraged farmers from adopting IAPs (M = 2.11, SD = 1.18). A majority of the farmers disagree with the statement that the lack an incentive to adopt IAPs on a leased plot due to tenure insecurity (M = 1.55, SD = 0.72).

A one-way ANOVA was conducted to determine the influence of land tenure on adoption of IAPs. As presented in Table 9, the levels of land ownership had a significant large effect on adoption of IAPs, $F(2, 97) = 6.59$, $p = 0.002$, $\omega^2 = 0.10$ (Kirk, 1996).

Table 7. Distribution of Farmers by the Kind of Land Ownership (N =100)

Land ownership	Freq. (f)	Percent (%)
Leased	4	4.0
Owned with title deed	48	48.0
Owned without title deed	48	48.0

Table 8. Descriptive statistics for land tenure and adoption of IAPs (N =100)

Statement	M	SD
I see no need to adopt agricultural indigenous practices since the benefits are long term	2.76	1.45
Land ownership insecurity compels me to use chemical fertilizers to maintain soil fertility, hence low adoption of agricultural indigenous practices	2.48	1.36
Lack of title deed for small farm discourages me from adopting agricultural indigenous practices	2.11	1.18
I see no need to adopt agricultural indigenous practices since the land is leased.	1.78	.85
I lack an incentive to adopt agricultural indigenous practices on a leased plot due to tenure insecurity.	1.55	.72

Note. [a] = 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Table 8. Descriptive statistics and ANOVA results for land ownership and adoption of IAPs[a] (N =100)

Variable	N	M	SD	F	p
Leased	4	20.25	1.26	6.59	0.002
Owned with title deed	48	18.46	2.67		
Owned without title deed	48	16.85	2.55		

Note: [a] = 1-25; $\omega^2 = 0.10$.

Planned contrasts revealed that leasing land significantly increased the adoption of IAPs compared to owning land without a title deed $t(97) = 3.05$, $p = 0.003$, $r = 0.29$. However, owning land with a title deed did not significantly increase adoption of IAPs compared to owning land without a title deed, $t(97) = -1.97$, $p = 0.052$, $r = 0.20$. Even though it was expected that the adoption levels of IAPs would be lower as land renters were fewer. Land renters are often concerned with short-term returns than long-term land value improvement (Deaton et al., 2018). The aim is to produce maximum yields from the rented land thus this incentivize the farmers to embrace practices that would aid in attaining the target. The lack of land ownership would deter farmers who did not own land with title deeds to invest in long term enterprises that would require adoption of such practices as IAPs. Lack of land ownership may have prohibited the farmers from accessing credit as title deed is used as collateral (Tenaw et al., 2009). Inadequate knowledge, access to extension and low farm incomes may have deterred farmers with freehold land to adopt IAPs.

CONCLUSIONS AND IMPLICATIONS

The adoption of IAPs in the sub-county was low due to inadequate access to extension, land ownership that may have affected decision making in the farm, and annual farm income. The annual farm income was found to be a major factor in the adoption of IAPs. Middle income earning farmers had adopted IAPs more than low income earning. The low annual income may have resulted from low adoption of practices and poor farming methods. Land tenure emerged as a significant predictor of adoption of IAPs. Three land ownerships forms were reported in the sub-county namely owned without title deed, owned with a title, and leased land. Leased land ownership was found to have the utmost influence on adoption of IAPs. This was driven by the desire to maximize returns from the rented land. Land ownership with and without a title deed had no significant influence on adoption of the practices.

The farmers who owned land with no title deed were discouraged from making long term investment on the land as the farmers felt insecure. A few of the farmers who owned land with title deeds engaged in the application of IAPs as the practices had long term benefits. Farmers engaging in subsistence agriculture should commercialize the farm enterprises. The County Extension Department need to sensitize farmers on the importance of IAPs, for the reason that IAPs are locally developed and cheaper to acquire. Indigenous agricultural practices are environmentally and agriculturally sustainable hence, promote soil structure and fertility. County government should facilitate the registration of land to enable farmers without title deed to use them as collateral to secure funds for agriculture.

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