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The Role of Extraneous Incentives and Drivers in Farm Enterprise Diversification: A Study of Passion-Fruit (*Passiflora edulis*) Uptake in Uasin-Gishu County, Kenya

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Abstract: Despite the continued production and overdependence of maize and wheat (traditional crops) as main source of income in Uasin-Gishu County, poverty among farmers has been increasing. To mitigate the poverty effects, farmers have tended to substitute land under the traditional crops for high yielding and high value crops, passion fruit inclusive. However, the uptake of passion fruit has been achieved with partial success. This study determined the extent of passion fruit adoption, factors affecting the adoption and its extent. Cross-sectional data from 100 randomly selected farmers were collected and subjected to Heckman two-step regression analysis to determine factors affecting passion fruit adoption as well as the extent of adoption. The results show that availability of water for irrigation (marginal effect = 0.481), title deeds (marginal effect = 0.316) and farming as main occupation (marginal effect = 0.486) significantly and positively affected the adoption of passion fruit while age (marginal effect = 0.009) was significant with negative effect. Private land ownership and access to extension services significantly and positively influenced the extent of adoption while age had significant negative effect. The results mean more incentives and innovative drivers are necessary for crop diversification and substitution in Kenya and not sufficient for adoption of the new crops. Government and other stakeholders should formulate and implement effective policies related to promotion of adoption, production and marketing of new agricultural technologies.

Key words: Adoption, farm enterprise diversifications, high value, high yielding, traditional crops

INTRODUCTION

In Kenya, agriculture is the main source of food and income for the majority of rural small-scale farmers, and those in Uasin-Gishu County are no exception. About 80% of the farmers in the County are small-scale owning less than 5 acres of land and depend mainly on agriculture as source of livelihood (Jayne *et al*., 2001). Maize and wheat have traditionally been relied upon by the farmers in the county as main source of food and income. Unfortunately the continued production and overdependence on these crops have not been beneficial to the smallholder farmers due to low incomes associated with them. As results of this, many farmers have remained net zero sellers in almost all the past production seasons. The increasing land sub-division and cost of production among other factors have resulted to low farm incomes and consequently the growth of poverty among majority of the farmers in the County (Jayne *et al*., 2001; Nyoro *et al*., 2004). The farmers face high cost of production due to escalating fertilizer, seed and fuel prices and relatively low output prices. For example in the case of maize production in the year 2008, the average production cost per acre increased by 50%. At the same time land preparation cost rose by 75% per acre while labor cost per worker per day rose by 100%. The cost of a 50 kg bag of Diamonium Phosphate (DAP) fertilizer rose by 111.11% (Kariuki, 2008).

To improve the low farm incomes and consequently reduce the growing poverty, the farmers have gradually diversified their farming activities by adopting high value and yielding crops. Passion fruit is one of such horticultural crops adopted and several farmers are practicing crop trade-off. That is, they substitute land under grain-crops such as wheat and maize for the passion fruit production. According to Gockowski and Michel (2004), horticultural crops are high yielding and have high market value but labour intensive in production. Anderson (2003) argues that horticultural crops have high market value and yields more and regularly and hence suit the needs of smallholder farmers who face resource constraint and have no marketable surplus. To improve adoption of the high value and yielding crops, Kenya Horticultural Development Program (KHDP) has initiated programmes that offer extension services on production and marketing of passion fruit as incentives.

Despite the adoption and commercialization of passion fruit in Kenya in 1933 and 1960, respectively (Morton, 1987), the rate and extent of adoption is perceived to be low. According to KHDP (2006), only

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about 1,500 out of 166,635 farmers in Uasin-Gishu Country have managed to adopt passion fruit. Therefore, this study was done with KHDP to determine factors affecting passion fruit adoption, extent of passion fruit adoption and factors affecting the extent of passion fruit adoption in Uasin-Gishu County.

MATERIALS AND METHODS

Study area: The study was done in Uasin-Gishu County between the month of July and August, 2009. Uasin Gishu County was selected because that was where KHDP programme was based and also an interest in passion fruit production was growing among farmers. The County covers a total area of 3327.8 km^2 and projected population is about 771,536 people. It has a population density of 232 per km^2. Approximately 2603.2 km^2 of the total area is arable land while 218 km^2 is land under water, swamps, rocks and hills. Urban areas cover about 196 sq km and current total land under agricultural production is 134,490 ha (Baraza *et al*., 2008). The County is located in the high potential (>1,800 m) and low potential (<1,800 m) agro-ecological zones. The high potential zone generally receives more rainfall over a longer period of time than the low potential zone. Rainfall ranges from 500 to 1,000 mm in low potential zones and 1,200 mm to 1,800 mm in high potential zones. The average annual rainfall is between 900 to 1,200 mm/year.

Data and sampling design: Multi-stage sampling procedure was used. First, Uasin-Gishu County was purposively selected because that was where KHDP program was based. Within Uasin-Gishu County, Moiben and Ainabkoi divisions were purposively selected because that was where an interest in passion fruit production was growing at that time. In each division, 5 locations were randomly selected to give a total of 10 locations. Each location was stratified into two groups of farmers: those who adopted passion fruit and non-adopters to give a total of 20 strata. From each stratum, 5 farmers were randomly selected to give a total sample of 100 farmers (50 passion fruit adopters and 50 non-adopters). Passion fruit farmers were randomly selected from the list of passion fruit farmers obtained from KHDP Eldoret offices. Primary data were collected using a structured questionnaire. Data on physical, institutional and socio-economic factors, output and input quantities as well as their respective prices were captured.

Analysis: Adoption of the new technologies normally involves two stages: The decision to either adopts or not and in the second stage involves how much of the new technology to adopt or use (or extent of adoption) (Mercer and Pattanayak, 2003). The decision to either adopt passion fruit or not in this study was built on utility maximization framework so that, the decision to adopt passion fruit or not depends on whether passion fruit gives the farmer higher utility than the existing technology. The decision to either adopts passion fruit or not is dichotomous and therefore, binary choice model was identified as appropriate for such estimation. However, this is only possible if the following assumptions are only observed:

- The households are faced with only two alternative choices
- Any choice an individual choose depends on their characteristics

The expected net utility derived from adopting or not adopting new technology given farmer's characteristics was determined as follows:

$$Eu_iA = f(Wi)+e_i$$
$$Eu_iN = f(Xi)+e_i \quad (1)$$

where, Eu_iA is the expected net utility of household *i* from adopting passion fruit and Eu_iN is the expected net utility of household *i* from not adopting passion fruit. *A* denotes passion fruit adopted while *N* denotes passion fruit not adopted. X_i and W_i are independent variables denoting technology, farm, institutional and household characteristics and e_i is an error term. The expected net utility from each of the decisions is then compared. To compare, Y_i was used as an indicator of whether household *i* adopted passion fruit or not, so that Y_i=1 if adopted and $Y_i = 0$ if not as indicated in Eq. (2).

$$Y_i = 1 \quad \text{if } Eu_iA\text{-}Eu_iN > 0$$
$$Y_i = 0 \quad \text{if } Eu_iA\text{-}Eu_iN < 0 \quad (2)$$

The interpretation of Eq. (2) is that, the probability that the household *i* adopts passion fruit is the probability that the expected net utility derived from adopting passion fruit is greater than the expected net utility derived from not adopting passion fruit. The decision to either adopt passion fruit or not and extent of adoption are dependent variables and were estimated simultaneously. Heckman two-step procedure was identified as appropriate for such simultaneous estimation. Heckman two-step procedure involves estimation of two equations: Selection equation in the first step and outcome equation in the second step. In this study, selection equation involves decision to either adopt passion fruit or not, while outcome equation involves the extent of passion fruit adoption per household. Previous studies show that, estimation of such relationships is normally problematic due to sample selection bias. But according to Heckman (1979), Inverse Mills Ratio (IMR) in the Heckman two-step procedure is a correction term for the selectivity bias. The equation *Z*

Table 1: Description of variables used in Heckman two-step procedure

Variable	Full definit	Description of the variables	Expectation
Typfrmer	Type of farmer (adopters and non-adopters)	Dependent variable for selection equation. (Dummy)	None
Extent	Extent of adoption (proportion of total land allocated to passion fruit per household)	Dependent variable for outcome equation (Proportion of land allocated to passion fruit production)	None
Fbusines	Combination of Farming and Business as an occupation	Farmers with off-farm activities	(-/+)
Ageyrs	Age in years	Age of household head	(+/-)
Individ	Individual land tenure	Farmers with title deeds	(+)
Gnder	Gender	Sex of the household head	(+/-)
Extbfore	Number of extension contacts per year	Accessibility to agricultural extension services	(+)
Wtrirrig	Water for irrigation	Availability of water for irrigation	(+)
Lnwealth	Wealth in Kshs	Value of household assets	(+)
Dstmkt	Market distance in kilometers	Distance to the near markets in kilometers	(-/+)
Credit	Credit access	1 = access, 0 = not accessed	(+)
Pasprice	Passion fruit price in Kshs per kilogram	Price paid for passion fruit	(+)
Farmonly	Farming only as an occupation	Farmers with farming as main activity	(+)
Edulevel	Education level	Farmer's level of education	(-/+)
Farmsize	Farm size in acres	Overall farm size owned by the farmers	(+)
Hsize	Household size in numbers	The size of households sampled	(+)

(Eq. 3), which is selection equation) in the first step was estimated with a set of *W* independent variables (Socio-economic, institutional and physical factors) and error term *e* and alpha coefficients (α) were obtained:

$$Z_i = W^1{}_I\,\alpha + e_i \quad (3)$$

The *Z* was assumed to have a normal distribution, independent error term *e*, mean zero and constant variance. To determine the extent of passion fruit adoption (Eq. 4, which is outcome equation), the expected value of *Y* was modeled conditional on its being observed so that, for values of Z = 1, Y is observed. For Y observed, it was modeled with some independent variables X (Socio-economic, institutional and physical factors) and a vector of coefficients (β) was estimated:

$$Y_i = X'_i\,\beta + u_i \quad (4)$$

where, Y_i is the extent of passion fruit adoption. *Yi* was assumed to have a normal distribution, independent error term *u*, mean zero and constant variance. The two errors (*u* and *e*) were assumed to have a correlation *rho* and their joint distribution is normal bivariate. The empirical model was specified as follows: Selection equation (Probit):

$$\begin{aligned}\text{typfrmer} = {} & \beta_0 + \beta_1{}^*\,(\text{ageyrs}) + \beta_2{}^*\,(\text{lnwealth}) + \\ & \beta_3{}^*\,(\text{fbusines}) + \beta_4{}^*\,(\text{individ}) + \beta_5{}^*\,(\text{wtrirrig}) + \\ & \beta_6{}^*\,(\text{edulevel}) + \beta_7{}^*\,(\text{extbfore}) + \beta_8{}^*\,(\text{gnder}) + \\ & \beta_9{}^*\,(\text{dstmkt}) + \beta_{10}{}^*\,(\text{creditk}) + \beta_{11}{}^*\,(\text{hsize}) + \\ & \beta_{12}{}^*\,(\text{farmsize}) + \beta_{13}{}^*\,(\text{farmonly}) \quad (5)\end{aligned}$$

Outcome equation (Simple OLS):

$$\begin{aligned}\text{Extent} = {} & \alpha_0 + \alpha_1{}^*\,(\text{ageyrs}) + \alpha_2{}^*\,(\text{creditk}) + \\ & \alpha_3{}^*\,(\text{fbusines}) + \alpha_4{}^*\,(\text{individ}) + \alpha_5{}^*\,(\text{wtrirrig}) + \\ & \alpha_6{}^*\,(\text{edulevel}) + \alpha_7{}^*\,(\text{extbfore}) + \alpha_8{}^*\,(\text{pasprice}) + \\ & \alpha_9{}^*\,(\text{farmonly}) \quad (6)\end{aligned}$$

Table 1 describes the variables estimated in this study. Several studies have found that farmer characteristics, technology traits, farm traits, institutional and economic factors to be common factors determining farmer's decision to either adopt new agricultural technology or not. Increase in education level catalyzes the process of information flow and exposes farmers to a wider field of knowledge thus promoting adoption of the new technologies (Masuki *et al*., 2003; Faturoti *et al*., 2006). Akkaya (2007) found that farmer's probability of adopting new farm technologies reduces when they engage in education. The effect of age on adoption of new agricultural technologies is inconsistent.As farmers get older, they tend to intensify adoption of new technologies in their farms as a result of more years of experience, higher accumulation of capital and large family sizes (Ashenafi, 2007). Other studies found older farmers lacking receptivity towards newly introduced technologies because they are risk averse due to failure to change their old ways of doing things (Arellanes and Lee, 2003; Rogers, 2003). Unlike men, women in Africa lack access and control over production resources such as land, information, credit and labour. As a result, women's overall responsibilities affect poor households' capacity to adopt new activities especially when additional family or hired labour is not available (Langyintuo and Mulugetta, 2005; Masuki *et al*., 2003). Large households have been found to positively affect adoption of new agricultural technologies through provision of sufficient labour (Rana *et al*., 2000; Ashenafi, 2007). Large farm size affects positively adoption of agricultural technologies. It provides room for adoption and increasing

Table 2: Description of farmer's demographic characteristics

Division	Type of farmer	Variables	N	Min.	Max.	Mean	SD	t-test
Moiben	Non-passion fruit produce	Age (years)	25	22	70	43.20	15.71	0.134
		Household size	25	1	12	5.04	2.56	0.965
		Farm size (acres)	25	1	60	16.40	17.16	0.856
	Passion fruit producer	Age (years)	25	25	70	40.72	13.46	
		Household size	25	1	12	5.24	2.35	
		Farm size (acres)	25	2	40	15.01	11.39	
Ainabkoi	Non-passion fruit producer	Age (years)	25	25	72	42.20	13.91	
		Household size	25	1	10	5.76	2.20	
		Farm size (acres)	25	1	38	12.64	11.46	
	Passion fruit producer	Age (years)	25	20	70	36.40	11.55	
		Household size	25	3	12	5.60	2.02	
		Farm size (acres)	25	1.5	34	13.1	19.43	

Survey data (2009); NB: Max-maximum, Min-minimum; SD: Standard deviation

Table 3: Occupation percentage distribution by type of farmer category

Type of farmer	Occupation	Frequency	Valid percent
Non-passion fruit producer	Farmer	31	62
	Farming and business	9	18
	farmer and employed	9	18
	Student	1	2
	Total	50	100
Passion fruit producer	Farmer	36	72
	Farming and business	8	16
	farmer and employed	6	12
	Tota	l50	100
	Education level		
Non-passion fruit producer	None	1	2
	Primary	13	26
	Secondary	31	62
	College	2	4
	University	3	6
	Total	50	100
Passion fruit producers	None	0	0
	Primary	15	30
	Secondary	29	58
	College	6	12
	University	0	0
	Tota	l50	100
	Gender		
Non-passion fruit producer	Male	39	7878
	Female	11	2222
	Total	50	100100
Passion fruit producer	Male	40	8080
	Female	10	2020
	Total	50	100100

Survey data (2009)

the usage of new technologies (Ashenafi, 2007). Access to credit facilitates adoption of new agricultural technologies through increasing farmer's ability to acquire (Fernandez-Cornejo *et al*., 2002). Higher household income increases likelihood of farmers adopting new agricultural technologies (Igbokwe and Okoye, 2000; Akkaya, 2007). But according to Rana *et al*. (2000), households that receive off-farm income are less likely to pursue on-farm diversification as a method of reducing financial risk. Extension services such as field days and seminars affect positively adoption of various new agricultural technologies. Access to agricultural education and extension creates awareness on new agricultural technologies among farmers and thus increases the ability to adopt the new agricultural technologies (Onemolease and Alakpa, 2009; Chitere and Doorne, 1985). Availability and access to water for irrigation positively correlate with adoption of new farm technologies (Arellanes and Lee, 2003). Farmers who own land privately are more likely to employ new farming techniques due to security of tenure. Security of land access enables farmers to make necessary investments in their lands (Hwang *et al*., 1994). Market failure brings about high transaction costs arising from searching, negotiation and acquisition of new farming technologies. Distances near good roads and towns are used to capture differences in transaction costs involved in marketing. The higher the transaction costs involved, the lower the probability to adopt new technologies (Obare *et al*., 2003; Tshiunza *et al*., 2001). High commodity prices have been

found to significantly and positively influence the adoption of new agricultural technologies (Arellanes and Lee, 2003).

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers: t-test at 5% level of significance was done to determine equality of means for age, household size, farm size and experience between passion fruit adopters and non-adopters. The results shows that all the variables (age p = 0.134, household size p = 0.965 and farm size p = 0.856) tested had p>0.05 indicating that there was no significant difference between the passion fruit adopters and non-adopters in terms of age, household size and farm size. Table 2 shows that, mean age of passion fruit adopters was approximately 38 years while that for non-adopters ofpassion fruit was approximately 42.5 years. The means majority of the farmers were not more than 42.5 years of age in both categories.was approximately 5 people and was in line with Kenya's national mean figure of 5 members per household according to CBS (2005). Large household size positively influences adoption of new agricultural technologies through provision of sufficient labour (Faturoti *et al*., 2006; Ashenafi, 2007). Rana *et al*. (2000) further revealed that increasing farm diversification among large households was due to availability of sufficient labour capacity. The average land size for both categories of farmers in the selected area was approximately 14 acres. However, Jayne *et al*. (2001) found that majority of the farmers in the County had 5 acres. Large farm sizes have been found to have positive effect on adoption of agricultural technologies (Rana *et al*., 2000; Fernandez-Cornejo *et al*., 2002).

In terms of gender, 80% of the passion fruit adopters were male while 20% were female (Table 3). Among non-passion fruit adopters, 78% were male and 22% were female. The difference can be attributed to the fact that unlike men, women in majority of Kenyan communities have neither rights to own agricultural production majority of them attained only secondary education. Among the passion fruit adopters, those who attained primary, secondary and college education were 30, 58 and 12%, respectively. 2% of non-passion fruit adopters attained no formal education, 26% primary education, 62% secondary education, 4% middle college education and finally 6% attained university education. The low percentage of farmers who attained tertiary education can be attributed to the fact that farmers tend to engage in off-farm activities such as formal employment as education level increases (Akkaya, 2007).

Extent of passion fruit adoption: The extent of adoption was determined as proportion of land allocated to passion fruit production given overall farm size per household. The extent of adoption was then compared between the two divisions. A t-test at 5% level of significance was used to determine whether there was significant difference in theextent of passion fruit adoption between Ainabkoi and Moiben divisions. The results shows that, p>0.05 (p = 0.997) and mean difference of -0.00012 indicating no significant difference. The extent of passion fruit adoption in the two divisions was equal at 0.169 (Table 4). The overall average extent of passion fruit adoption in the

Table 4: Extent of passion fruit adoption by type of farmer and division categories

Type of farmer	Division	Variable	N	Min.	Max.	Mean	t-test
Passion fruit producer	Moiben	Extent of adoption	25	0.025	0.5	0.169	0.997
	Ainabkoi	Extent of adoption	25	0.038	0.53	0.169	

Survey data 2009

Table 5: Marginal effects of Heckman two-step selection equation

Marginal effects after Heckman					
Variable	Marginal effects	S.E.	z	p>|z|	x
Farmonly*	0.487	0.183	2.66	0.008*	0.620
Fbusines*	0.336	0.204	1.65	0.100	0.200
Ageyrs	- 0.009	0.006	- 1.77	0.077***	41.43
Edulevel	0.096	0.108	0.89	0.370	12.95
Individ*	0.316	0.159	1.99	0.046*	0.840
Extbfore*	- 0.082	0.155	- 0.53	0.596	0.270
Dstmkt	0.001	0.005	0.21	0.836	22.11
Creditk*	0.081	0.205	0.40	0.691	0.110
Gnder	- 0.055	0.174	- 0.32	0.750	1.200
Hsize	- 0.005	0.035	- 0.16	0.875	5.540
Farmsize	- 0.003	0.007	- 0.37	0.710	15.93
Lnwealth	0.085	0.085	0.99	0.320	12.31
Wtrirrig*	0.481	0.123	3.93	0.000**	0.150
_cons	- 3.944	2.589	- 1.52	0.128	
mills lambda	0.111	0.064	1.75	0.080***	
Rho	0.941				
Sigma	0.1179				

Survey data 2009; (*): Is for discrete change of dummy variable from 0 to 1; **: Indicates significance at 1%, *: Significance at 5% and ***: Significance at 10%

study area as represented by the two divisions was 0.169 or 16.9% meaning that, 16.9% of the overall farm size per household was allocated to passion fruit in both Moiben and Ainabkoi divisions.

Econometric results:

Factors affecting passion fruit adoption: Heckman two-step procedure was estimated and results are presented in Table 5 and 6. Post estimation of selection equation results was done (Table 5) to determine marginal effects of variables to ease interpretation. The reason is that coefficients have no direct interpretation because they are values that maximize the likelihood function. On the other hand, marginal effects have direct interpretation and hence facilitate discussion of the results. Age (Ageyrs), farming as main occupation (Farmonly), individual land tenure system (Individ) and availability of water for irrigation (Wtrirrig) significantly affected the decision to adopt passion fruit. The coefficient of IMR was also significant and positive (0.080) indicating that there were unobserved variables that both increased the probability of selection and a higher than average score on the dependent variable. As stated in literature, the effect of age in adoption of new agricultural technologies is inconsistent. It can either have positive or negative effect. In this case, age (Ageyrs)significantly and negatively affected the adoption of passion fruit with marginal effect of 0.009. This shows that older farmers were less receptive to adoption of passion fruit. This can be attributed to the fact that the older farmers are risk averse when compared to younger farmers. The findings concurs with those of Langyintuo and Mulugetta (2005), Arellanes and Lee However, Masuki *et al*. (2003) found older farmers more receptive towards new agricultural technologies due to adequate experience and accumulation of capital. U-rungsimawong (2000) and Ndiema (2002) in their studies found no relationship between age and technology adoption.Availability of water for irrigation (Wtrirrig) significantly and positively affected the adoption of passion fruit with marginal effect of 0.481. The farmers who accessed water for irrigation were more able to adopt passion fruit than those who did not have access to. Most parts of Uasin-Gishu County are dry especially Moiben division, and therefore availability of water for irrigation was an incentive for farmers to adopt passion fruit. The findings concurs with that of Arellanes and Lee (2003) who found that availability of water for irrigation influences positively adoption of new farm technologies due to its sustainability effect in crop production especially during dry spell season. Farming as a main occupation (Farmonly), significantly and positively affected the decision to adopt passion fruit with marginal effect of 0.486. Table 3 indicates that majority of the farmers in Uasin-Gishu County had farming as their main source of livelihood. The perceived trait of passion fruit of being a high yield and high value crop was an incentive to the farmers who depended wholly on farming to adopt it to improve their farm income. The findings concur with that of Rana *et al*. (2000) who found households receiving off-farm income less likely to pursue on-farm diversification as a method of reducing financial risk. However, Igbokwe and Okoye (2000) found off-farm activities significantly and positively correlating with adoption of rice farming technologies. The argument is that off-farm activities provide income that eventually increases ability of farmers in acquisition of new agricultural technologies . Access to land title deeds (Individ) significantly and positively influenced the adopting of passion fruit with marginal under leasehold and community land tenure systems This shows that security in land use is an incentive thus increasing farmer's willingness to acquire new agricultural technologies. Studies by Arellanes and Lee (2003) and Hwang, *et al*. (1994) confirms that farmers with title deeds were more likely to employ more of new techniques due to security f land access.

Factors affecting the extent of passion fruit adoption: Table 6 presents Heckman two-step outcome equation results. Three variables (age, access to extension services and individual land tenure system)significantly affected the extent of passion fruit adoption.

Individual land tenure system (Individ) significantly and positively influenced expansion of passion fruit production. Those farmers with full rights of land ownership and usage were more able to increase the production of passion fruit in terms of acreage. Private land ownership with title deeds gives farmers right to use

Table 6: Dependent variable - Extent of passion fruit adoption

Variables	Coefficients	S.E	z	p>|z|
Farmonly	0.089	0.097	0.93	0.354
Fbusines	- 0.001	0.088	- 0.02	0.987
Ageyrs	- 0.004	0.002	- 2.51	0.012*
Edulevel	- 0.007	0.033	- 0.20	0.840
Pasprice	- 0.0001	0.002	- 0.07	0.948
Individ	0.139	0.066	2.11	0.035*
Extbfore	0.094	0.040	2.32	0.020*
Dstmkt	- 0.0002	0.001	- 0.18	0.854
Credit	- 0.067	0.055	- 1.21	0.225
cons	0.074	0.241	0.31	0.759

*Means variable is significant at 5%

the land for anything at anytime (security of tenure) thus creating an incentive to the farmers to adopt more of a new, long term and even riskier technologies. The findings concurs with that of Arellanes and Lee (2003) who found farmers owning plots privately four times more likely to employ new techniques as a result of access to land security regarding its usage. Age (Ageyrs) significantly and negatively influenced expansion of passion fruit production. The reason behind this was that unlike younger farmers, older farmers were resistant to change. Unlike younger farmers, older farmers are preoccupied by several off-farm activities and thus less receptive to new agricultural technologies. The finding concurs with that of Arellanes and Lee (2003). However, Ashenafi (2007) and Masuki *et al*. (2003) found older farmers intensifying adoption of new agricultural technologies as a result of more years of experience, higher accumulation of capital and large family sizes. Access to extension services (Extbfore) offered by the KHDP as an incentive significantly and positively affected the expansion of passion fruit production. Extension agents supply farmers with important information and skills on production, management and marketing. The availability of relevant and adequate information reduces the risk associated with crop production and thus an incentive to the expansion of passion fruit production. It has been found that, farmers in contact with extension agents or those with first-hand technical information are more likely or willing to pay more for the new crop-related innovations than those with no contact. (Qaim and de Janvry, 2003; Onemolease and Alakpa, 2009; Chitere and Van Doorne, 1985 and Omonona *et al.*, 2005). Nonetheless, Tshiunza *et al*. (2001) have found a negative relationship between extension visits and adoption of bananas.

CONCLUSION AND RECOMMENDATION

The t-tests showed that there was no significant difference between passion fruit adopters and non-adopters in terms of socio-economic and institutional characteristics facing them. That is, $p>0.05$ for all the factors captured. This indicated that passion fruit adopters had no comparative advantage of adopting passion fruit over the non-adopters of passion fruit in terms of incentives and drivers of technology adoption facing them. Farming as main occupation, access to land title deeds and water for irrigation were significant and positively influenced the decision to adopt passion fruit. Access to extension services and land title deed significantly and positively influenced the extent of passion fruit adoption. Age significantly and negatively affected the decision to adopt passion fruit and the extent of its adoption. This can be reversed through increasing agricultural education among older farmers to expose them to the importance of adopting new agricultural technologies. It is clear that if government can provide land title deeds, increase the number of agricultural extension officers and water supply for irrigation to the farmers in rural areas will facilitate adoption and expansion of not only passion fruit production but also other new agricultural technologies. The extraneous incentives provided by KHDP and other drivers of technology adoption were necessary but not sufficient for passion fruit adoption because the current extent of passion fruit adoption is low at 16.9% of the overall farm size per household allocated to passion fruit.

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