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Impact of the World Food Programme's (WFP) Purchase for Progress (P4P) pilot project on farm incomes in Kenya: Case of Uasin Gishu and Narok Counties

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The World Food Programme's Purchase for Progress Pilot project in Kenya has been under implementation since 2009 but its welfare impacts are not well understood. In this paper, a propensity score matching method is employed to evaluate the impact of the Purchase for progress project on household farm incomes in Uasin Gishu and Narok counties in Kenya. The findings from this study indicate that the farmers' decisions to participate in the Purchase for Progress project were significantly influenced by; gender of the household head, farm size, and price of maize, access to extension and access to credit. The results also indicate that the project participants had a higher gross margin per acre per year than the non-project participants. Additionally, the findings show that the project had a positive impact on the participant farmer's incomes. This information can assist the policy makers in formulating policies which improve the likelihood of farmer's participation in development based projects, whose objectives are to increase the farmer's income, thus such policies should be enacted by the government.

Keywords: Purchase for Progress (P4P), World Food Programme (WFP), Propensity Score Matching (PSM), Impact assessment, Gross margin

INTRODUCTION

The World Food Programme (WFP) is the food assistance arm of the United Nations (UN) and it is the world's largest humanitarian agency. WFP assists about 90 million people per year with food in over 70 countries in the world. Its main responsibilities include analysis of food security, procurement, logistics, nutrition and emergency responses (WFP, 2008). Through a 2009 programme referred to as Purchase for Progress (P4P), WFP expects to move smallholder farmer groups from informal to structured trade so that they can earn the higher margins that accompany selling high quality food. P4P is a programme implemented by the WFP in 21 countries in parts of Africa, Central America and Asia. In Africa the countries include Burkina Faso, Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mali, Mozambique, Rwanda, Sierra Leone, Sudan, Tanzania, Uganda and Zambia. In Asia the countries are Afghanistan and Laos. In Latin America the

countries include El Salvador, Guatemala, Honduras and Nicaragua.

The Purchase for progress builds on WFP's activities by reaching out to smallholder farmers through three approaches; direct contracting, forward contracting and pro-smallholder competitive tendering. The targeted P4P market entry points to the smallholder farmers are through farmers' organizations, small-scale traders (collectors), medium-scale traders, small scale processors and commodity exchange. In Kenya, the five-year pilot P4P project was implemented in 2009 and completed in 2013. The P4P project focuses largely on small scale farmers organized into self-help groups such that buying directly from these groups, the programme demonstrates the advantages of structured trade and provides a secure market outlet for farmer

organizations, working with partners to build their capacities to increase production, improve quality and bulk commodities for commercial markets.

The P4P project in Kenya works closely with the Ministry of Agriculture through District Agricultural Officers (DAO) and partners such as Cereal Growers Association (CGA), Agricultural Market Development Trust (AGMARK), and the Academic Model Providing Access to Health (AMPATH) project, Kenya Agricultural Commodity Exchange (KACE), farmers and agro-dealers with the potential to supply food to WFP.

The partners are actively engaged in assisting farmers to meet WFP quality requirements and develop their capacity to participate in market. Kenya's P4P project was approved by the United Nations World Food Programme board of directors in December 2009 although the implementation started in the first quarter of the same year. The targeted areas for the P4P project implementation plan were in Eastern Province (Mwingi, Machakos, Kitui, Makueni, Tharaka and Mbeere districts); Rift valley Province (Transmara, Bomet, Trans Nzoia and Uasin Gishu) and Western Kenya (Siaya, Kakamega and Bungoma). The project registered the farmer organization groups which had a capacity of supplying 56 Metric Tonnes (MT) of a particular commodity.

According to a P4P Kenya case study (2010), the P4P project was successfully implemented in Rift valley province and Western Kenya because the areas have a good agro-ecological zone for maize production (high maize yields) which met the amount of stock required by the WFP. Additionally, the farmers had good storage facilities where they kept their produce before sale thus reduced post-harvest losses. However, the P4P project implementation failed in Eastern Kenya due to the unfavorable climate (low rainfall amounts) which resulted into low maize production (poor yields) which did not meet the WFP's stock target in Eastern Kenya. Moreover, these farmers lacked adequate storage structures and had low confidence with the contracts due to the long procurement procedures leading to delays in payment.

In 2012, about 5,000 farmers organized into farmer organizations were trained on group marketing, quality improvement, post-harvest handling and resource mobilization along with 200 traders and agro-dealers. Around 70 farmer organizations and 30 traders are registered as WFP vendors under P4P. Some of these farmers' organizations and traders had been contracted for delivery of food commodities such as maize, sorghum, beans, cowpeas and pigeon peas. The available evidence suggests that these vendors (farmers and traders) have benefited by selling commodities as a group by accessing inputs and cash loans (Annual Review Report, 2010). However, the project has faced numerous challenges mainly associated with contract defaults. For instance, in the Rift Valley Province, participating P4P farmer organizations contributed less

than 50 percent to P4P maize stocks.

The low participation of farmer organizations in P4P were attributed to WFP's long procurement processes which delayed product procurement from collection points thus late payments, poor yields due to erratic rainfall, lack of adequate storage facilities, and low confidence (in P4P) due to farmers' previous experiences with National Cereals and Produce Board (NCPB)'s delays in payments. Other challenges included lack of clear information on commodities to be purchased by WFP and poor record keeping especially due to lack of bank accounts. However, some progress has been made by farmer organizations in improved access to inputs where some farmers have accessed loans from banks using WFP contracts through their organizations; improved access to credit by Farmer organizations for aggregation, enhanced capacity building of farmers and agro-dealers through training on post-harvest handling and group marketing.

Even though the project has been in operation since 2009 with reported achievements and challenges in Kenya, the welfare impacts of the project remain largely unknown. Therefore, there is need for empirical evidence to ascertain whether P4P has triggered increases in agriculture productivity, improvements in post-harvest handling and changes in marketing choices. This study attempts to shed light on the welfare effects of the project by assessing the differences in farm incomes between P4P participants and non-participants using the gross margin analysis; and evaluating the welfare impacts of the P4P project on farm incomes using the Propensity Score Matching (PSM) method in Uasin Gishu and Narok Counties in Kenya. The findings are useful in informing policy making especially by government, development partners, researchers and the farming community in Kenya, other parts of Africa and the world.

METHODS

Study site and data

This study was conducted in Narok (Transmara district) and Uasin Gishu Counties (Eldoret East district) in Kenya. Transmara district is located in Narok County, in the south western part of Rift Valley province. It consists of five administrative divisions namely; Kilgoris, Pirrar, Lolgorian, Keyian and Kirindon. The district's topography ranges from 1800m to 1950m. The population of the district is about 170,726 persons with a density of 58 persons per square kilometer and 32,000 households. The district has annual temperature ranges from 14.8°C to 20.3°C with the highest temperatures during the month of January to March and lowest (10.5°C to 15.5°C) during the months of June to August. It receives a bimodal type of rainfall pattern of an average of 1500 mm with the highest rainfall being 2300

mm and lowest being 700 mm which in normal years is well distributed throughout the year.

Uasin Gishu County has three constituencies namely Eldoret East, Eldoret North and Eldoret south constituencies. The study was done in Eldoret East district which has five divisions; Ainabkoi, Kapsaret, Kesses, Moiben, Soi and Turbo. It covers an area of 187 square kilometers with a density is 267 persons per square kilometers and a population of 894 179 persons. The district is characterized by two rainy seasons with an average rainfall of 900mm to 1200mm per annum. The temperature ranges from a minimum of 8.4 degrees celcius to a maximum of 27 degrees celcius. The county is characterized by arid and fertile farmland, flat parched plains and steep ridges. The main agricultural activities are; large scale maize farming and dairy farming.

A combination of purposive, stratified and simple random sampling procedures were used to select 113 participants and 137 non participants of the P4P project (a total of 250 respondents) in the two counties. The two counties were purposively selected for the household survey since they were among the few counties where P4P project was implemented by the WFP since 2009. The farmers in the list were then identified by their divisions, locations and villages and randomly selected from each village (stratified by P4P participation). This list formed the sampling frame for the project participants.

The non-P4P farmers were randomly sampled from a list of the non-participants which was obtained from the District Agricultural Office with their divisions, locations and villages. The total number of farmers interviewed in Eldoret district (Uasin Gishu County) was 126 where 57 farmers were participants and 69 farmers were non participants. In Transmara district (Narok County) a total of 124 farmers were interview, with 56 participants and 68 non-participants.

Theoretical framework and Econometric Model specification

The participation in projects is mainly based on choice experiments by many authors where the project reflects a new technology (Hagos *et al.* 2006). According to McFadden (1973), choice experiments share the same theoretical framework with dichotomous-choice contingent valuation in the Random Utility Model (RUM). According to this framework (RUM), the farmer's objective is to maximize utility. According to Thurston (1972), a household is assumed to maximize a welfare - enhancing factor which is the utility.

This study therefore is based on the random utility model (RUM) which was proposed by Thurstone (1972). RUM posits that the utility U that individual i gains from participating in project j is made up of an observable

deterministic component V (of observable attributes) and a random component. In this regard, the random utility function is represented as (Greene, 2003):

$$U_{ij} = V_{ij} + \varepsilon_{ij} \dots\dots\dots 3.1$$

In this study, an individual i is assumed to maximize his/her utility from a given project j if the utility derived from participating in that project (U_{ij}) is greater than that derived from participation in an alternative project (U_{ik}). Thus, project j will be chosen over some other alternative project k iff ($U_{ij} > U_{ik}$). The utility derived from participation in a project is assumed to depend on the attributes of the project X_j and the attributes of the individual Z_i (Maddala, 2001). However, these attributes may be viewed differently by different agents, whose socio-economic characteristics, Z_i , will also influence or affect utility. Thus, an individual may not choose what seems to the analyst as the preferred alternative. To explain such variations in project choice, a random element, ε , is included as a component of the participants' utility function. Therefore, equation 3.1 can be illustrated as follows (McFadden, 1973):

$$U_{ij} = V(X_j, Z_i) + \varepsilon_{ij} \dots\dots\dots 3.2$$

Given a choice set C made up of different projects, the probability that individual i will choose to participate in project P_j over another project P_k is as illustrated in equation 3.3 (Gujarati, 1995), where ξ is the sum of the two random error terms (ε_j and ε_k):

$$\begin{aligned} \Pr[j | C] &= \Pr[U_j > U_k], \forall j \in C \dots\dots\dots 3.3 \\ &= \Pr[(V_j + \varepsilon_j) > (V_k + \varepsilon_k)] \\ &= \Pr[(V_j - V_k) > \xi] \end{aligned}$$

Furthermore, assumptions must be made over the distributions of the error terms. A typical assumption is that the errors are independently, identically and normally distributed (McFadden, 1973). The difference between the net benefits derived from the project by participants and non-participants denoted as I^* are observable but the utility obtained from the net benefits after participating in the project are not observable. If the net benefits are greater than zero ($I^* > 0$), it follows that the net benefits from participation are greater than those from non-participation. Therefore, the net benefit (I^*) can be expressed as a function of the observable characteristics in the following latent model as shown in 3.4 (Greene, 2003) where Y_i^* is a dichotomous latent variable that equals 1 for household in case of participation in project j (i.e., $Y_i^* = 1$) and 0 otherwise ($Y_i^* = 0$); β is a vector of parameters to be estimated, Z_i is a vector of household, farm level and institutional characteristics and ε_i is assumed to be a normally distributed error term as shown below:

$$Y_i^* = \beta Z_i + \varepsilon_i \text{ iff } Y_i^* = (Y_i^* > 0) \dots\dots\dots 3.4$$

The probability of a farmer participating in the project is based on the underlying utility that the farmer obtains from the participation decision in the project (Todd, 1995) as shown in equation 3.5; where F is the cumulative distribution function of Y^* . Models such as probit and logit usually result from assumptions made on the functional form of F . The probit and logit models assume a normally distributed and a logistically distributed error term respectively. The logit model is often preferred due to its consistency in parameter estimation associated with the assumption that the error term has a logistic distribution (Ravallion, 2001, Baker, 2000) and is thus presented as followed:

$$\Pr(Y_i^* = 1) = \Pr(Y_i^* = 0) = \Pr(\varepsilon_i > \beta X_i) = 1 - F(-\beta X_i) \dots\dots\dots 3.5$$

According to Greene (2003), the generic logit model is motivated as follows:

$$P_i = P(Y = 1|X) \dots\dots\dots 3.6$$

Following Pindyck and Rubinfeld (1981), the cumulative logistic probability function is as illustrated by equation 3.7 where, e is the base of natural logarithms; X_i is the i th explanatory variable; P_i is the probability that an individual participates in P4P; α and β_i are parameters to be estimated.

$$P_i = F(Z_i) = F(\alpha + \sum_{i=1}^m \beta_i X_i) = \frac{1}{1 + e^{-(\alpha + \beta_i X_i)}} \dots\dots\dots 3.7$$

The interpretation of coefficients for the logit regression model is easier if the logistic model can be written in terms of the odds ratio (Greene, 2003). The odds ratio implies that the ratio of the probability that an individual is a participant (P_i) to the probability that he/she is not a participant ($1 - P_i$).

Following Greene (2003), the probability that the individual will not be a participant is defined by equation 3.8 or 3.9 as shown below:

$$(1 - P_i) = \frac{1}{1 + e^{z_i}} \dots\dots\dots 3.8$$

or

$$\frac{P_i}{1 + P_i} = \left(\frac{1 + e^{z_i}}{1 + e^{-z_i}} \right) = e^{z_i} \dots\dots\dots 3.9$$

Alternatively, equation 3.9 can be rewritten as follows in 3.10 (Pindyck and Rubinfeld, 1981):

$$\frac{P_i}{1 + P_i} = \left(\frac{1 + e^{z_i}}{1 + e^{-z_i}} \right) = e^{e^{(\alpha + \sum \beta_i X_i)}} \dots\dots\dots 3.10$$

Taking the natural logarithms of equation (3.10) gives the logit model as indicated below in equation 3.11 (Greene, 2003) where Z_i is the dependent variable or the probability of participation in P4P; X_i is the vector of observable covariates of the household; α and β_i are parameters to be estimated; and μ_i is the disturbance term:

$$Z_i = \ln \left(\frac{P_i}{1 - P_i} \right) = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} \dots \beta_m X_m \dots\dots\dots 3.11$$

The logit model shown in equation 3.11 is used to assess the probability of participation in P4P which generates the propensity scores (first step) used in the PSM model to evaluate the impact of P4P on smallholder farm incomes in Kenya.

Propensity score matching method

PSM is used to match participants and non-participants in P4P in order to create a plausible counterfactual (Rosenbaum and Rubin, 1983). The PSM is used to match a treated individual with a control individual based on similarities in all observable characteristics except the treatment in order to compute the difference in the outcome variable (Rosenbaum and Rubin, 1983).

The expected treatment effect for participating in P4P project is the difference between the actual income and the income of farmers who did not participate in the project. Farmers' participation in a project is a dichotomous choice which is influenced by the two groups - participants and non-participants. Assessing the impact of participation in a project on a series of outcomes is equivalent to assessing the causal - effect (difference between the outcome of the participants and non-participants) of the program on those outcomes (Gertler et al., 2011). According to Rosenbaum and Rubin (1983), this Average treatment of the treated (ATT) relationship is given by equation 3.12:

$$ATT = E \left(Y_{i1} - \frac{Y_{i0}}{P_i} = 1 \right) \dots\dots\dots 3.12$$

where Y_{i1} denotes the income when the i -th farmer participates in P4P; Y_{i0} is the income of i -th farmer when s/he does not participate in P4P; and P_i denotes the probability of P4P participation where one means participation and zero otherwise.

The ATT is the mean impact conditional on P4P participation. According to Rosenbaum and Rubin (:

1983), the mean difference between observable and control group is given as shown in equation 3.13

$$D = E\left(\frac{Y_1}{P_i} = 1\right) - E\left(\frac{Y_0}{P_i} = 0\right) = ATT + \varepsilon \dots\dots\dots 3.13$$

where $\left(\frac{Y_1}{P_i} = 1\right)$ is the treated (P4P participants) while $\left(\frac{Y_0}{P_i} = 0\right)$ is the control group (non-P4P participants) ε is the bias given by equation 3.14:

$$\varepsilon = E\left(\frac{Y_0}{P_i} = 1\right) - E\left(\frac{Y_0}{P_i} = 0\right) \dots\dots\dots 3.14$$

The true parameter of ATT is only identified if the outcomes of the treatment and control are the same (Rosenbaum and Rubin, 1983) and can be illustrated as equation 3.14:

$$E\left(\frac{Y_0}{P_i} = 1\right) = E\left(\frac{Y_0}{P_i} = 0\right) \dots\dots\dots 3.15$$

Estimation of the ATT on the treated group using matching methods relies on two key assumptions: (i) that of conditional independence (unconfoundedness) and (ii) that of common support (overlap condition)(Gertler et al., 2011).

The PSM method is based on the conditional independence or unconfoundedness assumption, which states that the researcher should observe all variables that simultaneously influence the participation decision and outcome variables (Caliendo and Kopeinig, 2008). This implies that selection into the treatment group is solely based on observable characteristics.

The conditional independence (unconfoundedness) is a strong identifying assumption which has to be met for the results of the PSM to be valid (Caliendo and Kopeinig, 2008). To solve this problem, the propensity scores are estimated in order to test the sensitivity of the estimated results with respect to deviations from this identifying assumption of conditional independence.

The common support is the area where the balancing score has positive density for both treatment and comparison units. According to Rosenbaum and Rubin (1983), there should be an overlap between the treatment and non-treatment groups in order to make matches which can estimate the average treatment effects on the ATT parameter. This problem of matching is solved by constructing a counterfactual which is done by constructing the control group(non-participants) to compare with the treated group.

Following Ali and Abdulai (2009), the basic relationship for evaluating the impact of participation in the P4P project on farm household income, which is a linear function can be identified as follows in equation 3.16:

$$Y^* = a + bX_i + cR_i + \varepsilon_i \dots\dots\dots 3.16$$

where Y^* denotes the net benefits (in this study refers to gross margin), R_i is a dummy variable that takes the value 1 if farmer i participates in P4P project and 0 otherwise; X_i is a vector of control or independent variables such as the farmer characteristics discussed earlier for the logit model; a is a constant, b measures the impact of P4P on mean returns; c is the average treatment effect or the treatment effect on the treated and ε_i is the error term which is normally distributed. Under the assumption of homogeneous treatment effects, b identifies the impact of P4P project on mean output of the farmers. The definition of the hypothesized independent variables affecting participation in P4P project and their expected signs are presented in Table 1.

Table 1: Definition of Variables in the empirical model_ logit model

Variable	Nature of the variable	Expected sign
Dependent Variables		
P4P participation	Dummy (Participates=1, does not participate=0)	Logit
Farm income	Farm income in Kenya Shillings	PSM
Explanatory Variables		
Age of the respondent	Age in years	+/-
Education level of the Household head	Years of formal education	+
Gender of the Household head	Dummy (Male=1, Female=0)	+/-
Access to credit	Dummy (yes=1, otherwise=0)	+
Household Size	Number of household members	+/-
Farm size	Acres	+
Price of maize(90kgs)	Amount in Kshs	+
Access to extension	Dummy (yes=1, otherwise=0)	+
Distance to P4P store	Measured in Kilometers (Km)	-
Group Membership	Dummy (Belong to a group=1 Otherwise=0)	+
Main Occupation	Dummy (Farming=1 Employed=2 Business=3 Other specify=4)	+

Source: Author's computation

RESULTS AND DISCUSSION

Descriptive results (socio-economic characteristics)

Table 2: Socio-economic characteristics of study respondents

Variable		PARTICIPATION				POOLED (TOTALS)		Chi square test
		P4P (n=113)	%	NON P4P (n=137)	%	n=250	%	
Gender	Male	73	64.6	109	79.6	182	72.8	51.984**
	Female	40	35.4	28	20.4	68	27.2	
Occupation	Formal employment	3	2.7	5	3.6	8		437.680**
	Business	13	11.5	23	16.8	36	14.4	
	Farming	96	85.0	108	78.8	204	81.6	
	Others	1	0.8	1	0.7	2	0.8	
Group Membership	Yes	108	95.6	8	5.8	116	46.4	1.296
	No	5	4.4	129	94.2	134	53.6	
Extension Access	Yes	105	92.9	87	63.5	192	76.8	71.824**
	No	8	7.1	50	36.5	58	23.2	
Credit Access	Yes	55	48.7	33	24.1	88	35.2	21.904**
	No	58	51.3	104	75.9	162	64.8	

* ** *** denote significance at 10 percent, 5 percent and 1 percent respectively.

Source: Author's computation

The results of the socio-economic attributes of the surveyed households as illustrated in Table 2 indicate that; 65 percent of the P4P farmers were male while 35 percent were female while 80 percent of non-P4P farmers were female and 20 percent were male and the chi square test of difference in frequencies indicated that the gender of the two groups was significantly different ($\chi^2 = 51.98$, $p < 0.05$). Households were also involved in different occupations where among the P4P farmers; 85 percent were farmers, 3 percent were formally employed, 12 percent were in business while 5 percent were in other small occupations. Among the non-P4P households, 79 percent were farmers, 4 percent were formally employed, 17 percent were in business while 5 percent were in other smaller occupations and the chi-square difference in frequencies between all the occupations showed that the two were statistically different at 1 percent ($\chi^2 = 437.68$, $p < 0.05$).

Moreover, 96 percent of the P4P farmers belonged to a farmers' organizations while 94 percent of the non-P4P farmers also belonged to farmers groups but the difference was not significant ($\chi^2 = 1.30$). About 93 percent of the P4P farmers had access to extension while 64 percent of the non-P4P farmers had access to extension and the difference was significant ($\chi^2 = 71.80$). Additionally, 49 percent of P4P farmers had access to credit compared to 24 percent of the non-P4P and the difference was statistically significant ($\chi^2 = 21.90$, $p < 0.05$).

The mean differences (Table 3) between the P4P and non-P4P participants are illustrated in Table 3. The mean age for P4P farmers was 44 years while that for non-P4P farmers was 42 years and the mean difference was not statistically significant ($t\text{-stat} = 1.36$). The average household size for the P4P participants was 7 persons which was the same for non-P4P farmers and the mean difference was not statistically significant ($t\text{-stat} = -1.59$).

The average number of years of formal schooling for the P4P farmers was 8 while that for non P4P farmers was 9 and the difference in means was not statistically different ($t\text{-stat} = -1.591$). The average distance to the P4P store was 13km for the P4P farmers and 11 for the non-P4P farmers and the difference in means was not statistically significant ($t\text{-stat} = 1.401$). The results show that the mean average maize price for the P4P farmers was 3034 Kenya shillings while the non-P4P was 2851 and the mean difference was significant at 5 percent ($t\text{-stat} = 3.85$). The mean yield of the P4P farmers was 20 90-kilogram bags per acre while the non-P4P had 17 90-kilogram bags per acre and the mean difference was significant at 5 percent ($t\text{-stat} = 2.82$). The P4P farmers had a mean farm income of 36,954 Ksh/acre/year, while non-P4P farmers had a mean of 29,640 Ksh/acre/year and the mean difference was statistically significant at 5 percent ($t\text{-stat} = 8.89$). The mean land size for the P4P participants was 10 acres while that of non P4P participants was 14 acres and the mean difference was not statistically significant ($t\text{-stat} = -1.04$).

Table 3: Mean differences between P4P AND Non P4P participants

Variables	Pooled N=250	P4P N=113	Non P4P N=137	Standard Deviation (pooled)	Mean differences	t-stat	Min (pooled)	Max (pooled)
Age (years)	43	44	42	12.40	2.16	1.36	19	78
HHsize -persons	7	7	7	3.33	-0.21	-1.59	1	25
Years of schooling	9	8	9	4.35	-0.88	-1.59	0	22
Farm size (acres)	12	10	14	23.46	-3.07	-1.04	1	200
Price	2934	3034	2851	384.16	182.91	3.85**	1800	4500
Yield(bags/acre)	19	20	17	7.57	2.82	2.98**	3	119
Gross margin/ Farm income: Kshs/acre/year)	32,946	36,954	29,640	7,553.14	7313.55	8.89**	13,574	49, 299
Distance to the market (Kms)	12	13	11	11.91	2.12	1.37	2	52

*, **, *** denote significance at 10 percent, 5 percent and 1 percent respectively

Source: Author's computation

Results of the Maximum Likelihood Estimates of the Factors influencing farmers' participation in P4P project

The logit model results (Table 4) showed that the gender, farm size, price, access to extension and credit were statistically significant. The price of maize, access to extension and access to credit positively and significantly influenced the decision of the farmers to participate in the P4P programme while gender and farm size negatively but significantly influenced participation. The price per bag of maize positively and significantly influenced farmer's participation in P4P project ($p=0.0002$) and the marginal effect on price shows that an increase in price by one percent increases farmer's probability of participating in P4P project by 0.2 percent due to the guaranteed high price by the P4P project and thus a ready market for their maize produce.

Access to extension positively and significantly influenced farmer's participation in P4P programme ($p=0.000$) which meant that the farmers who had better access to extension services were more likely to participate in the P4P project due to the good extension programs which help the farmers acquire knowledge and skills. Access to credit significantly and positively influenced farmers' participation in P4P project ($p=0.010$). This means that the farmers who had better access to credit were more likely to participate in the P4P project because credit eases the cash constraints and therefore farmers can afford the tools and materials needed for the implementation and sustenance of the projects.

The gender's negative coefficient implies that the probability of participation in P4P project for the female farmers is higher by 24 percent than for the male

farmers which may be true due to the fact that female farmers were more actively involved in the activities of the farm as well as the farmer's organizations, as opposed to male farmers. The farm size negative but significant influence implies that the larger the farm size, the less the farmers were likely to participate in the project which may be attributed to the fact that farmers who have large farm sizes had very high maize yields which could not be sold only through the farmers' organizations but also sold to different markets. (Table 4 here.)

Results of the PSM model

The PSM model impact results using the NNM, KBM and RM methods are illustrated in Table 5. The results show that the P4P farmers had a higher level of farm income (gross margin in Kenya Shillings per acre) than the non P4P farmers in all the three algorithm methods. The difference in the ATT's is positive in the three algorithms which implies that the impact of participating in P4P project resulted in an increment of the farmer's farm income by (Kshs / acre/ year) 7245.22, 7160.57 and 6974.14 using NNM, KBM and RM matching algorithms respectively. The results further show that the difference in the ATT's of the three algorithms are statistically significant at 10 percent (Table 5) which supports the argument of Caliendo and Kopeining (2005) that the three algorithms should yield the same results with slight differences for accurate impact results .

Table 4: Maximum Likelihood Estimates of the Factors influencing farmers' participation in P4P project

Variable	Maximum likelihood estimates				Marginal effects	
	Coefficient	S.E	t-stat	p-value	Coefficient	p-value
Age	0.005	0.14	1.393	0.736	0.001	0.736
Education	-0.007	0.040	-1.566	0.866	-0.002	0.866
Gender	-0.990***	0.354	-2.629	0.005	-0.242	0.005
Access to credit	0.812***	0.319	4.112	0.011	0.199	0.010
Household size	0.068	0.056	1.048	0.224	0.016	0.224
Farm size	-0.016*	0.021	-1.041	0.053	-0.004	0.053
Price of maize	0.002***	0.0004	3.849	0.0002	0.0003	0.0002
Access to extension	1.887***	0.441	6.145	0.000	0.388	0.000
Distance to market	0.021	0.014	1.365	0.133	0.005	0.113
Main occupation	0.274	0.315	1.207	0.385	0.067	0.385
Constant	-7.244***	1.839	3.94	0.000		

*, **, *** denote significance at 10percent, 5percent and 1percent respectively

Source: Author's computation

Pseudo $R^2 = 0.204$; $LR\chi^2 (p - value) = 69.88 (0.000)$.

Hosmer-Lemeshow $\chi^2 (10) = 8.92$ Prob $>\chi^2 = 0.5401$

Table 5: Comparison of treatment effect results using the NNM, KBM and RM

Matching algorithm	Sample	Treated	Control	Difference	Std error	T stat
	Unmatched	36,953.94	29,674.53	7,279.40	847.96	8.58
NNM	ATT	36,953.94	29,674.53	7,245.22	1,213.94	5.97**
	ATU	29,674.53	36,291.51	6,616.97		
	ATE			6,903.23		
KBM	ATT	36,953.94	29,793.36	7,160.57	1,035.43	6.92**
	ATU	29,674.53	36,581.70	6,907.16		
	ATE			7,022.63		
RM	ATT	36,953.94	29,240.48	6,974.14	1,308.56	7.13**
	ATU	29,694.53	36,134.98	7,037.95		
	ATE			7,008.87		

Source: Author's computation

Propensity score histogram

A propensity score histogram which is used to test the validity or performance of the propensity score matching estimation by verifying the common support or overlap condition (Bryson *et al.*, 2002) was also generated as shown in Figure 1. The propensity score graph shows that all the treated individuals had a suitable match (on support), therefore, no treated individuals did not have a match (off support) indicating

that all the individuals that participated in the P4P programme (treated group) found a suitable match (on support) among the non-P4P participants (control group). Both the treated and untreated groups are skewed on opposite directions, an indication that the common support assumption was achieved. Therefore, the results indicate that the sample was well matched and the assumption of common support condition was well

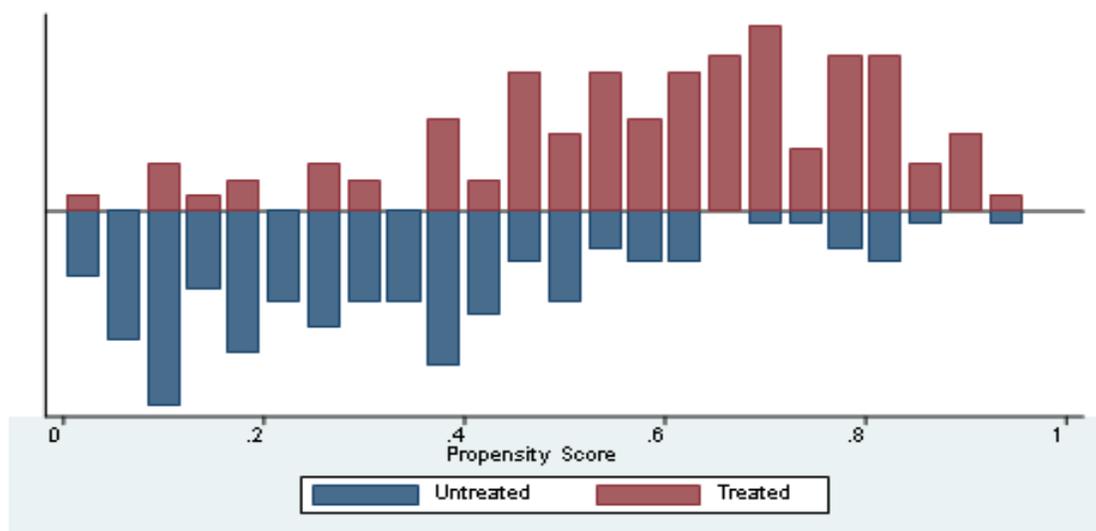


Figure 1: Propensity score histogram. Source: Author's computation

attained which confirms one of the PSM assumptions (Baker, 2000).

The diagnostic tests conducted for logit model were tests for multicollinearity, heteroskedasticity, and goodness of fit. The PSM model results were preceded by tests for; covariance balancing, quality matching, validity and sensitivity analysis for hidden bias

CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the impact of the WFP's P4P project on farmer's income using the propensity score matching in Uasin Gishu and Narok Counties. The study utilized primary data collected from a baseline household survey of 250 respondents in Eldoret East and Transmara district conducted in May 2012. The two counties were purposively selected where 113 P4P farmers were stratified by participation in the P4P project and the households randomly selected from the villages. Additionally, 137 non-P4P farmers were sampled from a list of non-participants from the District Agricultural offices in the two counties and randomly selected from the villages. Secondary data on empirical studies and the study areas were obtained from impact study journals and the Ministry of Agriculture respectively.

The findings from this study show that the P4P farmers had higher maize yields than the non-P4P farmers. This can be attributed to the benefits of extension services and credit access gained by the P4P farmers from the P4P project. The extension and credit services are mainly offered by the project's partners such as the AMPATH, CGA, KACE and Ministry of Agriculture among others. These partners link the small scale farmers to

partner-supported private sector agro dealers who provide inputs, production expertise, and output marketing services. The high yields have largely contributed to the farmer's food security.

Moreover, the average maize price was higher for the farmers who sold through the P4P project to the WFP than the non-P4P farmers who sold to other market types. The findings were that the P4P project offered stable maize prices. These prices encouraged the P4P farmers to produce more due to the certainty of the pre-determined maize prices. This promoted collective marketing as well since the P4P farmers were marketing their produce through their farmers' organizations. However, the non-P4P farmers to market their produce to other markets faced the challenges of market uncertainty especially due to price fluctuations.

The welfare analysis showed a positive impact of the P4P project on farmer's incomes. This is because there was a sizable increase in the farm income (gross margin) owing to participation in P4P programme which reflected a significant improvement in the welfare of the farmers. The positive impact of the P4P programme on farmer's farm income implies that farmers should be encouraged to participate in such project. It could therefore be concluded that the P4P project has also created a market for agricultural produce and inputs through collective marketing by farmers and agro-dealers respectively with the potential to supply food to WFP. The partners are also actively engaged in assisting farmers to meet WFP quality requirements and develop their capacity to participate in market.

The results showed that there were no significant differences in household demographic characteristics between the P4P participants and non-P4P participants.

The price and yields of the P4P farmers were higher than those of the non-P4P participants. The income of the P4P farmers was higher than that of non-participants. The P4P project had a positive impact on the farmer's income which leads to conclusion that participation in P4P had effect on farm household income in Eldoret East and Transmara districts. Finally, the significant income gain has significantly improved the welfare of the participants especially in terms of food security.

The findings of this study have very important policy implications. Policies which improve the likelihood of farmer's participation in development-based projects such whose aim is to better the farmer's income such as the P4P programme should be established by the government. These policies include improving credit, access to inputs and extension access to all farmers. Moreover, policies which improve the market infrastructure such as encouraging farmers to market collectively should be enacted by the government as well as the P4P programme partners such as CGA, KACE and Ministry of Agriculture among others. The policies should emphasize on improved storage structures, good procurement and logistics as well as formation of farmer's groups or organizations in order to enable the farmer's to access alternative markets for better prices to better their farm incomes.

REFERENCES

- Abdulai A. (2010). Socioeconomic Characteristics and Obesity in Underdeveloped Economies: Does Income Really Matter. *Applied Economics*, Vol. 42(2):157-169.
- AIEI. (Africa impact evaluation initiative) (2010). Impact evaluation methods. - *Working Paper Series*. 12th August, 2012. <http://go.worldbank.org/J35S3J8B60>
- Ali, A. and A. Abdulai. (2010). The Adoption of Genetically Modified Cotton and Poverty Reduction in Pakistan. *Journal of Agricultural Economics*, Vol. 61(1): 175-192
- Alston, J.M., M.C. Marra, P.G. Pardey, and T.J. Wyatt. (1998). Research returns redux: A meta-analysis of the returns to agricultural R&D. *EPTD Discussion Paper No, 38*. Washington D.C.: International Food Policy Research Institute.
- Baker. J. (2000). Evaluating the Impact of Development Projects on Poverty. "A handbook of Evaluation". *The World Bank Economic Review*, Vol.15(1): 115-140
- Barbara S. (2009). Propensity score matching. Institute for Fiscal Studies, University College London. 14TH August, 2012. London, United Kingdom. <http://www.esrc.ac.uk>
- Becerril, J. and A. Abdulai. (2010). The Impact of Improved Maize Varieties on Poverty in Mexico: A Propensity Score Matching Approach. *World Development*, Vol. 38(7): 1024-1035.
- Bourguignon, François, and Francisco H. G. Ferreira. (2003). "Ex Ante Evaluation of Policy Reforms Using Behavioral Models." In *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*, ed. François Bourguignon and Luiz A. Pereira da Silva, 123–41. Washington, DC: World Bank and Oxford University Press.
- Bradshaw, B., Dolan, H., Smit, B. (2004). Farm-level adaptation to climatic variability and change: crop diversification in the Canadian prairies. *Climatic Change*, Vol. 67 (1): 119–141.
- Bryson A., Dorsett R. and Purdon. S. (2002). The use of propensity score matching in the evaluation of labor market policies. *Working Paper No. 4, Department for Work and Pensions*. John Adam street, London. ISBN 1 84388 0431.
- Buddelmeyer H. and Skoufias. E. (2004). An evaluation of the performance of Regression Discontinuity Design on PROGRESA. *World Bank Policy Research Working Paper 3386, ZA. Discussion Paper 827*, World Bank, Washington, DC.
- Caliendo M. and Kopeinig. S. (2005). Some Practical Guidance for the Implementation of Propensity Score Matching. *IZA Discussion Paper, no. 1588. Bonn, Germany: IZA*
- Croppenstedt, A., Demeke, M., and Meschi, M. (2003). Technology adoption in the presence of constraints: the case of fertilizer demand in Ethiopia. *Review of Development Economics* Vol. 7 (1), 58–70.
- Davis, K., Nkonya, E., Kato, E., Mekonnen, D., Odendo, M., Miiro, R., and Nkuba, J. (2010). Impact of farmer field school on Agricultural Productivity and Poverty in East Africa. *IFPRI Discussion paper 00992*, June 2010.
- Dehja, R. H. and Wehba, S. (2002). "Propensity Score Matching for non-experimental causal studies" *The Review of Economics and Statistics*, Vol. 84 (1):151–161.
- Gebreaweria Gebregziabher and Regassa E. Namara. (2010). Investment in irrigation as a poverty reduction strategy: Analysis of small scale irrigation impact on poverty in Tigray, Ethiopia. Norwegian University of Life Sciences (UMB), N1432, Norway; and Mekelle University, Ethiopia International Water Management Institute, *Africa Regional Office, Accra, Ghana*.
- Gertler, P., Martinez, S., Premand, P., Rawlings, L., and Vermeersch, C. (2011). Impact Evaluation in Practice. @2011 The International Bank for Reconstruction and Development/World Bank. 1818 H Street NW, Washington DC.
- Gilligan, D., Hoddinott, J., and Taffesse. A. (2008). The impact of Ethiopia's Productive Safety Net Programme and its linkages. International Food

- Policy Research Institute 2033 K Street, NW Washington, D.C. 20006. *The Journal of Development Studies*, Taylor and Francis, Vol. 45(10), 1684-1706.
- Godtland, E., De Janvry, A., Sadoulet, E., Murgai, R. and Ortiz, O. (2003). The impact of farmer-Field school on knowledge and productivity; A study of potato farmers in the Peruvian Andes.
- Gujarati, D.N. (1995). *Basic Econometrics*. 4th Edition. Tata McGraw-Hill, New York.
- Greene, W.H. (2003). *Econometric Analysis*. Fifth Edition. Prentice Hall, Upper saddle River, New Jersey. Prentice Hall.
- Heckman, James J., and Edward Vytlacil. (2005). "Structural Equations, Treatment Effects, and Econometric Policy Evaluation." *Econometrica*, 73 (3): 669–738.
- Heckman, J., Lochner, L., and Taber, C. (1998). Explaining rising wage inequality: explorations with a dynamic general equilibrium model of labor earnings with heterogeneous agents. *Review of Economic Dynamics* Vol. 1 (1):1–58.
- Hujer, R., Caliendo, M. and Thomsen, S. L. (2004). New evidence on the effects of job creation schemes in Germany – A matching approach with threefold heterogeneity. *Research Economics*, Vol. 58 (1): 257–302.
- Kebede, Y., Kunjal, K., Coffin, G. (1990). Adoption of new technologies in Ethiopian agriculture: the case of Tegulet-Bulga District, Shewa Province. *Agricultural Economics*, Vol. 4 (1): 27–43.
- Khandker, S., Koolwal, G., and Salad, H. (2009). A handbook on Impact Evaluation: Quantitative methods and practices. *The World Bank*, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2422.
- Kiiza, B., Pederson, G., and Lwasa, S. (2011). The Role of Market Information in Adoption of Agricultural Seed Technology in Rural Uganda. *International Journal of ICT Research and Development in Africa*, Vol. 2(1), 30-47.
- Kirui, O., Okello, J., Nyikal, R., and Njiraini, G. (2013) Impact of mobile phone-based money transfer services in agriculture: evidence from Kenya. *Quarterly Journal of International agriculture* Vol.52 (2) : 141-162.
- Kenya
- Lancaster K. J. (1996). A new approach to consumer theory. *The Journal of Political Economy* Vol. 74 (2): 132-157.
- La Rovere, R., Mathema, S.B., Dixon, J., Aquino-Mercado, P., Gurung, K.J., Hodson, D., and Flores, D. (2008). Economic and livelihood impacts of maize research in hill regions in Mexico and Nepal: Including a method for collecting and analyzing spatial data using Google Earth. Mexico, DF: CIMMYT. E14 *Development Economics and Policies*. ISBN 978-970-648-167-2.
- Maddala, A.S. (2001). Limited Dependent and Quantitative Variables in Econometrics. *Cambridge University Press, Cambridge, UK*.
- Maurice. J., Wilfred. N., and Mahmud. Y. (2009). Production Risk and Farm Technology Adoption in Rain-Fed, Semi- Arid Lands of Kenya. Environment for Development, *Discussion Paper series October EfD DP 09-22*
- McFadden, D. (1973), Conditional logit analysis of qualitative choice behavior, in: P. Zarembka, ed., *Frontiers in econometrics. Academic Press, New York*.
- Ministry of Planning and National Development, 2010. Kenya National Bureau of Statistics. Strategic plan 2008-2012. Website: www.knbs.or.ke
- Muhammad H.U., Umar, Abubakar B.Z., and Abdullai A. S. (2011). Assessment of factors influencing Beneficiary Participation in Fadama II Project, *Nigerian Journal of Basic and Applied Science*, Vol.19 (2): 248-252.
- Ngugi, H.K., King S.B., Abayo G.O., and Reddy Y.V. (2002). Prevalence, incidence, and severity of Sorghum diseases in western Kenya. *Journal of Plant Disease*, 86 (1):65–70.
- Okello, J., Edith O., Oliver, M. and Ruth, O. (2010). Using ICT to integrate smallholder farmers into agricultural value chain: the case of DrumNet project in Kenya. *International Journal of ICT and Research Development*, 1:23-37.
- Owusu A. and Awudu L. (2009). The impact of non-farm employment on farm household Income and way out of poverty, using farm household data from Brong-Ahafo region of Ghana.
- Pattanayak, S.K., Mercer, D.E., Sills, E., Jui-Chen, Y. (2003). Taking stock of Agroforestry Adoption studies. *Agroforestry Systems* 57(3), 173–186
- Ravallion. M. 2001. "The Mystery of the Vanishing Benefits: An Introduction to Impact Evaluation." *The World Bank Economic Review*, Vol.15(1): 115-140.
- Pindyck, R.S, and Rubinfeld, D.C. (1981). *Econometric models and Econometric factors* 2nd Edition. *McGraw/Hill book Co. New York*.
- Ravallion. M. (2001). "The Mystery of the Vanishing Benefits: An Introduction to Impact Evaluation." *The World Bank Economic Review*, 15(1): 115-140.
- Rosenbaum, P.R. and Rubin, D.B. (1983). The Central Role of the Propensity Score in Observational Studies for Causal effects, *Biometrika*, Vol.70, (1) : 41–55.
- Sekumade A.B. and Akinleye S.O. (2009) Comparative Analysis of Maize Storage Technologies in North Central Nigeria, *Research Journal of Social Sciences*, Vol.4 (1) : 7-14.
- Senkondo, E. M., Msangi A. S., Xavery, P., Lazaro E. A., Hatibu N. (2004). Profitability of

808. J. Agric. Econs, Extens. Rural Develop.

- Rainwater Harvesting for Agricultural Production in Selected Semi-Arid Areas of Tanzania. *Journal of Applied Irrigation Science*, Vol. 39 (1) : 65 – 81.
- Schultz, Paul. (2004). "School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program." *Journal of Development Economics*, Vol. 74 (1): 199–250.
- Smith, J. A. and Todd, P. E. (2005). 'Does matching overcome Lalonde's critique of non-experimental estimators?', *Journal of Econometrics*, Vol. 125 (1): 305–353.
- Thurstone, L. L. (1927) "A law of comparative judgment," *Psychological Review*, Vol. 34, (4) :273–286
- Todd, P. (1995). Matching and Local Linear Regression Approaches to Solving the Evaluation Problem with Semi-Parametric Propensity Score. *University of Chicago: Mimeo*.
- WFP. (2006). Food Procurement in Developing Countries. Policy Issues - EB.1/2006/5-C. Rome, *UN World Food Programme*.
- WFP. (2008). WFP's Private-Sector Partnership and Fundraising Strategy. Policy issues - EB/1/2008/5-B/1. Rome, *UN World Food Programme*.
- Wainaina, P., Okello, J., and Nzuma, J. (2012). Impact of contract farming on income of commercial poultry farmers: The case of smallholder farmers in Nakuru County, Kenya. *Paper presented at International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012*.
- Wood M. D., Read, J. P., Palfai, T. P., Stevenson, J. F. (2001). Social influences processes and college student drinking: meditational role of alcohol outcome expectancies. *Journal of Studies on Alcohol*, Vol 62 (1): 32-43.
- Yemisrach. G. (2010). Impact assessment of input and output market development interventions of the IPMS project: *the case of Alaba and Dale Woredas, Snnprs, Ethiopia*
- Yirga, C.T. (2007). The dynamics of soil degradation and incentives for optimal management in Central Highlands of Ethiopia. *Ph.D. Thesis, Department of Agricultural Economics, Extension, and Rural Development, University of Pretoria, South Africa*.