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Does Technology Follow the Cash Holders only? Role of Credit Market Participation in Using Fertilizer by Farmers

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Abstract

Though agriculture has a vital role in economic growth and overall development of nations, especially the least developed countries, various socio- economic factors get in the way for its development. Poor technology adoption by small-holder farmers results substandard productivity of the agriculture sector. In this line, this paper has attempted to outline the factors affecting farmers' credit and fertilizer market participation in Nepal using Heckman model. The result shows that land size, membership in social organisation, consumer-worker ratio, and education of household head's education and total workforce in the household are positively affecting the participation. However, the extent of credit market participation is determined by land and total livestock unit only. The factors affecting fertilizer market participation are credit market participation, household head's age and education while the extent of fertilizer market participation is only land. We conclude that absence of collateral constraints the desired credit and inadequate liquid assets prohibits the use of fertiliser.

Introduction

Agriculture plays a vital role in the economy of the least developed countries (LDCs), both in terms of size of an economic sector and element of a development strategy (Sadoulet and de Janvry, 1995). Hence a high and sustained rate of growth in agricultural productivity becomes a necessary condition for the overall development of the economy. Modernization of agriculture sector becomes pre-requisite to fulfil this condition. The continuous creation and introduction of new technology has been used as a standard for distinguishing a modern agriculture system from a traditional one (Schultz, 1964). However, the introduction of many new technologies has met with only partial success, as measured by observed rates of adoption (Lin, 1991).

The problem of non-adoption is common around the world, and much research in this field has been carried out in developing countries, where the need for very basic agricultural technology is great (Filho et al. 1999; Ghose and Saith 1976; Guerin and Guerin 1994; Polson and Spencer 1991; Smale et al. 1995).For different enterprises and for different

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technologies or innovations, different constraints apply (Guerin and Guerin, 1994). Constraints to the rapid diffusion of a technology may arise from many sources, such as lack of credit, inadequate farm size, unstable supply of complementary inputs, and so on (Feder, Just, and Zilberman *cited in* Lin, 1991).

Using improved inputs requires high initial cost. But cash income is not expected before the harvest. Hence the availability of credit helps farmers to bridge time lag between expenditure and income. In the absence of credit, farmers have to maintain cash reserves so as to facilitate production and consumption in the next cycle. Credit, therefore, allows both greater consumption and greater purchased input use and thus increases welfare of the farmer (Feder et al., 1990).According to Carter (1989) credit can permit the purchase of a new technological package such as a high yielding variety which shifts the production surface leading to technically efficient production. These package cost only slightly more than the imputed value of traditional variety seeds, but shifts entire input-output relationship. Not only to purchase of new technological package but credit may also permit more intensive use of fixed inputs of land, family labour and farming skill through a nutrition-productivity link if credit enhances family consumption levels (Carter, 1989). In addition, in the absence of insurance markets, reliable access to credit allow farmers to invest in more risky but higher yielding crop and asset portfolios (Heltberg, 1998).

Despite the importance of credit to enhance productivity and output there is imperfect credit market. Rural economies in developing countries are characterized by significant transaction costs and market imperfection creating price bands which imply that household selectively decide to participate or not in markets (de Janvry et al., 1991; Hoeff et al., 1993).

A number of researches have been carried out to explain production decisions by farm household in underdeveloped countries. A common finding is that third world farmers often use less fertilizer and other inputs than they would have done if they maximized expected profits (Wik and Holden, 1996). Many researchers have cited lack of access to credit as one of the major cause using less fertilizer (e.g., Minot et al., 2000; Diagana et al., 2001; Holden et al., 2000; Hagos, 2003). In this paper I have tried to find the factors affecting credit and fertilizer market participation and effect of credit market participation in fertilizer market participation. The maintained hypothesis is that credit market participation leads to fertilizer market participation resulting in the use of fertilizer in the farm.

The remainder of the paper is organized as follows. In section two, I discuss the theory behind the market participation and non-participation briefly. In section three I have constructed a theoretical model of market participation and non-participation under imperfect market situation. Section four explains about study area, data and variable specification. Section five outlines the econometric models and discusses estimation methods. In section six I have presented the results and discussion. Finally section seven summarizes and concludes.

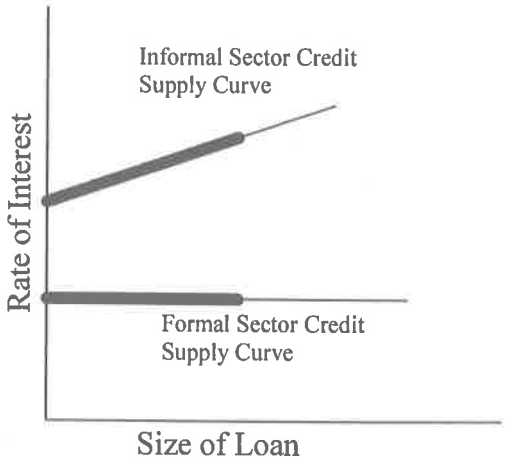
Theory

In the world of perfectly competitive market, households participate in all factor and commodity markets when these factors are used in production and commodities are produced and/or consumed by the households, as long as factors and commodities are imperfect substitutes and distribution of factors and commodities vary across households. But farm households are located in an environment characterised by a number of market failures for some of its products and for some of its factors ((Sadoulet and de Janvry, 1995). High transaction costs and imperfect information cause market imperfection and non-separability of production and consumption decisions in poor rural economies (Holden et al., 2001).Basically there are two major explanations for farm households' involuntary non participation in the market (credit and fertilizer market).

Rationing out

It is frequently assumed that poor people are rationed out of markets or they are unable/ unwilling to participate (Stiglitz and Weiss, 1981). Because of the risk and asymmetric information inherent in agriculture, formal financial institutions ration the amount of credit supplied to the farm sector, giving rise to a liquidity or credit constraint (Carter, 1988). Financial institutions routinely require collateral in the form of land or other fixed assets as a condition for offering loans (Binswanger and Rosenzweig, 1986). It is very difficult to find a financial institution for rural farm household to get loan due to seasonality and synchronic timing and covariance of yield risk in agriculture (Binswanger and Rosenzweig, 1986). This leads small farm household to be dependent on informal money lender for credit.

Although the informal moneylenders often have better information regarding the activities and characteristics of their clientele, the same problem renders this sector unsatisfactory to poor farmers. The possibility of default and informational asymmetries lead to credit rationing, even by the informal sources where collateral requirements are flexible and information regarding borrowers is available to lenders in relatively better ways (Debela, 2001). It is found that credit supply curve drawn in loan size and interest rate space is horizontal for formal sector and upward sloping for informal sector indicating well-to-do households are also not free from credit rationing (Kochar, 1997).

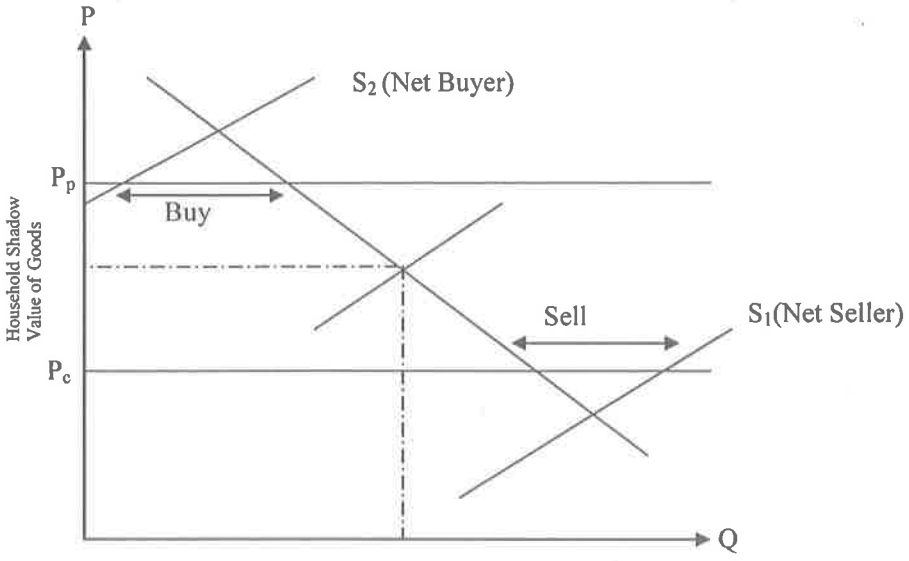


Small farmers are restricted to borrow within the range of heavy range of the curves depending on their household

characteristics and cost of lending. Thus the effective supply schedule of credit for these farmers is a combination of the two parts with the actual size of the loan depending on household characteristics and cost of credit.

Transaction Cost

We may define transaction cost as the cost incurred during the enforcement and exchange of property rights. Transactions cost include distance from the market and poor infrastructure that increase transportation costs, high marketing margins due to merchants with local monopoly power, high search and recruitment costs due to imperfect information, and supervision and incentive cost.(Sadoulet and de Janvry, 1995). The transaction cost creates price band restricting some people to participate in the market as shown in the following figure.



In the figure, P_p is the purchasing price and P_c is the selling price. Selling price and purchasing price are different due to transaction cost. Those farmers whose shadow value of good lies below the selling price are net seller while those whose subjective value of good lies above the purchasing price are net buyer. That farmer whose subjective value of goods lies within the price band does not participate in the market.

Theoretical Model

To explain the impact of credit constraint on fertilizer use, this article uses simple household model following (Key et al., 2000; de Janvry et al., 1991; Sadoulet and de Janvry, 1995). Models which incorporate consumption goals of households into microeconomic models of peasant decision making are called household models (Wik and

Holden, 1996). In a household model, a household is assumed to maximize utility subject to full income constraint. The household model shows that if all markets exist and all goods are tradable then all prices are exogenous and production and consumption decisions are separable. But if the commodities of the model are exposed to severe market failures, errors will occur when the model is specified as if markets are perfect with exogenous prices. If a credit market or some commodity or labour market does not exist, production and consumption decisions are linked together through endogenous prices.

Let us assume a representative household whose objective is to maximize utility

Max U (X_a, X_m, X_l)

Subject to

1. Production constraint: Q = $Q(X_F, L, \bar{A})$
2. Budget constraint: $P_m X_m + wX_L = P_a(Q - X_a) - P_f X_f + wT - wL$
3. Credit constraint: $P_f X_f + w[L - (T - X_L)] = C_r \leq \bar{C}_r$
4. Labour constraint: $L - (T - X_L) = L_h$

Where X_a = Agriculture commodity X_m = Non-agricultural commodity X_l = Consumption of leisure X_F = Fertilizer Q = Quantity of agricultural commodity Produced $\bar{A}$ = Fixed land Area; w = wage rate T= Total family time

P_m = Price of non-agricultural commodity P_a = Price of Agricultural commodity P_f = Price of fertilizer C_r = Amount of credit $\bar{C}_r$ =Credit limit

Here I assume seasonal labour market and it is reasonable to assume this for the study area as in Southern low land of Nepal there is a labour peek in the early rainy season when everyone work in her/his own fields and labours are hired in or out very rarely.

On collapsing equation (1) and (2) to get full income constraint

$$P_m X_m + P_a X_a + wX_L = P_a Q(X_F, \bar{A}) - P_f X_f + wT - wL$$

Setting Lagrange function to maximize utility subject to budget constraint and credit constraint

$$L = U(X_a, X_m, X_l) + \lambda\{P_a Q(X_F, \bar{A}) - P_f X_f + wT - wL - P_m X_m - P_a X_a - wX_L\} +$$
$$\mu[C_r - w\{L - (T - X_L)\} - P_f X_f] + \eta[L_h - L + (T - X_L)]$$

The First order condition is

$$\frac{\delta L}{\delta X_f} = \lambda P_a Q_f - (\lambda + \mu)P_f = 0$$

$$i.e. P_a Q_f = \frac{(\lambda + \mu)}{\lambda} P_f \qquad \text{(For Fertilizer)}$$

Similarly

$$P_a Q_L = \frac{(\lambda + \mu)}{\lambda} w + \frac{\eta}{\lambda} \qquad \text{(For Labour)}$$

The first order condition clearly says that if there is no credit constraint then $\mu=0$ i.e. the household will produce at the usual optimum where value of marginal product of fertilizer equals market price of fertilizer. But if there is credit constraint i.e. $\mu>0$, household shadow prices of fertilizer is higher than market prices, and the households will use less amount of fertilizer. This shows that failures in credit market causes peasants to produce less output than they would have done if all markets were well functioning.

It is shadow price which makes a household to participate or not to participate in the market. If shadow price lies within "price band" (Key et al., 2000) then household becomes self sufficient (Sadoulet and de Janvry, 1995) i.e. do not participate in the market. So in the case of fertilizer, if shadow price lies within the price band household will not participate in the fertilizer market and, if it lies above the price band household will buy the fertilizer.

In previous section I explained that market participation depends on the width of "price band" and value of shadow price. Width of price band depends on the transaction cost, shallow markets and price risk and risk aversion. Shadow prices are determined internally at the household level; hence they depend on household characteristics and house-hold specific indicators of market participation (Arslan, 2005). Hence I hypothesize that probability of farm household's participation or not to participation in the market (credit and fertilizer) depends on the characteristics of that market (transaction cost, information asymmetries) and socio-economic characteristics of the household;

$$\text{Prob}M_i^n \begin{cases} M=1 \text{ if participate} \\ M=0 \text{ if does not participate} \end{cases} = f(F_i, R_i, Z_i)$$

Where, $M_i^n = i^{th}$ households decision to participate n^{th} market

F_i = Farm Characteristics of i^{th} household

R_i = Resource Characteristics of i^{th} household

Z_i = Household Characteristics of i^{th} household

If any of these variables are significant then this is a sign of market imperfection otherwise one can conclude that market functions reasonably well.

Study Area, Data and Variable Specification

Study Area

Data for this study was collected from a sample of 153 households in four villages (Sitapur, Bageshowri, Sonpur and Khajura) in the Banke district- a western low land part of Nepal. The survey was carried out in June and July 2005. The study area is located about 500 Kilometre (KM) west from the capital city of Nepal and adjacent to the border of India. This specific location has important impact on various types of market as India and Nepal has open border and we observe uncontrolled inflow of Indian agriculture produce. Similarly there is a Regional Agriculture Training Centre which, we can expect, influence farmers to use modern agriculture technology.

The data were collected on the "recall" basis for the period of July2004 to June 2005 using enumerator. Hence whatever respondents replied has been taken as truth. Regarding the value of credit, respondents had roughly separated agriculture credit from consumption credit. From the agriculture credit it was not possible to separate credit used for rice production and other production.

Variable specification

In theory section we discussed how farm household's decision to participate or not on the market is dependent on household characteristics, resource characteristics and farm characteristics in the context of market imperfection. But due to very limited time and lack of agriculture technician during data collection, it was not possible to collect plot level data such as soil type, slope of the plot etc. Hence we have not included plot characteristics in our model. Hence independent variables are from resource characteristics and household characteristics. Different variables from these two categories have been used for different model as discussed below.

Variables for credit market participation

Following variables have been taken as the independent variable to determine credit market participation.

A. Resource characteristics

a. **Land:** As we knew from the literature (Binswanger and Rosenzweig, 1986) that collateral is must to borrow from formal institution. Land serves as the best source of collateral in the study area. In this context we expect that larger the area of land holding higher will be the chance of credit market participation. On the other hand land is the measure of affluence of household. It can be expected that household with more land may not take loan. To capture this aspect we have used quadratic function of land.

b. **Total Livestock Unit:** Although livestock unit is not a good source of collateral it indicates how rich the household is. Rich household is assumed to be more efficient to enter the credit market. Hence larger the number of livestock unit higher will be the chance of credit market participation. In this study all livestock have been converted into the oxen unit using conversion table given in the appendix.

c. **Total Work Force:** Large number of workforce may help a household to earn more wage income. Hence higher the wage income, lower will be the liquidity constraint reducing probability of credit market participation. But there is seasonal labour market. During the season of rice production, hardly a farm household hire in or hire out the labour. All the labour force work on their own field. Working in the own field will require more capital equipment forcing the household to take part in the credit market.

B. Household characteristics

If market was perfect then we know that household's decision to participate or not would depend on the market price. But in the situation where there is imperfect market the decision is influenced by household characteristics such as age, sex and education of household head, consumer worker ratio. Following household characteristics have been included in this category:

a) **Age of household head:** Older farmer, in comparison to younger one, will have more public relationship and less chance to be defaulter. So we expect older household head will have more probability to participate in the credit market.

b) **Sex of household head:** As Nepal is male dominated society, male household head may have more probability to participate in the credit market than female one. Moreover it is generally found that female headed household heads are relatively more risk averse and expected to participate less compared to their male counterpart.

c) **Household head education:** In the society where there is rampant illiteracy, educated person have high social prestige increasing chance to participate in the credit market in comparison to less educated person. Moreover we are considering agriculture labour which is required to purchase improved inputs. Educated farmer is expected to invest more on improved inputs. Hence educated farmer participate more in the credit market.

d) **Consumer Worker Ratio:** Consumer worker ratio has ambiguous impact. In one hand higher consumer worker ratio means more liquidity constraint forcing to participate in the credit market. On the other hand higher consumer worker ratio may make household to be more risk averse reducing the probability of participating in the credit market.

e) **Television:** Having the television in the home indicates that farmer has access to information. If farmer has access to information then we can expect that probability of participating in the credit market will increase.

f) **Member of Social Organization:** If the farmer is member of any social organization then he is more likely to participate in the credit market as he may have more information about credit market.

Table 1 summarizes the variable used to explain the credit market participation with their direction of response.

Table 1: Variables Determining Credit Market Participation with Expected Sign

Variables	Expected Sign of the Coefficient
Resource Characteristics	
Land holding size	+
Square of land holding size	-
Total Livestock Unit	+
Total Work Force	+/-
Household Characteristics	
Membership of Social Organization	+
Education of HH head	+
Sex of HH head (Male)	+
Age of HH head	+
Consumer Worker Ratio	+/-
Television	+

Source: Field Work, 200?.

Variables for fertilizer market participation

We have already explained that in the perfect market world input demand will be determined by input prices, output prices, quasi-fixed factors of production, and variables that influence the marginal product of the input. But in the context of underdeveloped country, wider range of variables may be relevant.

A. Resource characteristics

Since crop production is subject to random shocks and farmers are risk averse, ability to bear risk (measured by income and ownership of assets) may influence fertilizer use (Minot et al., 2000). Additionally increased asset holding may enhance household's access to credit which ultimately may increase the household's propensity and ability to use fertilizer to intensify the production (Bhatta and Adhikari, 2004). We have included following variable under this category:

a. **Land:** Increased land holding size will help to mitigate risk leading to encourage the farmer to use fertilizer. Hence land holding size will affect fertilizer market participation positively.

b. **Total Livestock Unit:** Livestock unit has ambiguous impact on fertilizer market participation. In the one hand livestock unit may create same impact as land create i.e. positive impact. On the other hand with the increased livestock unit farmer can

use more manure to avoid costly fertilizer use. In this situation farmer will not participate in the fertilizer market.

c. **Total Work Force:** Large number of workforce may help a household to earn more wage income. Hence higher the wage income, lower will be the liquidity constraint increasing probability of fertilizer market participation. But there is seasonal labour market so wage income is rare. In this situation total work force will have negative impact on fertilizer market participation.

d. **Credit market participation:** We assume that credit market participation increases the probability of fertilizer market participation. But if we use credit market participation variable as independent variable then there will be possibility of endogeneity problem. To avoid this problem we have used predicted value of credit market participation.

B. Household characteristics

Due to the same reason as explained in the credit market participation, household characteristics matters in the fertilizer market participation as well. Following household characteristics have been included in this category:

a. **Age of household head:** Age reflects the experience of the farmer. More experienced farmer can be expected to be more innovative resulting in the higher probability of fertilizer market participation.

b. **Sex of household head:** As explained in the credit market participation female headed household may have lower participation in comparison to male headed household in fertilizer market as well.

c. **Household head education:** Education leads to innovation. Innovative farmer can be expected to use fertilizer i.e. to participate fertilizer market.

d. **Consumer Worker Ratio:** Higher consumer worker ratio will create liquidity constraint leading to discourage fertilizer market participation.

e. **Television:** Having the television in the home indicates that farmer has access to information. If farmer has access to information then we can expect that probability of participating in the fertilizer market will increase.

f. **Member of Social Organization:** If the farmer is member of any social organization then he is more likely to participate in the credit market as he may have more information about it.

Following tables summarize the variables used to explain the credit market participation with their direction of response.

Table 2 Variables Determining Fertilizer Market Participation with Expected Sign

Variables	Expected Sign of the Coefficient
Resource Characteristics	
Land holding size	+
Total Livestock Unit	+/-
Total Work Force	+/-
Household Characteristics	
Education of HH head	+
Sex of HH head (Female)	-
Age of HH head	+
Consumer Worker Ratio	-
Television	+
Credit Market Participation	+
Member of Social Organization	+

Table 3 gives the description of the variables and summary statistics.

Table 3: Description of variable used in Analysis

Variable Name	Variable Type	Variable Definition	Mean	Std. Dev
Resource Characteristics				
land	cont	Area of land hold (in Kattha)	30.82353	25.42141
tlu	cont	total livestock unit measured in terms of number of oxen	3.06883	2.457124
totwf	cont	No of total work force	4.69281	2.233952
Household Characteristics				
hhheduc	cont	Household head education (no of years of schooling)	4.346405	4.583035
hhsize	cont	household size	6.764706	2.844118
cwratio	cont	consumer worker ratio	1.418954	0.414839
tv	dummy	Television 1 if hold 0 otherwise		
fertexpr	cont	Fertilizer expenditure per Kattha	3361.085	3484.23
fertma	dummy	Fertilizer market participation 1 if participate 0 otherwise		
cmphat	cont	Predicted value of creditma		
creditma	dummy	Credit market participation 1 if participate 0 otherwise		
sms	dummy	member of at least one social organization 1 if yes 0 otherwise		
totwf	cont	Total work force	4.69281	2.23395
hhhsex	Dummy	Household Head Sex 1= male 0= female		
hhhage	Cont	Household Head Age (Years)	52.18301	15.1138

Estimation of the Model[1]

We want to examine the factors that affect rural farm household's decision to participate credit and fertilizer market. Since there are a large number households that do not participate either or both market, the error terms will not be normally distributed and the coefficients estimated by ordinary least squares will be biased. On the other hand, limiting the regression to households that use fertilizer will introduce sample selection bias. To overcome from the problem we use the Heckman's approach (Heckman, 1979) as discussed below.

The estimable econometric model for the market participation:

$Y_1 = X_1 \beta_1 + u_1$ .....(1)

Here Y_1 is the extent of market participation i.e. amount of credit in case of credit market participation and fertilizer per unit of land in case of fertilizer market participation. X_1 is the vector of explanatory variables and u_1 is the stochastic error term.

Equation (1) could be estimated using standard regression framework if Y_1 was observed for every one in the population. But Y_1 is observed for those only who participate in the market. Hence a potential sample selection problem arises. Let Y_2 is the binary market participation indicator then our model become

$Y_1 = X_1 \beta_1 + u_1$

$Y_2 = 1[X \delta_2 + v_2 > 0]$ ..... (2)

Here we assume

i) (X, Y_2) are always observed while Y_1 is observed only when $Y_2 = 1$.

ii) (u_1, v_2) are independent of X i.e. X is exogenous.

iii) $v_2 \sim N(0,1)$

iv) $E(u_1/v_1) = \gamma_1 v_2$

In the above set of equations, equation (1) is called output equation and equation (2) is called selection equation.

Let we picked up randomly (Y_1, Y_2, X, u_1, v_1) then we estimate

$E(Y_1 \mid X, v_2) = X_1\beta_1 + E(u_1 \mid X, v_2) = X_1\beta_1 + E(u_1 \mid v_2) = X_1\beta_1 + \gamma_1 v_2$ .....(3)

Here if $\gamma_1 = 0$ then it implies $u_1$and v_2 are uncorrelated. In this situation $E(Y_1 \mid X, v_2) = X_1\beta_1$ i.e. there is no sample selection problem and β_1 can be consistently estimated by OLS using the selected sample.

If on the other hand $\gamma_1 \neq 0$ then it implies $u_1$and $v_2$are correlated. In this situation we will have

$E(Y_1 \mid X, Y_2) = X_1\beta_1 + \gamma_1 E(v_2 \mid X, Y_2) = X_1\beta_1 + \gamma_1 h(X_1, Y_2)$ .....(4)

But for selected sample $Y_2 = 1$, equation (4) can be written as

$$E(Y_1 \mid X, Y_2) = X_1\beta_1 + \gamma_1 E(v_2 \mid X, Y_2) = X_1\beta_1 + \gamma_1 h(X, 1) \quad \ldots\ldots\ldots\ldots\ldots(5)$$

In equation (5) if we know h(X,1) then we can estimate $\beta_1$and y_1. But

$h(X,1) = E(v_2 \mid v_2) > X\delta) = \gamma(X\delta_2)$ where $\gamma(.) = \phi(.)/\Phi(.)$ is the Inverse Mills Ratio (IMR). So equation (5) can be written as

$$E(Y_1 \mid X, Y_2 = 1) = X_1\beta_1 + \gamma_1 \gamma(X\delta_2) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Our desired equation is equation (6) and it is estimated by (Heckman 1979) procedure.

The major problem with the above model is the problem of multicollinearity. To check the multicollinearity I used Variance Inflation Factor (VIF). VIF shows how the variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 2003).VIF is the diagonal element of the inverse of correlation matrix, which is $(1-R^2_i)^{-1}$, where R^2_i is the R^2 obtained from regressing the i^{th} independent variable on all other independent variables (Hamilton 2003). Therefore, a high VIF indicates an R^2_i near unity and hence suggests collinearity. According to Hamilton (2003), VIF of more than 10 indicates a harmful collinearity. The VIF result showed that there is no problem of multicollinearity.

Another problem in this model is to determine whether X_1should be strict subset of X or not. Wooldridge (2002) suggests that it is not necessary to be X_1 as a strict subset of X but there is the possibility that this can introduce collinearity among the regressors leading large standard errors of the elements of β_1. To avoid the possible problem we have used at least one variable in selection equation which is not in the output equation.

Results and discussions

We have already explained that a farm household's decision to participate or not to participate in the market is influenced by two major sources i.e. rationing and price band. If a farmer participates in the market then question arises about the extent of market participation. Here we have explained these two questions i.e. who participate in the market and in what extent. The market chosen to explain these questions are credit market and fertilizer market.

Credit market participation

In our analysis we have analysed the credit market for agriculture production i.e. we have taken only agriculture credit into the consideration. The major sources of agriculture credit in the study are (i) Family relatives (ii) Agriculture Development Bank (iii) Small Farmers Development Project. Last two sources are formal sources while first is informal source. Among these Agriculture Development Bank requires collateral while first and third may not. But to get credit from first and third source, at least farmer should have high credibility of repayment. Table 4 shows the Heckman two step calculation indicating factors affecting the decision to participate in the credit market and extent of participation.

Table 4 : Heckman Selection Model for Participation in the Credit Market

	Coefficient	Standard Error	p>|z|
credit (dependent variable)			
land***	91.996	19.62025	0
land2	-0.14337	0.1559198	0.358
tlu***	176.9089	70.61959	0.01
totwf	-3.54667	121.8453	0.977
hhhsex	-24.038	572.3833	0.967
hhhage	-11.674	14.55276	0.422
hhheduc	-0.08453	55.20045	0.999
cwratio	-238.565	514.1393	0.643
_cons	1176.314	1979.379	0.552
creditma (dependent variable)			
land**	0.033073	0.0130945	0.012
land2**	-0.00025	0.0001185	0.038
tlu	0.047241	0.0588515	0.422
totwf**	0.224992	0.0925867	0.015
hhhsex	0.366294	0.4126836	0.375
hhhage	0.072259	0.0492788	0.143
age2	-0.0006	0.0004355	0.166
hhheduc***	0.099655	0.0305762	0.001
cwratio**	0.781359	0.361483	0.031
tv	0.185675	0.2409647	0.441
sms**	0.871404	0.268557	0.001
cons***	-5.60464	1.579149	0
mills			
lambda	-381.8423	719.1824	0.595
Number of obs	153		
Prob > chi2	0		

*** significant at 1% level of significance ** significant at 5% level of significance

From the table we see that access to credit increases with the increase in the land size and credit market participation decreases after the land holding size reaches to 67.5 *Kattha* of land. To know this we have squared the land. This indicates that very rich people do not take part in the credit market as they may have sufficient liquid asset with themselves. Another reason for getting this result is that we have not considered net seller in the credit market.

Other factors which increase the credit market participation are household heads education and membership in the social organisation. Higher education and membership in the social organisation increases the information regarding the importance and sources of credit leading to increase in the market participation. Similarly higher total workforce and consumer worker ratio also increases the credit market participation. Since land and household heads education are significant for the credit market participation we can say that land and education poverty prohibits farmers to enter the credit market.

Although not significant but total livestock unit, household head sex, household head age and holding TV are positively affecting credit market participation to support our expectation.

The extent of participation, defined by amount of credit taken, is determined by land and total livestock units only. This clearly indicates that amount of credit depends on the availability of collateral. We again used the variables land and its square and found, although not significant, square of land has negative sign. This again indicates that amount of credit increases with land but after reaching a certain point it starts to decline. Similarly amount of credit increases with the increased live stock unit as they are source of wealth and increases the confidence of farmer to repay if agriculture is spoilt by some or other reason. From supply point of view it can be argued that more livestock unit, a reflection of wealth holding, ensures credit providers to lend more.

Fertilizer market participation

We have already examined agriculture credit market. Farmers who participate in the credit market can be expected to participate in the fertilizer market also. Following cross table shows how many farmers have participated in the fertilizer market who participated in the credit market.

Table 5 : Credit Market Vs Fertilizer Market

creditma	fertma		Total
	0	1	
0	26	32	58
1	8	87	95
Total	34	119	153

From the table we see that out of 95 farmers who participated in the credit market 87 farmers participated in the fertilizer market. On the other hand out of 153 farmers 119 farmers have participated in the fertilizer market. This indicates that farmers are aware of using fertilizer to increased agriculture production. We used same method used in the analysis of credit market participation to analyze the fertilizer market participation. The result has been presented in the following table.

Table 6 Heckman Selection Model for Participation and in the Fertilizer Market

	Coefficient	Standard Error	p>|z|
fertexp (dependent variable)			
land***	74.22	19.18	0.000
tlu	230.483	144.2929	0.110
totwf	68.7448	197.407	0.728
hhhsex	242.597	1061.911	0.819
hhhage	39.3832	44.04342	0.371
hhheduc	109.595	161.6479	0.498
cwratio	-422.955	883.6995	0.632
sms	400.116	698.2784	0.567
con	-3661.23	5236.831	0.484
fertma (dependent variable)			
land	0.01228	0.0079364	0.122
tlu	0.03257	0.0642984	0.613
totwf	0.04974	0.1038683	0.632
hhheduc***	0.14442	0.0368321	0.000
hhhsex	0.04663	0.4175435	0.911
hhhage***	0.03588	0.0128701	0.005
cwratio	0.32328	0.3691123	0.381
tv	-0.14015	0.2696844	0.603
sms	0.2165	0.2846395	0.447
cmphat***	0.43658	0.1598022	0.006
cons	-2.70414	1.035594	0.009
mills			
lambda	3450.47	2951.605	0.242
Number of obs	153		
Prob > chi2	0.000		

*** significant at 1% level of significance

From the table we see that decision to participate in the fertilizer market depends on credit market participation, age and education of household head. The result shows that the credit market participation is influencing fertilizer market participation positively which is according to our hypothesis. Similarly fertilizer market participation depends on the age and education of the household head. Age can be taken as the proxy of experience. An experienced farmer can decide whether to use fertilizer in the field or not as use of fertilizer may depend largely on the plot characteristics known to the experienced farmer. Similarly

educated farmer know more about the importance of fertilizer so he can be expected to participate in the market. All other variables are not significant.

The quantity of fertilizer on the other hand is dependent on area of land holding only. It is obvious that increased land holding demands more fertilizer. This is why extent of fertilizer expenditure is positively related with land size. Although not significant, all other variables are also positively determining the quantity of fertilizer. It means increased livestock unit, total work force, age of household head, education of household head, and membership of organisation increases the probability of fertilizer market participation.

We used Heckman model in order to avoid sample selection bias. In both the model we find that the value of lambda (Inverse Mills Ratio) is insignificant indicating there is no sample selection bias.

Conclusion

Our objectives in this paper was to find the factors affecting farm households decision to participate or not in the credit market and fertilizer market and the extent of participation in both the market. To find this we used Heckman's selection model. It was necessary to use this model as all the farmers were not participant in the market.

From the data analysis we found that credit market participation is determined mostly by level of poverty i.e. poverty becomes barrier to enter the credit market. This result is according to our expectation. Similarly amount of credit depends on the size of land holding and total livestock unit indicating the need of collateral and farmers confidence to enter the credit market.

Fertilizer market participation largely depends on the credit market participation, experience and education of the farmer. It means modern technology is biased towards rich people. Poor farmers handicapped by liquidity constraint to use fertilizer. Similarly amount of fertilizer use depend on the size of land which is the obvious result.

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