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Impact of Credit Policy on Agricultural Expansion and Deforestation

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ABSTRACT. *The causes of tropical deforestation are classified into three levels: direct (first-level), intermediate (second-level) and indirect (third-level) causes. The direct causes include expansion of agricultural land, cattle ranching, logging, etc. The intermediate causes are the decision parameters influencing the direct causes. Some possible examples are agricultural input and output prices, level of technology, land distribution, wage levels, property rights, etc. The indirect causes are macro-level variables and policy instruments that influence deforestation through the other two levels. Agricultural expansion is the major direct cause of deforestation. The model of Angelsen et al. (1999) hypotheses effects of several of the intermediate causes on agricultural expansion and deforestation. They discuss two approaches, i.e., subsistence versus market approaches, for the farmers' behaviour on forestland clearing (deforestation) for agricultural production. However, their model does not explicitly consider the effect of agricultural credit on the farmer's decision making with respect to purchasing of optimal amount of fertilizer and its effect on deforestation. Since agricultural credit programs have been an important policy tool for improving agricultural productivity and incomes of traditional farmers, the model needs to be extended for the effect of credit constraint of the farmers on agricultural expansion and deforestation. While extending the theoretical model for this aspect, this paper also derives a fertilizer demand function with respect to credit and other socio-economic factors, and empirically evidences for the policy effect of removal of credit subsidy on fertilizer use. The evidence from Zambia suggests that the credit constraint of farmers needs to be considered explicitly in the theoretical model of agricultural expansion.*

INTRODUCTION

The large-scale depletion of tropical forest is one of the most serious environmental problems in recent times. It has become an issue of global concern because of tropical forests' relevance in biodiversity conservation and in limiting the greenhouse effect. Forest depletion also affects economic activity and threatens livelihood and cultural integrity of forest-dependent people at local level. It reduces supply of timber and other forest products, and causes siltation, flooding and soil degradation. Tropical rain forests, in particular, constitute about 41 percent of total tropical forest cover on the earth's land surface. It is the richest and the most valuable ecosystem that provides habitation for between 50 and 90 percent of all species on earth (WCED, 1987). For example, during the 1980's about 15.4 millions ha of tropical forests were lost annually (FAO, 1992). The annual loss was at 12.7 million ha between 1990 and 1995 (FAO, 1997). Reliability of the FAO Tropical Resources Assessment (1992) estimates on the loss of forest area is questionable because of the poor definition and the data used (Rudel and Roper, 1997). Further, it is also dubious whether the annual reduction in the loss of forest area between the periods 1990-1995 is a representation of slowdown in the actual forest clearance, or new definition and better data used by the FAO (Angelsen and Kaimowitz, 1999). At the global level, tropical deforestation accounts for about 25 percent of the heat trapping emissions (Houghton, 1993).

Most of the forest depletion happens in tropical developing countries where the status of development and welfare of the citizens are crucial factors in determining the extent of the forest depletion. Poverty, over-population and indebtedness accentuate deforestation in many of the low-income tropical countries. The requirement for economic growth and expansion of income result in growing demand for agricultural and forest derived products. Such trend is quite unlikely in many developed countries where higher level of (national) income growth leads to changes in the composition of demand for goods and services, with greater demand for environmental services. In many cases, however, the studies of deforestation do not provide a clear picture of its causes. In recent literature the causes of deforestation are distinguished at three different levels (Angelsen and Kaimowitz, 1999; Angelsen *et at.*, 1999; Kaimowitz and Angelsen, 1998). At level 1, the direct causes (or sources) of deforestation are considered. This includes expansion of agricultural land, cattle ranching, logging and fuel wood collection as taken up by the *agents* involved in deforestation. At level 2, the intermediate (or structural-institutional-technological) causes of deforestation are considered. They are the decision parameters of the direct causes (i.e. the agents of deforestation) at level 1. Some possible examples are agricultural input and output prices, level of technology, land distribution, wage levels, property rights, etc. At level 3, the indirect causes of deforestation are considered. They are the macro-level variables and policy instruments that influence deforestation through the other two levels. These variables do not enter into the agent's decision problem directly but they influence through the decision parameters at level 2. Examples should include national income level, economic growth, foreign debt, export prices, demographic factors and macro level policy instruments.

Agricultural (cropland) expansion is the major direct cause (or source) of deforestation compared to the other direct causes such as pasture, logging (timber harvesting), harvesting of forest products, and development of infrastructures. Some evidence shows that agricultural expansion alone is held responsible for about 50-60 percent of total deforestation. Several econometric studies analyse the causes behind agricultural expansion and deforestation at micro- and regional levels (Panayotou and Sungsuwan, 1994; Barbier and Burgess, 1996; Angelsen *et al.*, 1999). Angelsen (1999) discusses theoretically two different models of agricultural expansion for the effects of the intermediate causes (decision parameters of farmers) on deforestation. Both approaches, subsistence (population driven) and market (open economy or profit maximizing oriented) are, however, two extreme versions, and are useful to explore a range of hypotheses (or stylized facts). Other approaches, *i.e.*, Chayanovian (for a utility maximising household that balance leisure and consumption) or a general equilibrium approach could yield the hypotheses which are consistent with both of these approaches. Angelsen (1999) discusses also the Chayanovian approach. For a general equilibrium approach and the effects of government policies on deforestation see Deacon (1995). The subsistence approach emphasizes the food (or income) requirements of farm households but the market approach emphasizes the relative profitability of agriculture. Angelsen *et al.*, (1999) tested empirically a range of hypotheses related to the farmers decision parameters (*i.e.*, the intermediate causes) under the above two approaches. They analysed econometrically regional panel data from Tanzania and also estimated the location specific effects of 19 regions by the least squares dummy variable (LSDV) approach. However, the theoretical model of

Angelsen *et al.*, (1999) does not explicitly include agricultural credit as one of the decision parameters of the farmers. The study assumed that farmers are not constrained by agricultural credit: "implicitly we are assuming that farmers are not credit constrained or have sufficient cash to purchase the optimal quantity of fertilisers" (Angelsen *et al.*, 1999).

Provision of agricultural credit at subsidized rates of interest has been one of the primary policy actions for improving the productivity and incomes of traditional farmers in developing countries. The programs for such policies are based on the belief that the main barrier preventing the transformation of traditional agricultural technologies to modern and productive technologies is the inability of farmers to purchase the necessary technologies such as chemical fertilizers owing to a lack of credit facilities. If such subsidized credit policies could facilitate the farmers to purchase the modernized production inputs, such as fertilizers, the productivity of lands, and hence income, of traditional farmers will improve (Taylor *et al.*, 1986). Evidence also suggests that the probability of farmers using agricultural credit increased with more secure land tenure, more household wealth (for example, number of durable goods), higher liquidity and higher levels of household education (Graham and Darroch, 2001).

But the availability of subsidized agricultural credit is often limited in developing countries and this imposes changes in farmer's decision making and their land use patterns. Often government policy on subsidized credit for agricultural inputs could have greater impact on agricultural land expansion (Reed, 1996; Culas, 1997; Holden, 1997; Anderson, 1997). It is also noted that the subsidy policy on credit acts in many cases as subsidized fertilizer. Conditions in African countries support that there is a net gain from a fertilizer subsidy policy because the value of net output of agricultural sector from fertilizer subsidy exceeds the cost of subsidy disbursed (Gladwin, 1991). Thus, the main objective of this paper is to analyse policy effects arising from subsidized agricultural credit on agricultural land expansion and deforestation within the theoretical model of Angelsen *et al.* (1999). While extending the theoretical model, this paper also derives a fertilizer demand function with respect to the credit and other socio-economic factors, and empirically analyses the policy effect of removal of credit subsidy on fertilizer use. The evidence from Zambia suggests that the credit constraint of farmers needs to be considered explicitly in the theoretical model of agricultural expansion.

Theoritical Model of Agricultural Expansion

This section sketches the simplified model of subsistence versus market approaches presented in Angelsen *et al.* (1999). Like all theoretical models, it represents a compromise between analytical tractability and the complexity of the real world. The subject we are interested in analysing guides the choice of the model, namely for the effect of different intermediate causes on agricultural expansion and deforestation, and partly for the effect of policy arising from subsidized credit on agricultural expansion and deforestation.

We extend the basic model slightly to analyse the policy effect of subsidized credit. This was done by specifying the fertilizer input as a function of credit in the production function and adding a linear equation for the relationship of fertilizer input, farmer's initial capital and their credit (cash) constraint in the model. Accordingly, other changes were made in the model. Otherwise we followed the same structure and notations of the model closely. The policy effect arising from subsidized credit for fertilizer and its likely impact on deforestation is analyzed in a general equilibrium framework by Anderson (1997). For this analysis Anderson extended the basic model of Deacon (1995) slightly and followed the same structure and notations closely.

The subsistence approach and credit constraint

The subsistence approach assumes that a person satisfies his subsistence requirement mainly from agricultural production. In its simplest version the subsistence requirement is fixed and the economic problem of the person is to minimise the labour inputs subject to his subsistence requirement. Agricultural production is determined by

$$X = Af[L, H, F(C)] \qquad (1)$$

where X represents production in physical units, A is the technological level, L is (on-the-field) labour input, H is total land area homogenous of quality, and $F(C)$ is fertilizer input as a function of credit C which is available at interest rate r.

We consider explicitly that farmers have a credit constraint or do not have sufficient cash to purchase the optimal quantity of fertilizer. For that we assume a simple linear relationship between fertilizer input and credit constraint as,

$$F(C) = a + bC \qquad (2)$$

where a is the initial capital (cash) of the farmer and b is the ratio between amount of fertilizer input and the amount of credit constraint.

The production function (1) is concave, with positive but decreasing marginal productivity of all inputs ($f_i > 0;\ f_{ii} < 0$), and all the inputs are normal and any pair of input is complementary ($f_{ij} > 0;\ i \neq j$). It is assumed that no market exists for land and uncultivated land (forest) can be brought into cultivation on a "first come first served basis" where open access prevail (i.e. forest clearing gives land rights). However, there are costs related to clearing of new land (given by L) and also costs from having a large area to cultivate in terms of walking, transport of inputs and outputs. These costs are represented by a convex function $h(H)$.

The farmer's problem is to minimize labour input subject to net income from the production. The Lagrangian function for this minimization problem is therefore;

$$G = L + h(H) - \lambda\{pAf[L, H, F(C)] - qF(C) - rC - sN\} \qquad (3)$$

where p is price of output and q is price of fertilizer. It is assumed that the credit obtained is solely spent to purchase the fertilizer (*i.e.* subsidized credit acts as a subsidy to fertilizer) and that there are cost of fertilizer and cost of credit. The subsistence requirement is given by subsistence consumption (=income) per capita (s) multiplied by the total population (N). Hence, the first-order conditions (FOC) are given as:

$$\frac{\partial G}{\partial L} = 1 - \lambda pA\frac{\partial f[L,H,F(C)]}{\partial L} = 0$$

$$\frac{\partial G}{\partial H} = \frac{\partial h(H)}{\partial H} - \lambda pA\frac{\partial f[L,H,F(C)]}{\partial H} = 0$$

$$\frac{\partial G}{\partial C} = -\lambda pA\frac{\partial f[L,H,F(C)]}{\partial F}\frac{\partial F(C)}{\partial C} + \lambda r = 0$$

$$\frac{\partial G}{\partial \lambda} = -\{pAf[L,H,F(C)] - qF(C) - rC - sN\} = 0$$

The following equations are obtained from the FOC:

$$pA = \frac{1}{\lambda f_L} = \frac{h_H}{\lambda f_H} = \frac{q}{f_F} + \frac{r}{f_F F_C} \quad \text{(from equation (2)} F_C = b\text{)} \quad (4)$$

$$pAf[L,H,F(C)] - qF(C) - rC = sN \quad (5)$$

The term $(1/\lambda)$ in equation (4) should represent the shadow wage of labour in the model. At the optimum the marginal costs per output unit of inputs should equal the price of the output (*p*) multiplied by the technological level (*A*). The marginal cost of per output unit of labour is derived as $(1/\lambda f_L)$ and the marginal cost of per output unit of land is derived as $(1/\lambda f_H)$. But due to the credit constraint imposed for the fertilizer input, the price of the output (*p*) multiplied by the technological level (*A*) should equal the marginal cost of per unit of output for fertilizer (q/f_F) plus marginal cost of per unit of output for credit $(r/f_F F_C)$.

The equation (5) implies that income for the subsistence requirement, given by subsistence consumption (=income) per capita (*s*) multiplied by the total population (*N*), is equal to the net income subject to the cost of fertilizer and the cost of credit. In this relationship the interest rate (*r*) will decide the cost of credit and therefore the amount of fertilizer input and the extent of land brought into cultivation.

Thus the effects of exogenous changes of the parameters on land area are fairly straightforward in this model. An output price increase or technological progress will make it economical for farmers to meet the subsistence requirement by producing from a smaller land area. Lower fertilizer price will induce the farmers to substitute fertilizers for land (and labour) and thereby reduce the pressure on forests. Similarly, a policy for subsidized credit (*i.e.* low value set for the *r*) will induce the farmers to substitute fertilizers for land (and labour) and thereby reduce the pressure on forests. But improved accessibility to forest land (lower costs of bringing new land into cultivation) will have the opposite effect. Population growth will increase the overall consumption (income) requirement and will leads to increased area of cultivation and deforestation.

The market approach and credit constraint

The market approach is a very different way of reasoning compared to the subsistence approach. In this approach the underlying assumption is that a labour market exists where labour can be sold or hired at a fixed wage (*w*). This wage rate is equal to the opportunity costs of labour used in agriculture. Land expansion decision is studied as a profit (land rent) maximising problem, although the household has other objectives. The assumption of a perfect labour market implies that production decisions can be separated from consumption and labour supply decisions of the household, and that the utility maximising problem of the household can be analysed as a profit maximising problem. It is noted that this way of modelling is often associated with profit-minded and commercial farmers, as opposed to highly risk averse and survival oriented peasants. The market approach does not need to specify any particular behavioural assumption for the farm household.

The household's production problem is to maximize the profit (or land rent) subject to fertilizer and labour inputs and the cost of credit

$$R = pAf[L, H, F(C)] - qF(C) - rC - w[L + h(H)] \qquad (6)$$

The FOC conditions are given as:

$$\frac{\partial R}{\partial L} = pA\frac{\partial f[L,H,F(C)]}{\partial L} - w = 0$$

$$\frac{\partial R}{\partial H} = pA\frac{\partial f[L,H,F(C)]}{\partial H} - w\frac{\partial h(H)}{\partial H} = 0$$

$$\frac{\partial R}{\partial C} = pA\frac{\partial f[L,H,F(C)]}{\partial F}\frac{\partial F(C)}{\partial C} - q\frac{\partial F(C)}{\partial C} - r = 0$$

The following equation is obtained from the FOC:

$$pA = \frac{w}{f_L} = \frac{wh_H}{f_H} = \frac{q}{f_F} + \frac{r}{f_F F_C} \qquad \text{(from equation (2) } F_C = b\text{)} \qquad (7)$$

It appears that the FOC are similar in the two versions of the model. But there is a fundamental difference that wage rate (w) is exogenous in the market approach and the shadow wage ($1/\lambda$) is endogenous in the subsistence approach. Further, population is endogenous in the market approach but exogenous in the subsistence approach. These differences make agricultural production and land use within the market approach as determined by relative profitability (R) in agriculture but not by any subsistence requirement.

It can be seen straight away from the equation (6) that a policy for subsidized credit (*i.e.*, low value set for the r) will increase the relative profitability of agriculture and induce farmers to increase the extent of their agricultural land and therefore increase deforestation. This argument is, however, depends on whether the credit is an investment for forest clearing or for forest management and agricultural intensification. Higher output price, or technological progress, will increase the relative profitability of agriculture and will have the same effect. Higher fertilizer price will reduce the relative profitability in agriculture and therefore reduce the area of cultivation and deforestation. Improved access to forest area (is similar to the subsistence case) will lead to an area expansion and deforestation. But higher wage rate will make cultivation on the forest margin unprofitable. Even though the population variable does not enter the model explicitly, population growth may have general equilibrium effects through labour and output markets, where it will affect indirectly through lower wages and higher food (output) prices.

Hypothesis

A summary of hypotheses for the effects of economic variables is given in Table 1 (as an extension of Angelsen *et al.*, 1999). The effect of changes in output price, technological level, fertiliser price and subsidized credit are opposite in the two approaches. The subsistence approach focuses on the effect of population growth but the profit maximising approach highlights the role of alternative employment (that is expressed through the wage rate).

Table 1. Hypotheses derived from the subsistence and market approaches.

Parameter	Effect on deforestation of an increase in the parameter	
	Subsistence approach	Market approach
Output price (*p*)	Decrease	Increase
Technology (*A*)	Decrease	increase
Fertiliser price (*q*)	Increase	decrease[O]
Clearing and access *h(Hj)*	Decrease	decrease
Wage (*w*)	not applicable	decrease
Population (*N*)	Increase	(increase)[*]
Subsidized credit (C)	Decrease	increase

[O]This effect is depends on when fertilizer and land are complementary inputs but the effect would be an increase if they are substitutes.
[*]Although the variable population does not enter into the model directly, population increase can have indirect effects through lower wages and higher food prices if a general equilibrium approach is used.

The demand function for agricultural land expansion in terms of the intermediate causes discussed under the both approaches is specified as

$$D = f(p, A, q, h(H), w, N, C) \quad (8)$$

where, D is area of land expansion (as a proxy for deforestation), and the other parameters are as specified in Table 1. The expected effects of the parameters on land expansion can vary depending on which approach dominates. However, availability of micro or regional level data limited empirical testing of the equation (8).

Demand for Fertilizer Use

We derive a demand function for fertilizer use (*F*). It is to test mainly the effect of subsidized credit on fertilizer use along with other parameters, because an increase in subsidized credit would have a negative effect on deforestation for the subsistence farmers in contrast to the profit-oriented farmers (Table 1). Following the production function (equation 1) and the fertilizer function (equation 2) the demand function is defined as

$$F = \alpha + \beta_1 a + \beta_2 C + \beta_3 L + \beta_4 H + \beta_5 S + \varepsilon \quad (9)$$

where *F, a, C, L, H* and *S* represents, respectively, the fertilizer input, initial capital of farmers, subsidized credit, labour, area cultivated (deforested) and sex of the farm household head. The intercept, slope coefficients of the variables and the error term are represented, respectively by α, *β's* and *ε*.

The variables initial capital (*a*) and amount of subsidized credit (*C*) will determine the amount of fertilizer affordable. The variable farm labour (*L*) would be a substitute for fertilizer input. Extent of area cultivated (*H*) depends on the amount of fertilizer used. The variable sex of the farm household head (*S*) is included in the model because the goals and preferences of the household are gender specific, and the use of fertilizer in production may vary with respect to whether the household is male-headed or female- headed (Ellis, 1993)...Further, the effect of fertilizer subsidy removal programs and their impacts on women farmers are somewhat different than on the male farmers in African countries as evidenced by Gladwin (1991). Usually an input demand function would be defined in terms of input and output prices (if conditional) or input price and output level (if unconditional). But the prime interest in this instance is to have an empirical relationship between fertilizer use and subsidized credit (and some other interesting factors). Even if input and output prices are included in the demand function for fertilizer, empirically it would be useless because there is no variation in the price variables since cross-sectional data for a particular cropping season is used. Otherwise, if the level of output could be included in the function, it would have to be done by the explanatory variables, labour and area cultivated, which are arguments in the production function (equation 1). Incorporation of the other variables, such as income of the farmers and sex of the household, are justified in the text. These variables are somehow important since they have policy implication in the context of fertilizer use in Zambia.

Empirical evidence from Zambia

Evidence from African countries, for example northern Zambia, showed that agricultural credit (access to credit) has been an important constraint to farmers to purchase sufficient amount of fertilisers. It has constrained the farmers even more particularly after the structural adjustment program (SAP) that has resulted in a contraction in the credit supply (or access to subsidized credit) to farmers (Culas, 1997). Because the credit markets in northern Zambia was usually rationed and interlinked with the supply of fertiliser.

There is also evidence that the reduced amount of fertilizer use by the farmers, particularly after the adjustment reforms, has shifted the intensive land use system into the (traditional) extensive land use system at the expense of forests, i.e. increased deforestation, in northern Zambia (Holden, 1997). Reed (1996) discusses the negative effects of the collapse of the rural credit system that resulted from the adjustment policy reform and its likely impact on deforestation for four of the African countries, Tanzania, Zambia, Cameroon and Mali.

The response of agricultural economies to the adjustment reform policies has been somewhat mixed. Commercial farmers have responded to new price signals by expanding and often diversifying production that have had both positive and negative environmental effects depending on the type of crops expanded and the degree of soil mining, *etc.* The response of small holders (*i.e.*, subsistence farmers) has been quite different. Deteriorating economic and social conditions during the transition phase of the adjustment program have lead to increased pressure on marginal land. The removal of input subsidies in many African countries moved agricultural inputs and credit beyond the reach of many small farmers, leading to more extensive land use practices and deforestation. This is in line with the subsistence approach discussed in the theory section.

The multilateral agencies contend that SAP clearly holds the potential for promoting both economic growth and environmental conservation, as repeatedly stressed in World Bank publications (World Bank, 1992). In practice such win-win gains have often not been realized because SAP has not been accompanied by the necessary policy and institutional reforms. This reflects both "the lack of intention to use the adjustment process to strengthen national environmental performance" (Reed, 1996) and the fact that the institutional reforms are much more difficult to implement than some of the basic "getting the prices right" reforms. SAP have boosted the economic growth and provided new incentives for resource extraction without undertaking reforms that could counter-balance the increased pressure on the environment.

We discuss farm level evidence from Northern Zambia with respect to the effects of SAP on removal of subsidized credit for fertilizer use in maize production. The study by Culas (1997) tested the equation (9) for the pre- and post-adjustment period policies in Zambia (for the cropping seasons 1986/87 and 1991/92) with respect to the year 1989 adjustment program. There have been on and off policies in Zambia with respect to the adjustment programs but we considered the periods before and after the 1989 reform. The regression results indicate that access to subsidized credit (measured by dummy variable) influence positively the amount of fertiliser used by the farmers irrespective of the periods. However, the farmers are found to be using less fertiliser during the post-adjustment period than the pre-adjustment period. The reason is that the adjustment policy reforms have substantially reduced the credit subsides to those farmers (Table 2).

Table 2. Variables influencing fertilizer use (Kg) in maize production.

Cropping season	1986/87		1992/93	
Constant	14.01	(61.27)	349.0	(121.6)***
Work force (man labour)	-6.336	(7.627)	1.07	(17.68)
Area deforested (*Chitemene*) in ha	-0.003356	(0.006527)	-0.00280	(0.02022)
Previous year farm income (in Kwacha)	178.72	(25.59)***	96.50	(32.93)***
Credit (0,1, yes is 1)	173.96	(28.19)***	316.73	(57.94)***
Sex (0,1, 1 is female)	-15.86	(29.08)	-191.75	(61.12)***
Degrees of freedom	57		45	
R-squared	0.707		0.675	

***Significant at 1 per cent level (standard errors are in parenthesis)

Chitemene is a term used to describe the traditional system of cultivation to produce maize in northern Zambia which involving deforestation by means of cutting and burning forest and woodland.

Further, the variable previous year's farm income, proxy for the variable farmer's initial capital, influenced the amount of fertilizer used for both cropping seasons. But the influence was higher for the 1986/87 cropping season compared to that for the 1992/93 cropping season (as can be seen by the respective regression coefficients). The variable area deforested is not significant but gets negative sign for both seasons. This implies that amount of fertilizer used is a substitute with the area of deforestation. The same is also true for the variable labour but only for the season 1986/87. The variable sex of household head influenced only for the 1992/93 cropping season. Female-headed households have reduced fertiliser use more than the male-headed households in that season. It is because the effect of fertiliser cost due to removal of subsidy is more on female-headed households than (labour rich) male headed households. Or, goals and preferences of the households with respect to fertiliser use vary and that can have an important policy implication (Ellis, 1993; Holden, 1991).

CONCLUSIONS

Agricultural expansion is the major direct cause of deforestation. The model of Angelsen *et al.* (1999) hypotheses effects of intermediate causes on agricultural expansion and deforestation under subsistence and market approaches. This model was extended for the credit constraint of the farmers for agricultural input because agricultural credit programs as a policy tool for improving agricultural productivity and incomes of traditional farmers has a long history. The empirical evidence from Zambia was discussed for the policy effect of removal of credit subsidy on fertilizer use. The evidence from Zambia suggests that the credit constraint of farmers needs to be considered explicitly in the theoretical model of agricultural land expansion.

The empirical evidence indicates that access to subsidized credit and the farmer's initial capital influence fertilizer use and also fertilizer is substitutable with extent of area of cultivation (deforestation) and labour input. Further, female-headed households have reduced fertiliser use more than male-headed households due to the removal of the credit subsidy for fertilizer.

An empirical analysis to test the effect of subsidized credit on deforestation, with respect to the subsistence and the market approaches, would be more appropriate to draw an effective credit policy in the future but this will depend on availability of the relevant data.

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