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Policies for sustainable land management in the highlands of Ethiopia

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Credit policy and intensification in mixed crop–livestock systems: A modelling perspective

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Provision of credit to smallholder farmers is one strategy for promoting adoption of improved crop and livestock technologies. Governments have often used credit programmes to promote agricultural output and credit policy could play a more efficient and equitable role in development if appropriate policies were adopted. However, advancing credit to smallholder farmers for encouraging technology adoption is a complex policy issue. Among the related issues are amount and form of credit, the interest charged, targeting of specific farmers' groups and specific activities, and repayment schemes. The objective of this ongoing research is to identify the appropriate credit policies for encouraging intensification. In this paper, we analyse the impact of advancing credit in kind in form of fertiliser on three groups of smallholder farmers with different levels of wealth.

Land degradation is severe in the highlands of East Africa. Soil erosion and soil nutrient depletion are critical problems. Ethiopia is among the sub-Saharan Africa countries with the highest rates of soil nutrient depletion. FAO (1986) has estimated that 50% of the arable lands in the Ethiopian highlands are moderately to severely eroded. These problems are contributing to low agricultural productivity, poverty and food insecurity and malnutrition in the highlands. The technological response to soil erosion and nutrient depletion is adoption of effective erosion control measures and improved soil fertility management technology, principally use of inorganic fertilisers. In the absence of technological response, poor smallholder farmers respond by cultivating more land to compensate for low crop yields. As with the situation in the Ethiopian highlands, the high population growth shifts the demand for food outward.

To respond to the increasing food demand, crop cultivation expands into pasture and steeply sloping marginal lands. The immediate consequence is further crop yield decline and rapid soil erosion rates. With the expansion of cropland, farmers need to keep more and more animals for traction, leading to a higher animal population. Besides, the cultivation of pasture land reduces feeds available for livestock, where feed inadequacy leads to low milk yields, high young stock mortality, longer parturition intervals and low animal weights. The consequences are poverty resulting from low crop and livestock productivity, malnutrition and food insecurity. Therefore, soil nutrient depletion, low crop productivity, inadequate livestock feed availability and inadequate human nutrition are strongly linked.

The lack of adequate quality feeds is the major constraint to improving livestock productivity in the highlands of Ethiopia, mainly because of shortages of grazing land due to expansion of crop production on grazing areas, lack of concentrates and the generally

low quality of available pasture. Despite recognition of this and the efforts to overcome it through feed research and development, progress in extending feed technologies, particularly forage crops, has been slow. This is principally because farmers cannot afford to allocate land to forage at the expense of food production. In modelling results for Selale, increased fertilisation of barley, the major crop in the area, increased adoption of on-farm production of oats or vetch intercrops, substantially. This suggests that increasing land productivity with improved soil fertility management will ease the competition for land between food and feed crops since now higher output can be produced from the same or smaller land area, freeing land for on-farm forage production.

Substantial evidence exists supporting the productivity and profitability gains from fertiliser application and intensification. With the increased use of mineral fertiliser during the 1995-96 and 1996-97 crop seasons, Ethiopia recorded its highest harvests of the major crops ever. Intensification also reduces the necessity of expanding cropping onto steep slopes and, thus, reduces erosion. Thus, intensification is a land saving strategy and impressive savings, similar to those that have accrued to China and India through application of modern technology to increase yields, can be expected. Since improved soil fertility management enhances crop stands and vegetative growth, this will also enhance straw production for animal feeds, thus, improving animal productivity. Improving animal productivity will contribute to food security, better nutrition and increased incomes. Besides, availability of more manure will contribute to further improvement in soil fertility and structure.

However, adoption of intensive crop production technologies requires that inputs be available to farmers and that farmers can afford them, provided that these technologies are profitable. Farmers often lack financial resources to purchase inputs. A sound credit policy helps to alleviate this financial constraint either by providing inputs when credit is given in kind or allowing them to buy these inputs when cash credit is considered without constraining their consumption plans.

A mathematical programming household model was developed and applied to data collected from the Holetta area (located 40 to 70 km west of Addis Ababa) to model the effect of credit on adoption of fertiliser technology. Substantial variability in crop allocation decisions exists among smallholder farmers. This variability is due to differences in level of resources such as land and labour, goals and needs. Moreover, the level of the farmer's wealth is among the important determinants of adoption of new technologies. As such, farmers cannot be treated as a homogenous group in predicting adoption and impact of new technologies. In this study, the Holetta sample farmers were disaggregated into relatively poor, medium and rich (by local relative standards) farmers taking into account livestock holding size, cropland area and family size as an indicator of labour availability. For each group, the impact of fertiliser credit is modelled. The model selects the cropping plan, the level of fertiliser used and the level of credit borrowed.

Because satisfying subsistence requirements of the household and production of sufficient quantities of straw are typically the principal objectives of the Ethiopian highlands smallholders, fertiliser credit is used by the three groups on the two major cereals: wheat and teff. In each case, the farmer borrows sufficient quantity of fertiliser for the entire area of these crops, according to the model results. However, the areas of these two crops differ

between the three wealth groups and are a function of total crop area of the household, available area and consumption requirements of the household (a function of family size). This scenario contrasts sharply with cropping allocation without credit where no fertiliser is used, according to modelling results. These results suggest that purchases of fertiliser compete unfavourably with consumption plans at planting time. Because of the low crop and livestock productivity caused by soil nutrient depletion, most farmers may have little food reserves and cash until next harvest. Some may need to sell some of their livestock. The last option was not included in this analysis.

The quantity of borrowed fertiliser is relatively small and ranges between 115 kg for poor farmers to 240 kg for rich farmers or 207–431 Ethiopian birr (EB; US\$ 1 = EB 8 in October 1999) worth of credit. The area fertilised is also relatively small, ranging from 0.9 to 1.87 hectares (ha) with moderate rates of application. Nevertheless, the income effects were substantial. Poor farmers increase their income by 25%, while rich farmers increase their income by 57%. Moreover, application of fertiliser allowed substantial increases in the quantities of residues (straw) produced for livestock feeding, since fertilisation also enhances the growth of the above ground biomass.

The above analysis considers the effect of fertiliser credit advanced to smallholder farmers disaggregated by their wealth. The results support our hypothesis that credit will encourage intensification of the smallholder farming system of the Ethiopian highlands. This is expected to indirectly respond to the prevailing animal feed constraint. Based on this analysis and the empirical framework introduced, several hypotheses are formulated and will be tested in subsequent research:

1. Credit is an effective policy option to encourage adoption of intensive agricultural technologies.
2. Beside wealth, market participation is a major determinant of the amount of credit demanded by farmers. For example, credit demands of smallholder dairy farmers with crossbred cows are expected to be higher than those of subsistence farmers.
3. Intensification of crops and livestock reinforce each other, e.g. crop intensification allows market-oriented smallholder farmers to free some land for on-farm production of fodder and feeds for their herds, which, in turn, leads to livestock intensification.
4. Since the conditions are already favourable for intensification in the highlands (population pressure and land scarcity), in-kind or cash credit will have the same effect, provided that farmers have access to these inputs.
5. Given the tendency for low crop prices immediately after harvest, the repayment terms of the credit are important in determining farmers' decisions regarding the amount of credit to borrow and the crops to produce.

Reference

FAO (Food and Agriculture Organization of the United Nations). 1986. *Ethiopian highlands reclamation study. Final Report*. 2 volumes. FAO, Rome, Italy.