Economic conditions for sustainable agriculture

A new role for the market and the state

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Field research by the Development Economics Group of Wageningen University on various agro-ecological practices used by farmers in Central America (Nicaragua, Honduras, Mexico and Costa Rica), East Africa (Kenya, Ethiopia, Zanzibar) and West Africa (Mali, Burkina Faso, Benin) provides interesting comparative results regarding the economic effects in different settings. For this research, four specific criteria were used to assess the economic attractiveness of different types of agro-ecological practices: (i) profitability, e.g. the contributions to farmers' income and consumption, (ii) effect on input efficiency, (iii) consequences for labour use, and (iv) impact for risk management. On the basis of these findings, recommendations for policy reform are discussed.

Profitability

Adoption of agro-ecological practices can only be expected when farmers attain higher and more stable income and consumption opportunities. Contrary to what is usually expected, farmers are likely to apply yield-increasing and sustainability-enhancing inputs for commercially-oriented production activities. In the cotton belts of Southern Mali and Burkina Faso, fertilisers, crop residues and animal manure are mainly used for cash crops that guarantee sufficient monetary returns to warrant these costs. Similarly, animal traction and improved tillage yield higher returns when applied on more fertile fields where commercial crops are grown. In the Central Chiapas region of Mexico, crop residue mulching only appears to be profitable when combined with animal traction on fields devoted to intensive market-oriented maize activities.

Although we found that agro-ecological practices are likely to be adopted by subsistence-oriented, medium-size farmers in remote regions where opportunity costs are usually low, farmers' engagement in market exchange can still be considered an important condition for profitable and sustainable agriculture. Engaging in trade provides financial resources for the purchase of complementary inputs and consumption goods. Market development enhances the willingness to invest, while involvement in market exchange generally improves farmers' responsiveness to price incentives.

Input efficiency

Agro-ecological approaches are strongly based on the substitution of chemical inputs by integrated nutrient and pest management systems. High costs of inorganic fertilisers and other agro-chemicals often drive farmers to rely on locally available resources. Reducing the reliance on purchased inputs implies that good substitutes can be found and that complementary relations between different inputs are recognised.

Prospects for sustainable agricultural intensification strongly depend on the possibilities to improve *input efficiency*, e.g. the marginal returns derived from an additional unit of (organic or inorganic) inputs. Nutrient efficiency (i.e. fertiliser uptake) is determined by the availability of complementary micro- and macro-nutrients, notably soil organic matter and phosphorus. Nutrient recovery and the efficiency of uptake can be enhanced through (i) soil and water conservation measures, and (ii) frequent nutrient applications at times required by the crops (e.g. shortly after sowing and with sufficient rainfall). Both activities are highly labour-demanding and can hardly be mechanised. Input efficiency tends to be low when complementary inputs are not available at the right time or in sufficient amounts.

Organic and chemical inputs are not full substitutes, and combinations of locally available resources with selectively applied external inputs often yield the best results. We found that farmers hesitate to refrain completely from the use of purchased inputs, because it permits better timing of activities, reduces the demand for labour in critical periods, and contributes to a better appearance of the products in the marketplace. Given the low nutrient content and the delayed nutrient availability from organically produced fertilisers (green manure, mulch, dung, compost), chemical fertilisers are gradually reduced but not completely abandoned.

Labour productivity

Most analyses of sustainable practices devote attention to short- or long-run yield effects without acknowledging labour requirements and returns to labour. Family labour is thus wrongly considered as an 'abundant' resource. For most small farmers labour is scarce and strong limitations exist for substituting external inputs by labour. For a systematic evaluation of the attractiveness of such practices from the farm household's perspective, returns to land and labour need to be compared simultaneously. Agroecological intensification can only contribute to poverty alleviation when returns to land and labour increase simultaneously. When agroecological practices are analysed, attention has to be given to *marginal* returns compared to other activities (i.e off-farm employment; hiring-out of land).

Agroecological practices can be relatively intensive in the use of labour. Physical soil conservation measures promoted in the Central American hillsides and West African lowlands have resulted in yield increases, but require large amounts of labour for construction and maintenance and involve substantial costs for the purchase and transport of materials. Given their high labour intensity and long gestation period, returns to labour of such measures are mostly critical. Similarly, green manure practices and crop residue mulching in Mexico and Honduras require additional labour for harvesting, transport and under-ploughing. Mixed cropping and agroforestry systems in Central America and East Africa show low returns to labour due to high establishment, maintenance and harvesting costs. Production of fodder crops for livestock in West Africa improves the availability of manure and enable farmers to recycle crop residues, but demand considerable labour investment. Labour requirements for integrated pests and disease management in Zanzibar are equally high due to the substitution of manual for chemical operations. Mechanisation is not a feasible option due to very sloping terrain and the small scale of operations.

We found that high labour intensity can be a major limiting factor for adoption. Labour tends to be scarce in semi-arid areas during the periods of soil preparation, weeding and harvesting and competition for labour occurs when mulching, manuring or crop residue recycling are introduced. Resource-poor farmers are likely to derive part of their income from off-farm activities that have to be reduced when labour-led intensification of their farming system takes place. Farmers are likely to adjust their production system only when the additional income derived from those activities favourably compares to labour's opportunity cost. Some practices, notably physical soil conservation measures, can be executed in off-season periods, but take up leisure time that may be reserved for social or communal purposes.

Risk-coping

Resource-poor farmers prefer to rely on fairly diversified patterns of activities to ensure appropriate levels of risk management. Farmers facing risk prefer immediate revenues and therefore investment activities with long gestation lags are not popular. Diversification of cropping and livestock production and their integration with (agro)forestry, aquaculture and improved fallow practices could reinforce the resilience of farming systems through processes of nutrient recycling, biodiversity management and integrated pests and disease control. Consequently, yield levels tend to be more stable and dependency on purchased inputs can be reduced.

Risk management can also take place through farmers' engagement in off-farm and non-farm activities. The revenue streams derived from these activities are far less dependent on variable weather conditions and thus provide an adequate insurance against shocks.

Policy Reforms

Agroecological practices are widely promoted by farmer groups and NGOs to reduce the dependency on purchased inputs and to reinforce ecological sustainability. On the long run, genuine sustainability requires that these practices become economically feasible and independent of external support. To facilitate sustained adoption of agroecological practices, the following economic policy conditions should be in place:

Stable and remunerative *market prices* for agricultural products are effective as incentives to mobilise resources towards sustainable production systems. Massive adoption of new cropping systems could, however, lead to pressure on market prices and loss of initial returns.

Agricultural intensification also implies that land, labour and capital resources can be effectively mobilised. Secure and recognised *land and water rights* are an important condition to enhance farmers' willingness to invest. Well-defined ownership, use and transfer (inheritance) rights permit farmers to invest in land improvements and input purchase, and provide a suitable collateral for lending.

Rural *financial systems* are necessary to facilitate farmers' borrowing for investment, input purchase and insurance purposes. While formal banks are usually less inclined to lend to smallholders, local credit and savings schemes could contribute substantially to reduce transaction costs and risks for rural investment.

Reinforcement of the market environment can be considered as an important incentive for investments in sustainable agriculture. However, incentives should be related to '*farmer needs pull'* rather than '*technology push'*. Market prices should reflect real scarcity relations as perceived by the farmers and must not be distorted by improper interventions by the state or local NGOs. Subsidies on inputs or credit are not useful to enhance the lasting adoption of agroecological practices. Subsidies on demonstration plots are less convincing to farmers compared to experiments conducted on their own fields and investments made with own resources. In a similar vein, financial support systems based on farmers' own savings proved to be far more sustainable than subsidised credit systems.

Interventions to improve the market environment in favour of agro-ecological practices:

- Increasing the prices of imported inputs like fertilisers and other agrochemicals through adjustment of the exchange rate (devaluation) and elimination of input subsidies;
- Improving the efficiency of input delivery and output marketing systems, looking for a reduction of the transaction costs involved in market exchange through (public and private) investments in services and infrastructure provision;

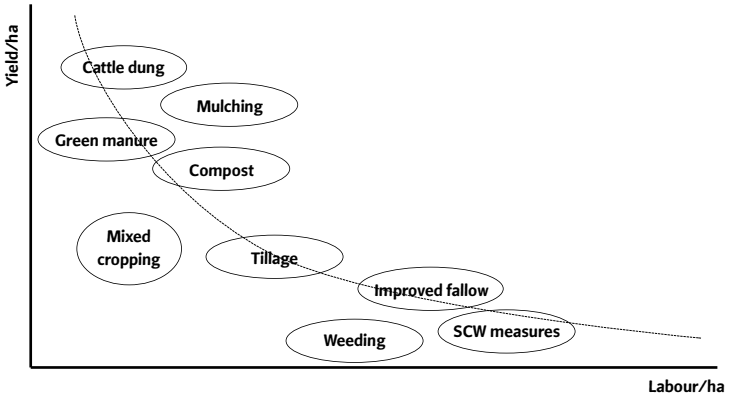

Figure 1: Factor intensity and yield effects of major NRM practices

The figure provides an overview of some agro-ecological practices used by Central American farmers, taking into account expected yield effects and labour requirements. The final selection of suitable practices made by the farmer is likely to depend on the labour/output price relationship.

- Introduction of user charges and fees for water, roads and technical assistance to facilitate the rationing of scarce resources towards the most efficient farmers, and to guarantee the institutional sustainability and maintenance of these services;
- Creation of more competitive markets through reduction of the market entry costs, including the establishment of farmers trading co-operatives, market information services, etc.;
- Improving value addition in agricultural production and marketing through investments in agro-processing, trade centres, product certification, etc.;
- Enhancing the backward and forward linkages of agricultural production, promoting integrated agro-commodity chains based on delivery of improved implements;
- Diversification of factor and commodity markets, enabling farmers to gain access to off-farm and non-farm income sources that will enable the intensification of their farming systems.

Public investments in infrastructure are required to support the development of local factor and commodity markets. Market development and reduction of transport costs are the most important requirements for sustainable agricultural intensification, since exchange relations favour access to complementary inputs and provide incentives for investment. Improving poor farmers' access to physical infrastructure represents a major condition for equitable and sustainable rural development. Without such efforts, low-input technologies tend to be restricted to medium-size farmers who are only marginally engaged in market exchange.

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