Economic evaluation

In the ILEIA Newsletter a broad number of relevant practical experiences in making farming systems "sustainable" at farmers' level are reported. The economic appraisal of these practices, however, receives relatively minor attention, while costs and benefits are not always clearly identified. Also, a positive cost-benefit relation does not mean that adoption is feasible for all types of farmers. Therefore, methods are required that permit the appraisal of different technical options from the viewpoint of farmer economy. However, suitable methods for economic appraisal of sustainable agriculture are still little developed. Moreover, guidelines for economic policies that may enhance farmers to adopt LEISA practices are not readily available. In this article the appropriateness of some basic tools for economic appraisal are discussed.

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Quantitative assessment of the attractiveness of production techniques is usually realised within a cost-benefit framework. Private or financial cost-benefit evaluation uses market prices to value inputs and outputs. With appropriate policies to correct for market imperfections, environmental off-site effects could also be incorporated into input costs or output price, but acceptable standards to do so are still not available. In addition, a suitable interest rate is required for calculating (discounting) future costs and benefits. For smallholders with limited access to local sources of finance (financial markets) and few (marginal) relations with input and output markets, such a financial evaluation (valuation) is far from easy.

If, for example, High-External-Input (HEIA) is compared to Organic (OA) or Traditional (TA) Agriculture differences in the following aspects of the cost and benefit structure need to be analysed:

- external - internal input costs;
- net (physical) land productivity;
- labour intensity
- market prices

Table 1 presents a data set for the comparison of HEIA, OA and TA (based on UNDP, 1992). The relevant costs and benefits for banana production in the Dominican Republic are compared. The table suggests that short-run conversion from HEIA to OA is only feasible when market prices increase substantially (from $330 to around $430). This supposes the existence of a separate market segment for organic products.

Besides these directly measurable items, other aspects should be taken into account as well. A large part of land productivity can be based on soil mining, thus affecting prospects for future harvests. Evaluations of income flows based on nutrient depletion and valued against market prices for fertilisers, indicate that in Southern Mali up to 40% of farmers' incomes proceed from soil mining (vd Pol, 1992). These benefits will decrease in time and should be taken into account within a multi-year framework. Sometimes environmental (repair) costs are included in the cost price, but this procedure generally will depress production and is not warranted as long as producers decisions are based on real market prices.

The data presented in table 1 indicate that, in these cases, physical labour productivity (measured in kg/man-day) in OA

Table 1
Financial comparison of banana production in HEIA, OA and TA

Parameter	HEIA	OA	TA
Production (tons)	36	29	16
Fertilizer input			
N (kg)	400	-	-
P (kg)	100	-	-
K (kg)	400	-	-
Compost (ton)	-	2	-
Manure (ton)	-	58	-
Input costs (US$/ha)			
NPK	602	-	-
Manure/compost	-	462	-
Pesticides	110	-	-
Labour input			
man-days	321	468	156
costs (US$/ha)	1030	1503	501
labour productivity (kg/man-day)	112	62	103
Total Costs (US$/ha)	1741	1965	657
Gross Income			
at market prices[1]	11880	9570	5280
at modified prices[2]	11880	12470	6880
Net Income			
at market price	10139	7605	4623
at modified prices	10139	10505	6223

Source: UNDP, 1992.
Notes:
[1] Market prices are US$ 330/ton;
[2] modified prices offer a premium of US$ 430/ton.

# of LEISA farming

production is far behind the levels reached in HEIA as well as TA production due to higher labour input for weeding and manuring.

The actual income from land and labour resources can also be higher or lower than the income obtained if they would have been used in another way (alternative use value). Where off-farm employment is an important additional income source, the organic farmer has less and the traditional farmer has more time left for this activity when compared to the HEIA farmer. Depending on the relative price payed for off-farm labour this can favour development of organic farming or can be a constraint. The same reasoning is valid for land resources.

Economic evaluation

For farmers, financial costs and benefits are not the only relevant parameters for selecting techniques, as profit maximisation is usually not the ultimate goal. Other less tangible economic benefits that should be valued include the reduction of risk, less dependence on markets to guarantee household food security, reduced credit demand and several cultural gains. Sustainable land use is not always an explicit priority at farm level and has to be made consistent with other household objectives. A composite index of household utility could be derived, in order to evaluate the possible acceptance of alternative techniques by farmers. Food security, risk avoidance, access to a range of services (education, health) and especially leisure contribute to utility. But readily available procedures to account for these additional factors are more difficult to find.

The assessment of risk is based on reduced yield variance due to, for example, improved soil management (soil moisture and organic matter content). Moreover, price risk depends among others, on the coincidence of harvest time (yield co-variance) among farmers in the same region. Small farmers are considered to be risk-aversive, thus willing to sacrifice part of their income for risk diversification. This trade-off should be included into the cost-benefit framework.

Pricing procedures also directly affect the results of financial evaluation. Production for home consumption could be valued at higher prices, if e.g. alternatives are absent on the local market. The cost of labour proves to be a very debatable issue. For on-farm labour a reservation wage can be determined as a kind of minimum remuneration required to mobilise labour resources for a particular type of work. Otherwise also leisure time has to be valued, as it clearly contributes to household utility. In case additional labour demands are met with family labour, leisure decreases. This may be compensated by relying on hired labour. This often means that more produce is sold on the market (to guarantee wage payment) and thus reinforces the influence of market risks. Consequently, while natural risk is avoided by using organic fertiliser, market risks may increase.

Photo: Bertus Haverkort

Better access to inputs and improved market infrastructures will lead to more favourable prices and thus farmers will be induced to produce for the market.

Production function approach

Analysis of economic feasibility of LEISA techniques can be improved by making use of production functions. While cost-benefit analysis only offers partial results from a comparison of a limited number of farmers, for production function estimates a substantial data set from a wider number of farms is required. Production functions measure for different input quantities the amount of physical or monetary output. They can be represented graphically as a function between production and one input, keeping all other inputs constant.

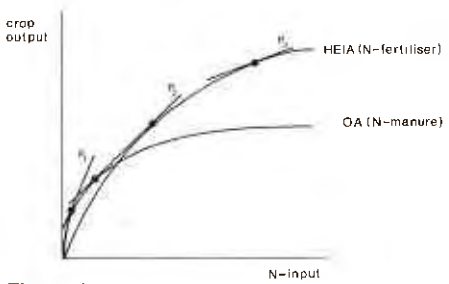

Figure 1

HEIA and OA use different inputs and different techniques for producing agricultural output. The OA approach emphasises the use of organic manure, biological pesticides and home-produced seeds, while HEIA relies much more on the use of chemical fertiliser and pesticides, and purchased (hybrid) seeds. These two approaches to farming are therefore based on different production functions. In figure 1, the relationship between only one input (e.g. N-input from chemical fertiliser or manure) and the quantity of output is depicted for HEIA and OA.

At low input levels, OA is likely to be more efficient than HEIA. Small input quantities of manure, biological pesticides, and indigenous seeds are likely to give better results than comparable quantities of external inputs (see also Hayami and Ruttan, 1985: pp. 133-136). The (hypothetical) OA production function is depicted as an inwards curved line, because of the law of diminishing returns which states that when increasing amounts of inputs are being used additional output per unit input will decrease. At a certain point, the OA curve will intersect with the HEIA-curve. High-yielding (hybrid) varieties that are highly responsive to fertiliser are likely to produce more output than OA-techniques using the same quantity of N-input. Again, the (hypothetical) HEIA function is assumed to have an inwards curved shape.

The price relationship between N-input and crop output determines the preference for HEIA or OA. At low output market prices and high fertiliser prices OA will be preferred. At relatively high output and low external input prices HEIA tends to offer better economic prospects. The price ratio of output to input prices can be shown in the figure by drawing the line that is tan-

gent to the curve. When the ratio of input to output price is high (p1), the angle between the line and the x-axis is large and OA will give the highest profit. When the ratio of input to output price declines (p2), the angle becomes smaller. For one price ratio, the line that is tangent to the OA curve is also tangent to the HEIA curve (marginal output equals marginal input for both techniques). When the price ratio declines further, HEIA becomes more profitable than OA.

The shapes of the production functions may vary for different soil types. On deep fertile, well drained soils with less acidification risks the production function will assume a more steep form, as there is a greater crop response to N-fertiliser input. Therefore, the point where the same line is tangent to both the OA and the HEIA production function will be located more to the left (i.e. at a lower input level) and at a higher level of output per hectare. This explains why OA techniques are assumed to be used mostly in less favourable conditions, mainly to increase soil buffer capacity.

Markets

Market prices and conditions directly influence the feasibility of market oriented production systems. Improvements in (transport) infrastructure, information availability, access to credit and other improvements in the functioning of markets will usually reduce the costs of purchasing inputs and increase the farm gate price received for crop output. When prices become favourable small farmers producing mainly for self-sufficiency will be induced to produce for the market and - after the input-output price ratio has passed a certain critical level - to adopt high external input production techniques. Therefore, agriculture which uses mainly internal inputs tends to be restricted to an environment with low market development and in the long term its opportunities to improve its economic performance may belimited (Leegte, 1994).

Decisions on land use and resource allocation may be influenced by the government through agrarian policies that modify the economic environment and thus the outcome of the production process. For example, the above picture may change when prices of important external inputs are such that they reflect external environmental costs. The incorporation of environmental costs related to high chemical input use will raise the ratio of input to output prices for high external input agriculture. As a result, its profitability declines and organic fertilisers and biopesticides are likely to be preferred by more farmers.

Another way of promoting OA is to increase the price of products produced by using OA techniques. The example given in table 1 indicates that a price increase of at least 30% is required to enable profitable production with OA techniques. Such a price premium can be reached only after a period of adjustment, when the organic nature of the product can be certified and marketing channels are established to specialised wholesalers and retailers. Financing mechanisms are to be defined that permit the coverage of lower net benefits during this transitional period.

Conclusion

Introduction of OA practices means a fundamental change in input requirements and will be accompanied by changes in land and labour productivity. Prices of inputs and outputs determine to a large extent the economic feasibility of OA. Small farmers with limited land resources will give priority to high land productivity at lowest possible risk. Moreover, the effects of different production techniques on labour demand and internal division of labour should be taken into account. If OA requires more labour, the sacrifice of farm households in terms of leisure or external wage income may limit its adoption.

Economic comparison of different approaches to farming could be reinforced by making use of a production function approach. Alternative production systems can be compared if they produce similar output while production takes place with different combinations of inputs. External effects can be taken into account (by looking at the joint output), while the long-term impact on soil structure requires an analysis of growth paths of production. Results are especially useful for the analysis of effects of price policies and to orientate rural extension and technology appraisal.

The ratio of input to output prices determines the feasibility of each production technique. High external input prices compared to market prices tend to favour OA, but rising output prices will again promote a shift to HEIA. Therefore, different types of farmers can select specific production techniques as most profitable, depending on their resource availability (soil quality, land tenure, labour availability) and the effective prices they meet.

Empirical analyses of the economic rationality of LEISA and OA are urgently needed. They should be based on empirical data sets describing farmers' behaviour. Detailed registration and analysis of input use and output level, their prices and relative scarcity, and the impact on labour use will offer valuable insights into the conditions that could favour HEISA or LEISA. ■

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Further reading

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A comprehensive reader with mainly European case studies on farm-level performance of organic farming systems, economic requirements for conversion towards organic farming, and agricultural policy instruments to assist farmers during the transitional period.
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Farm management research for small farmer development by JL Dillon and JB Hardaker. FAO Farm Systems Management Series No 6, 1993. 302 p. ISBN 92-5-103305-6. Available in English, French and Spanish.

A classical publication on conventional farm and village level economic assessment of smallholder agriculture in developing countries. The book has recently been updated with new methodologies developed in Farming Systems Research, Rapid Rural Appraisal and Policy Analysis. Use of computers in data analysis is included too. Participation of farmers in economic assessment is not yet considered. (CR)