Ecosystem Health and Sustainable Agriculture

Sustainable Agriculture

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Efficiency is a relative measure of performance between farms or within the same farm over time. Considering all elements of production, the measure refers to technical efficiency. It is important to distinguish between productivity and efficiency, since if a farm is productive then it is also technically efficient but not necessarily economically efficient, as this depends on prices. To be efficient the farm does not need to be at maximum production, since the intensity and scale of the business also plays an important role. In an environmental sense, productivity and input-specific efficiency are both crucial measures. From a nutrient point of view farms should have as high productivity as possible. It is also important to realise that high productivity is not equivalent to high intensity. Although this all sounds confusing, the elements can be clarified in a diagram (Figure 14.1).

The system boundary is the extreme observation. Typically the boundary is determined by parametric or non-parametric econometric methods such as stochastic boundary or data envelopment analysis. The relative efficiency value of the observations can vary between one and zero, with one indicating technical efficiency (TE) or simply that the observation is on the boundary. Low TE values indicate that the relationship between outputs and inputs is worse than on other farms or in other years, indicating either too high inputs or too low outputs. Moving vertically in the diagram gives increasing technical efficiency and moving horizontally gives increasing input-specific efficiency, or environmental efficiency as it is also called.

When it comes to actually measuring efficiency and productivity, we often have to rely on farm accountancy data or experimental data. The benefit of farm accountancy data is that the economic activities are all handled similarly. However production possibilities, e.g. soil types, are not distinguished from management. The benefit of experimental data is that it eliminates the management component, as well as including a range of intensities for the same type of production.
Nutrient management is important for productivity, since appropriate fertilisation of crops increases output considerably. The use of crop protection chemicals also increases the uptake of nutrients that will end up as outputs. Clearly the maximum biological output is not the same as the highest productivity. In most cases the intensity of nutrient use has the following sequence: the biological maximum requires the highest amounts of inputs, then follows the economically efficient production level, which is dependent on prices and is close to the economic optimum and thereafter the level of input that is at the most productive level. Reducing inputs even further decreases output even more and therefore productivity. The environmental efficiency or the input specific efficiency might be anywhere on the boundary but on average is probably close to the most productive output level.

In a study by Bäckman (2008), livestock density was shown to increase technical efficiency using results based on aggregation of products with 2004 prices (Increased cereal prices in relation to intermediates could change this interdependency since the competitiveness of self-sufficient farms would increase). However, this increased efficiency is associated with an increase in nutrient management problems. Having high livestock units per hectare (LU/ha) creates a need to export fertilisers (manure) from farms. In cases with regionally intensive livestock production there is a need to process organic fertilisers. In Sweden, for example, there is a LU/ha density upper limit, while in organic farming there is an indirect livestock density restriction in that only a certain degree of feed is allowed to be imported to livestock production on the farm.
Chapter 13


Chapter 14


Chapter 15


Chapter 16


Chapter 17


