5 Evaluation of the methodology as applied in the VEGINECO project

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5.1 Introduction

The prototyping methodology of designing, testing, improving and disseminating new farming systems as described and used in the VEGINECO project is based on Vereijken (1999). It can be characterised as a synthetic research/development effort starting off with a profile of demands (objectives) in agronomic, environmental and economic terms for a more sustainable, future-oriented farming and ending with tested, ready for use prototypes, to be disseminated on a large scale. So far, the general concept of the methodology proofed to be useful. However, the methodology as developed by Vereijken, was mainly developed for arable farming systems. When going into details, adjustments need to be made to make the methodology fit for field-grown vegetable farming systems as was shown in Chapter 2.

5.2 Analysis and diagnosis

The analysis and diagnosis of the shortcomings in the present vegetable farming systems were the basis for the formulation of the system targets and the design. A new strategy was set up by dividing the analysis into three areas: farming practices, social demands and ecological and environmental effects. These areas cover all aspects of farming. In Chapter 3, no attention was paid to the agro-ecological state-of-the-art technology because this is described in the other method manuals (VEGINECO project reports 3, 4 and 5).

In the VEGINECO project, the analysis was done in the first year of the project. During this year, the systems were already running because the length of the project was limited. This means that in the VEGINECO project, the conclusions from the analysis and diagnosis could not be the basis for the design of the systems, as it should have been. In addition, the analysis was limited in detail because data was not available on some factors such as emission of nitrates and pesticide residues on produce. Sectoral statistics were often not available in sufficient detail. Lack of reliable and useful data for a complete analysis and diagnosis is a general problem that cannot be overcome.

In new projects, it is advisable to take sufficient time for analysis and diagnosis before starting the design phase. In addition, analysis and diagnosis should be updated during the project. From testing and improving, new questions arise and new information is needed to improve the design, to which analysis and diagnosis can contribute. The analysis and diagnosis should be as extensive as possible to have a complete picture of the problems in a region. Deficits have to be defined clearly to be able to resolve them in the other phases.

5.3 Design

In the design phase, the objectives and the set up of the system have to be determined. This phase is complete when a theoretical prototype with complete crop programmes is ready to be put into practice. First objectives have to be formulated. Next, parameters have to be developed with target values to be able to test the objectives. The system needs to be designed with the aid of state-of-the-art, multi-objective methods. Finally, this results in an evaluated and complete prototype that in theory can satisfactorily meet the objectives.

5.3.1 Objectives and themes

The hierarchy of objectives as described by Vereijken was converted to a set of themes covering almost all of the aspects of farming systems. The themes used in the VEGINECO project were quality production, clean environment, natural resources and landscape, sustainable use of resources and farm continuity. In addition to these themes, health could be defined as another theme. This theme is especially of importance in animal production systems.

5.3.2 Parameters

Parameters with target values were defined to evaluate the performance of the farming systems. A suitable set of parameters needed to be defined. In the opinion of Vereijken (1994), these parameters needed to be multi-objective. In the VEGINECO project, this was not a requirement; parameters were connected to a specific theme. In addition, parameters must be influenced by the farming practices. However, other factors influence the value of the parameters, for example, net surplus (NS) in which prices play an important role and nitrogen available reserves in autumn (NAR), where weather (rainfall, temperature) is an important factor.

New parameters were also developed. To evaluate specific pesticide damage to the environment, a parameter was developed for the potential emission of pesticides in addition to the existing parameter for pesticide use (EEP). This parameter was used during the project in the testing and improving process, and proved to be a good basis for the selection of the most harmless pesticides. The parameter energy input (ENIN) was developed as an indicator for fossil energy use and CO_2 emissions, which gives a good insight into energy use. This parameter was not used in the testing and improving process as it was in the developmental stage and too labour intensive. Standardised calculation methods were not available and the basis to define target values is still missing.

More research is needed to make the parameter suitable for practical use. For the theme nature and landscape, a complete set of new parameters was developed as is described in more detail in the manual on Ecological Infrastructure Management (VEGINECO project report no. 5).

In addition, the parameters on quality and quantity of the produce were redefined. Quality and quantity parameters can now be quantified at a farm level, and were compared between regions by making crop yield and quality relative to good regional yields and quality levels. Farm level quality and quantity is calculated from an area considered to be average in the relative crop quality and quantity. Making yields and quality relative to good regional yields made it possible to compare yield levels for regions. However, it is difficult to establish objective good regional yields and quality levels.

Some existing parameters seem to be inadequate such as soil cover index. In the VEGINECO systems, this parameter was not useful because the main reasons to have soil cover; prevention of erosion and leaching and nature aspects were not a problem in the systems (erosion) or were covered with other parameters (leaching and nature). In first instance, magnesium available reserves and the magnesium annual balance (MgAR, MgAB) were included as parameters. As magnesium availability appeared to be no problem in one of the systems, the parameter was eliminated. The same could have been done with the parameter for nitrate content in crop produce (NCONT). High levels were not encountered and the target value was reached in all systems. However, this parameter was not eliminated.

The total set of parameters should cover the entire farming system, or at least all the problems encountered for similar farming systems in the region. In the VEGINECO project, a parameter on water use was missing, although increasing efficiency of water use in most systems is an important item, especially in Spain. In addition, parameters were missing because of costs, for example, nitrogen leaching to ground and surface water. As measuring was too expensive, the available nitrogen reserves before the start of the leaching season (NAR) were used as indicators for nitrogen leaching.

5.3.3 Setting target values

Parameter target values should be ambitious and relevant. They can differ per system because of differences in legislation or system specific differences. Especially when target values are negotiated between stakeholders, differences can occur. Differences between target values between systems for the same parameter are very clearly visible for the quality of production parameters QLP and QNP. Yield and quality targets per crop are set, dependent on the good regional yields in the region. Another example is the different target values for the soil reserves (PAR/KAR) as they are dependent on the analytic technique used, which is different in each country.

Target values can be unattainable and/or not be based on good scientific data. This was the case for the nitrogen reserves before the start of the leaching season (NAR) in Spain. The target value set is based on a rainfall deficit of approximately 400 mm because in Spain the deficit is only 128 mm. Therefore, the target value is inadequate. Research is needed to derive a target value for NAR in the Spanish systems. Another option is that target values are attainable, but only in the long term as is the case for available phosphate and potash reserves (PAR and KAR) in Italy and Spain. It will be at least 10 more years before the values reach the target range. Within the duration of the project, the values will maximally show a tendency in the direction of the target.

Switzerland had problems with setting targets for their farms, in general, as these farms more heterogeneous in farm type and environment than experimental farms. Nevertheless, working with subjective elements is inevitable in this type of research and setting targets has proven very helpful in the improvement of farming systems.

5.3.4 Methods

Farming methods are used to construct the prototype. New, multifunctional farming methods are replacing the conventional, one-sided methods that only aim to increase production. Four of these methods are described in the method manuals (Multifunctional Crop Rotation (MCR) in this manual, Integrated and Ecological Nutrient Management (I/ENM) in VEGINECO project report no. 3, Integrated and Ecological Crop Protection (I/ECP) in VEGINECO project report no. 4 and Ecological Infrastructure Management (EIM) in VEGINECO project report no. 5). These methods are very much interlinked and, therefore, in contrast to what may be suggested in each separate manual, they cannot be viewed separately. The MCR method describes crop rotation. I/ENM takes into account all contributing sources in nutrient management and helps to determine fertiliser type, amount and optimal time to be applied. I/ECP is supporting crop rotation perfecting the crop protection strategies. In integrated systems, much attention is paid to pesticide selection. EIM places the rotation in its natural resource and landscape context, providing maximal positive interaction between the environment and the landscape.

In the VEGINECO project, little attention is paid to the methods Farm Structure Optimisation (FSO) and Minimum Soil Cultivation (MSC). MSC is not examine because few of the concepts are useful and specific for vegetable farming, and are not valid all over Europe. Attention is paid to soil cultivation in the Netherlands by testing the eco-plough and in Italy and Spain by using the rotary hoe. FSO is not examined because the project was aimed more at the agronomical side. However, for commercial

farms, FSO is a very important integrating method because of the emphasis on the evaluation of economic aspects of farming. In the project, attention was paid to FSO with the economic evaluation, which was done in the last year. Extensive discussions on the different methods can be found in the method manuals.

5.3.5 Theoretical prototype

The results of the farming methods are used in the theoretical prototype. Using the objectives to evaluate the prototype guarantees that an optimal prototype has been developed. If the deficits are too large, the design can be changed before the prototype is put into practice. This can reduce the costs during the expensive testing and improving phase.

5.4 Testing and improving

Testing and improving consist of lying out and running the system in practice. Measurements are made to evaluate the system annually. A clear analysis of the reasons for the shortfall is the basis for improvement. Then, redesign of the system may be necessary. Those topics and methods that caused the shortfall need to be focused on. This is a difficult process because pinpointing the causes or source of shortfall can be difficult. If a source is found, it is often difficult to redesign the system because changing one part means that other parts may also need to be changed as well. Also in many cases, solutions are not available. For example, many fungi infections such as late blight in potato cannot be removed completely in organic systems. In years or regions with high infection pressure, infections can are inevitable. In addition, there are other barriers such as psychological, cultural, social or financial barriers to overcome in order to improve the prototype. Every researcher is more or less limited in vision by his or her environment. In addition, the right balance between being innovative and being accepted by the farmers has to be found. The discussions on the farms between partners have proven to be a great help to overcome these barriers.

The closer the parameters come to their targets, the more improvement of the methods will become a fine-tuning of them. The remaining shortfall can probably only partially be solved by a further fine-tuning of methods. To completely meet the demands for all year round sustainability, new instruments have to be created such as small-scale mechanisation, resistant varieties and a range of available pesticides with low ecological risks. This is especially important for the very intensive vegetable farms, even then it is questionable whether the remaining shortfall can be solved without drastic changes to the farm structure.

The right balance between being innovative and being accepted by the farmers has to be found. In the experimental settings, it is difficult to determine whether methods are acceptable and manageable for the farmers. For the experimental systems, it is essential to communicate with the farmers about the developed methods and to check whether methods are acceptable and manageable for the farmers. During the project, the on farm discussions between partners have proven to be a great help to overcome these barriers.
The work on the pilot farms in Switzerland, and also the intermediate form of experimental and practical farms in a number of the Spanish and the Italian organic systems, provided good opportunities for discussions and feedback.

5.5 Dissemination

Dissemination is the process of translating the results of the experimental farm into practice. This should not be the starting point of discussions with farmers, but merely the ending. Farmers should be involved in the whole prototyping process from the start of the project. Analysis of the current situation, design of the prototype and the testing and improving requires interaction with farmers to be certain that problems are solved in ways that are applicable for farmers. However, farmers are not the only stakeholders in the project. Discussions with other interested parties such as government; environmental organisations; and trade companies need to be held as well.

Dissemination can be done on a small scale and preferably followed by a large scale. The dissemination process can be accompanied with on farm research as this was done in Switzerland.

In the other countries, results were already disseminated during the project. In Spain and Italy, where systems were part of practical farms, the farm manager played an important role in this process. As the farmer was involved in the process, this person could explain and convince other farmers the necessity for the changes made in the systems. In the Netherlands, farmers were involved in the set up of and making changes in the systems. These farmers were very important in the dissemination process.