14 Prototyping on farm nature management

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Summary
Farmers in the Netherlands are increasingly involved in protection and development of nature on their farms. To support their efforts, specific nature plans for their farms are being developed. Unfortunately, most plans are developed within the borders of the farm only and do not consider the regional context. In this paper, a methodology is presented which makes it possible to analyse and evaluate the achievements of on farm nature management. The methodology provides tools for optimising on farm nature management with respect to the landscape, development policies and farm specific possibilities.

Key words: buffer zones, biodiversity, biotope, circuitry, connectivity, prototyping

Introduction
Over the last decades both quantity and quality of nature have dramatically decreased in The Netherlands. The landscape characteristics are becoming increasingly similar and the biodiversity is still decreasing (Maas, 1997). Intensification of agriculture and increasing urbanisation have resulted in the removal of natural elements from the landscape and a decrease in the quality of the remaining landscape elements. To improve the functioning of existing nature core areas, the Dutch Government has launched a national Nature Policy Plan (LNV, 1989). An important aspect of this plan is the establishment of an ecological network by formation of new corridors and nature development areas connecting the existing nature areas.
Farmers can play an important role in connecting nature core areas, enhancing the quality of the landscape and providing recreational possibilities. These activities may provide the farmers with a broader economic basis in the future than production of food alone. At present, most plans for the optimisation of natural elements on farms are developed within the borders of these farms and focus mainly on protection of natural elements. In fulfilling the demands of society, plans have to be developed for on farm nature management in which the regional context of the farm and the development policies for that specific area are taken into account. Ideally, these plans must evaluate the present situation, describe the desired situation and indicate the measures needed to realise this. To optimise on farm nature management, the prototyping methodology may be used (Vereijken 1997, Wijnands 1999). Prototyping is a methodology to design, test, improve and implement new farming systems. This paper explores the possibilities for using the method of prototyping in optimising on farm nature management.

Material and methods
The methodology of prototyping on farm nature management involves three steps:
1) analysis and diagnosis, 2) design and 3) testing and improving. These steps will be elucidated in the following sections.

Analysis and diagnosis
Regional landscape and policy
In The Netherlands, 17 million people live and work on a relative small area and consequently pressure on the available land is high. The main claims for land use are for housing, industry, transport, nature, recreation and food production. In order to harmonise this, rural development plans are designed for almost all areas on provincial and community levels. A thorough knowledge of these plans is necessary for determining development routes for individual farms.
Besides that, a thorough analysis of the existing landscape in which the farm functions is necessary. Existing biotopes (size, frequency, distribution, connectivity etc.) and present land use are described.
From these two types of analysis a target vision for the regional nature and landscape can be deduced.

Agro-ecological lay-out and management
A general picture of the agro-ecological layout of the farm

Table 14.1 Objectives and themes of research in relation to parameters

Objectives	Theme	Parameters
Nature and Landscape	Functioning of landscape Increasing potential biodiversity Agro-ecological lay-out	Percentage of woody elements Connectivity Circuitry Representative biotopes Maximum field width Buffering of landscape elements
Environment	Clean environment Preventing disturbance	
Welfare	Attractive landscape Recreation	Not yet developed

Table 14.2 Parameters and target values

Nature and landscape	
PWE Percentage of Woody Elements	Percentage at farm level (scale 1:5000) = percentage at landscape level (scale 1:25000). At landscape level the presence of larger woody elements in 250/250 meter squares is scored, at farm level the presence of individual trees in 50/50 meter squares is scored. For the landscape level, maps around 1970 are used. If rural development plans for the area differ from the actual landscape, target values may be adjusted.
CoLE Connectivity Landscape Elements	Connectivity of landscape elements surrounding and on the farm > 30%.
CiLE Circuitry Landscape Elements	Circuitry of landscape elements surrounding and on the farm > 50%.
BTP Biotopes	50% of existing biotopes in the 6.25 km^2 surrounding of the farm must be present on the farm.
Environment	
BZI Buffer Zone Index	Length of buffer zones per length of ditches, watercourses or woody elements between 1 and 2. For elements at the border of the farm the index is 1, for internal elements the index is 2.
BZW Buffer Zone Width	The average width of the buffer zones = 4 m. For the calculation of this parameter buffer zones wider than 4 m are fixed at 4 m.
Agro-ecological layout	
EII Ecological Infrastructure Index	Percentage of the farm which is managed as a network of linear- and non linear biotopes for flora and fauna including buffer strips > 5%.
FSI Field Size Index	Width of the fields < 125 m. FSI =(AI * (WI-125)/At) with AI the area of the farm with fields wider than 125 m, WI the average width of that part of the farm and At the total area of the farm. Every 25 units corresponds with a 10% shortfall.
BTS Biotope Target Species	Number of target species present in a biotope. For each biotope 20 target species are chosen. These 20 species can be divided into 4 groups corresponding to a specific stage in the succession of the vegetation.

and the imposed management has to be constructed. Therefore, a spatial image of the farm and its close surroundings has to be drawn, indicating the production fields, the buildings, roads and the different landscape elements. This delivers information on the diversity and frequency of the different biotopes, the length of transition zones, the level of buffering of landscape elements, the connectivity of the ecological infrastructure etc.
To complete the picture, the imposed management is described which enables the qualitative judgement on the chances of success for biotope-specific vegetation development. The complete overview of the existing agro-ecological layout is the basis for the next step in prototyping: the design.

Design
The design phase consists out of the following steps: 1) determine objectives; 2) to develop a suitable set of parameters and their target values; 3) development of methods to reach the target values; and 4) development of a theoretical prototype. This paper describes the first two steps in this process.

Objectives
The design phase starts with the elaboration of objectives for on-farm nature management (Table 14.1). The general objectives were derived from the functionality of nature and landscape both from an ecological, environmental and societal point of view. The specific objectives then detail these general aspects in more casual and operational criteria. These general and specific criteria have to be matched with a farm specific situation, e.g. adaptation to the specific position of an individual farm in the regional context and networks.

Parameters and target values

The specific objectives have to be translated into a suitable set of parameters to quantify them. The quantified objectives are used as the desired results for the evaluation of on farm nature management. In Table 14.2, parameters and their target values are presented which are used to evaluate on farm nature management. In evaluating the results of on farm nature management, emphasis is on the difference between the achieved results and the desired results (shortfall). The shortfalls for the different parameters are the basis for the design of the new prototype. A new prototype aims at fulfilling all target values.

The parameters proposed for linking the farm to the landscape (PWE, CoLE, CiLE and BTP, see Table 14.2) have recently been developed and have yet to prove their suitability in different landscapes. PWE was developed to provide a guideline as to how much woody elements on a farm reflect the landscape the farm is situated in. The same holds for BTP. CoLE and CiLE were derived from landscape ecology where connectivity and circuitry are used to describe the functioning of networks (Forman & Godron, 1986). In this methodology, they are used to involve farms in realising corridors and so connecting nature areas. The introduction of specific stepping stones on the farm may improve the connectivity and circuitry of existing networks. Moreover, when new landscape elements are introduced on a farm, the positioning has to be evaluated regarding the connectivity and circuitry in relation to existing networks.

BZI and BZW are based on pesticide drift reduction studies, which show that with 4 meter wide zones drift can be reduced to zero.

EII is the only parameter which is also used in the original prototyping methodology (Vereijken, 1997). FSI was developed to express what the possibility for stabilising the agro-ecosystem of the specific farm is. Expert judgement indicates that the optimal field size for predators to reach the centre of the field is 125 meter (Booij; pers. comm.)

For all parameters (except BTS), it is hypothesised that when the target values have been achieved, preconditions are present for a certain basic level of quality of the (agricultural) landscape. What the ultimate quality will be, depends largely on the management of the different elements. This can be evaluated with the BTS parameter. This parameter has so far only been developed for the management of dyke grassland vegetation (Sprangers & Arp, 1999). Similar methods for other biotopes are now being developed.

Testing and improving

In order to optimise and evaluate the methodology it has to be tested in different situations. Whether the proposed set of parameters is the proper set is subject to testing and improving. The relative value of the parameter is tested, e.g. how sensitive, how descriptive, how indicative is the parameter? What is the similarity with visual assessments? All the parameters as a whole should reflect the desired target image and objectives. The parameters PWE, CoLE, CiLE. BTP and BTS will have different target values in different regions and their validity has to be tested and improved in different landscapes and with different development policies. Therefore, testing and improving of the methodology has to be carried out with groups of pilot farms in different regions. For this purpose farmers have to be found who are interested in on farm nature management, who consider it important to develop this aspect for the continuation of their farm and who are able to communicate their experiences to other farmers.

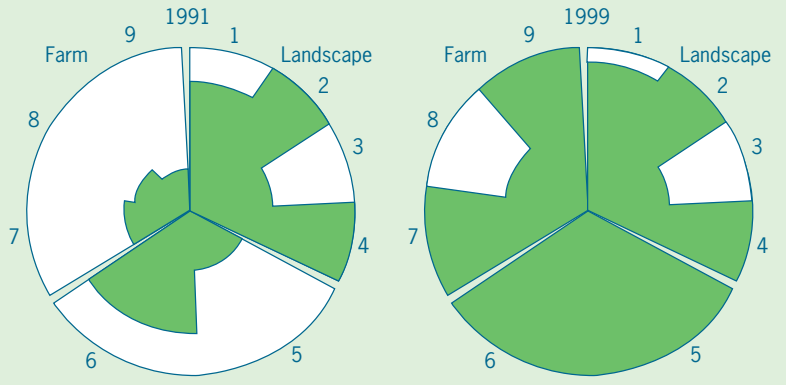

Fig. 14.1 Results of prototyping on farm nature management for an experimental farm in The Netherlands in 1991 and 1999. The outer sides of the circle represent the specific target values for each parameter. When a segment is filled the target value is reached. 1 PWE, 2 CoLE, 3 CiLE, 4 BTP. 5 BZI, 6 BZW, 7 EII, 8 FSI, 9 BTS. For explanation of the abbreviations used, see Table 14.2.

Results

To illustrate the methodology, the results of the prototyping methodology for one of our experimental farms are shown in Figure 14.1. In 1991 shortfalls were observed for all parameters except for CoLE and BTP. Through the continued process of testing and improving, in 1999 six target values were reached. For PWE, CiLE and FSI shortfalls were present. In the process the following actions were taken: 1) all ditches and woody elements were buffered with 4.5 m wide buffer zones; 2) ditch sides and buffer zones were cut twice a year and the hay was removed; 3) small bushes of Salix spp. were planted every 100 meter along the ditches; 4) through the arable fields grass

strips were realised; and 5) new hedges were planted with native species.

Discussion

Prototyping on farm nature management provides a tool to analyse and evaluate the achievements of nature management on a farm. The data presented in Figure 14.1 show that with a relative small set of parameters insight can be gained in the main shortfalls of a farm with respect to nature and landscape, the environment and the agro-ecological layout. This provides the farmer or researcher with clues how to improve the functioning and the quality of the nature on the farm and the surrounding area. It is important to emphasise that the methodology presented evaluates whether the conditions are present for a basic level of quality of the (agricultural) landscape. The achieved quality depends largely on the management of the different elements.

Parameters for the evaluation of the latter will be developed in analogy with the BTS parameter (Table 13.2). The prototyping methodology for on farm nature management is still in an experimental phase and has to be improved in co-operation with pilot farms in different regions. For this purpose, we have recently started a project in which the methodology will be tested on 25 pilot farms in five different regions in The Netherlands. This project will be supported by our research on our experimental farms where we test and improve farming systems and where we focus on the relationship between functional biodiversity and stability of agro-ecosystems.

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