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The Future of Organic Agriculture

ENGLISH ABSTRACTS

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Optimisation of Organic Agriculture on the basis of nature protection and economic aspects

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Introduction: A series of investigations have shown that organic agriculture significantly contributes to environmental protection. As a consequence, the SRU (1996) suggested to increase the share of land, managed by organic land use systems. Organic agriculture is not a historic form of land use, but a technologically modern and market oriented, cost efficient form of land use. Therefore, the protection of special species of the open landscape (eg. field-birds or hares) is not guaranteed and needs special attention. Organic agricultural systems offer a number of possibilities and potentials to improve organic agriculture with respect to nature protection.

According to Buckwell (1997), more and more verified ecological effects which go beyond 'Good agricultural practice' will be used to claim compensation payments (see EU-Kommission 2000). With reference to the policy question of efficient and effective policy instruments which respond to real ecological achievements there is one main question for agricultural and biological research: How can organic agriculture be optimised both, from the economic and the ecological point of view? This is the main objective of the development and implementation project 'Nature Conservation Farm Brodowin', financed by the Federal Nature Conservation Agency (BfN). The research activities are executed and narrowly coordinated with the Demeter farm 'Ökodorf Brodowin' in Brandenburg (1200 ha), 60 km north-east of Berlin in the biosphere reserve Schorfheide-Chorin. The project will contribute to the definition, level and fostering of the ecological performance of arable systems in organic farms as well as to the formulation of modified or new agri-environmental programmes.

Hypotheses: The conservation and creation of long-term suitable living conditions for arable land based flora and fauna can be realised cost efficiently on the basis of organic land use systems. To do so, the whole farm organisation including field specific crop rotations has to be optimised with regard to both, ecological and economic objectives. Potential conflicts between different objectives can be minimised by searching for Pareto-optimal solutions to whole farm organisations and by using a multi-objective linear programming farm model.

Methods: On the basis of field trials and literature studies, potential conflicts between nature conservation and production objectives are analysed. Modified production procedures are designed on the basis of crucial habitat requirements of typical farmland species (field birds, hedgerow birds, amphibians, insects, mammals and segetal flora). Simultaneously, the effects of these modified production techniques on yield and product quality as well as on economic parameters are evaluated (cost benefit analysis). The economic analysis performs a farming systems approach, based on linear programming techniques (MODAM). The crop rotation on every single field is optimised in the context of the total farm organisation as well as with respect to restrictions at field level. At farm level, fodder production and organic manure processing are the two main restrictions. At field level, restrictions concerning phytosanitary risks, nitrogen balance, weed control and the compatibility of subsequent crops are included. Above, restrictions with respect to nature conservation objectives, i.e. no tillage at a certain period, will be implemented. Thus, the economically optimal farm organisation can be calculated for different objective levels. With the help of this modelling approach, policy instruments can be evaluated with respect to their efficiency and ecological performance.

Results and discussion: Arable and dairy farms show different conflicts between agricultural and nature conservation goals. The farm in question has dairy cattle and pig fattening, which mainly determine forage requirements and thus crop rotations. Table 1 shows several potential strategies for the optimisation of nature conservation aims as well as a first assessment of the feasibility of these strategies with regard to technical aspects, farm organisation and financial effects.

Tab. 1: Assessment of the feasibility of a number of nature conservation measures within a Demeter dairy farm

Nature conservation optimisation	Formation of stands	feasibility		
		technical	organisational	financial
Reducing the intensity of weed control	• renunciation of/reduction in harrowing	+	0	+/0
	• renunciation of/reduction in hoeing	+	0/-	0/-
Changing the vegetation structure	• establishment of thin stands	0	0	0
	• increase in row spacing	0	0	0
	• field-internal set-asides	0	-	0/-
Changing the mowing pattern in legume-grass-forage	• increase in the cutting level	-	0	- -
	• delay of the cutting period	+	0	-
	• use of special (harmless) mowing and pick-up methods	-	0/-	- -
Increase in attractive crops from the nature conservation point of view	• increase in the amount of spring crops	+	0/-	-
Spatial pattern of crops	• narrow spatial pattern of crops with different production methods and vegetation development	0	--	0/(-)
Optimisation of field structures	• establishment of an optimal amount (5-15% of the arable land) of non cultivated resp. optimal cultivated structures (no grove-structures)	- -	- (-)	- -
	• limitation of field sizes (25 ha)	0	-	0

Comments: Qualitative assessment of feasibility (F), [GM = gross margin]

	technical:	organisational (incl. crop rotation planning):	financial:
+	slight F	no changes of farm organisation	no GM-losses
0	F basically possible	slight change of farm organisation	mean GM-losses, F only with compensation
-	F only by changing the technical equipment	considerable changes of farm organisation, needs consultancy	high GM-losses, F only with compensation
- -	F only by changing the technical equipment, temporarily special technique necessary	considerable changes of farm organisation, permanent higher management effort	high GM-losses, high need of capital investment, F only with compensation

The mentioned conservation strategies are currently tested with respect to their effects on target species. In general, the number and method of agricultural measures, eg. during the reproductive seasons of ground-breeding birds like skylark (*Alauda arvensis*) or Yellow Wagtail (*Motacilla flava*), play an important role in the breeding success. Temporal synchronisations of 'harmful' agricultural procedures during these periods crucial to birds have to be identified.

Preliminary results:

The investigations of the last two years have shown, that there is no conflict between mechanical weed control in winter- and spring cereals and the needs of the birds during breeding-starts/nest-building-starts (Tab. 2). It has to be considered, however, that the earliest breeding-starts within the investigated crops were fairly late. One reason for that could be a relatively thin crop density, so that despite of a good vegetation height (10-20 cm) there might have been insufficient soil cover to start nest-building.

Tab. 2: Mechanical weed control in cereals during the nest-building-periods of ground-breeding birds (skylark, yellow wagtail, corn bunting)

Month		April				May				June			
Weeks		1	2	3	4	1	2	3	4	1	2	3	4
Winter wheat	Harrowing	**X**	**X**										
	Nest-building-periods					**>**	**>**						
Spring wheat, Oats	Harrowing			**X**	**X**								
	Nest-building-periods							**>**	**>**	**>**			

At the same time, there was a significant preference for dicotyledonous plants as nest-cover compared to cereal crop plants: more than 80 % of the nests of ground-breeding birds were found under well-covering weeds like chamomile, creeping thistles, vetches or clover. Thus, yellow wagtail and corn bunting breed only on arable fields with a certain amount of dicotyledonous plants guaranteeing a multi-stage plant horizon. But, according to Lukashyk et al. (2002), specific circumstances can cause weed problems eg. by *Vicia hirsuta*, which requires harrowing winter wheat at later periods (until BBCH 61), especially within cultures with low crop density. In these cases, weed control can be necessary until the beginning of June with the effect that the nests get destroyed, and the conflict can not be avoided.

Changes within the mowing pattern of legume-grass forage (Tab. 1) show a positive effect on ground-breeding birds. Experiments show, that, in order to protect ground-breeding birds by normal cutting hight (about 7 cm), a delay of the cutting intervall between first and second cut of at least 7 weeks is necessary. In 2001, the fodder quality was that dramatically reduced through the delay (NEL < 5,2 [MJ/kg TM]), that the fodder was not suitable for dairy cows. A compromise could be an increase in the cutting level at the first cut (to about 14 cm hight) to reduce the direct losses of young birds, young brown hares and amphibians. This simultaneously could result in suitable vegetation conditons after already 1-2 weeks which support a quicker reestablishment of the birds for the next brood with the additional positive effect, that the second cut can already start 5-6 weeks later. With regard to the fodder quality this will cause lower losses to the farm. A comparison between normal and increased cutting hights at the first cut showed, that the quality of fresh fodder and silage was increased with a cutting level of about 14 cm, while the yield decreased by about 30 %. On the basis of further experiments compromises that consider soil fertility, yield quantity and quality has to be found, in order to protect ground-breeding birds and at the same time ensure productivity and the health of dairy cows.

Different crops provide different habitat qualities, therefore, the optimisation of the spatial pattern of crops as well as their portion in the rotation plays an important role. At the research sites, five times more field birds breed in legume-grass forage and spring cereals than in winter cereals. The actual crop rotation includes about 45 % winter cereals and only about 10 % spring cereals. An increase in spring crops, would therefore have positive effects from the nature conservation perspective. From the economic point of view however, this requires compensation, due to the relatively low yield level and yield security of spring cereals.

Conclusion: The constitution of the 'Nature Conservation Farm' aims at the development of solutions to conflicts between economic and nature conservation objectives at farm level. The effects of adaptations of cropping techniques with respect to nature conservation have to be quantified concerning yield level and quality as well as different target species. With the help of MODAM and based on the quantification of technological and ecolological effects of conservation measures, two kinds of analyses will be performed: (1) determination of the level of compensation payments for a given site and (2) determination of the costs of conservation measures if a given conservation level has to be achieved by a whole farm.

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