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BIODIVERSITY CONSERVATION IN AGRICULTURE: THE EXPERIENCE OF POLAND

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Abstract: Over remarkably large areas, Polish agriculture has still retained many valuable species, ecosystems and landscapes which presently are subject to accelerated destruction or degradation. It has been shown, that the occurrence of rare and endangered species of butterflies is a good indicator of the level of natural features retained by agricultural production areas nationwide. The concentration of these species is positively correlated with several indices which illustrate properly the features of extensive and small-scale farming.

In Poland, biodiversity is perceived as two separate domains. The first, managed by the Ministry of Agriculture, pertains solely to species, varieties and races cultivated or bred. For this group, extended gene banks are set, together with support plantations or breeding centres. The remaining «wild» species, their associations, and ecosystems, as well as the issue of diversity of landscape in agrocoenoses should be left to the Ministry of Environment

The international conventions – e.g. Convention on Biological Diversity – direct Polish agriculture towards environmental sustainability and consequently this approach will have to be adopted by Poland. The whole area used for agricultural production should be divided and placed either under the responsibility of the Ministry of Agriculture (when earmarked for production purposes) or the Ministry of Environment (when devoted to preservation). Those areas whose priority role is preservation should be managed by segregation i.e. in accordance with the adopted management planned by specialised nature protection authorities. For the remaining areas, the principles of management compliant with the postulates of conservation of wild plants and animal species should be drafted.

Key words: agriculture, biological diversity, management for conservation, butterflies, monitoring, extensive farming, Poland

RICHNESS OF BIODIVERSITY IN POLISH AGRO-ECOSYSTEMS AND THE NEED OF ITS CONSERVATION

The area used for agricultural production covering almost 60% of the Polish national territory (Kamieński 1998), still features attractive landscapes, richness in species and ecosystems and the occurrence of extraordinarily high numbers of unique plant and animal species. This diagnosis is confirmed by the Red Lists of plants (Kaźmierczakowa and Zarzycki 2001) and animals (Głowaciński 2001), where a significant proportion of rare and endangered species is dependent on semi-natural open ecosystems under extensive use by man.

The studies of vascular plants accompanying cereal and root crops in the Nida River valley (Fu-Dostatny 2000) revealed an amazing richness among species accompanying these extensive crops (Table 1). A similar situation occurs among animals. Our agro-ecosystems still have rich vertebrate (Karg and Ryszkowski 1996; Krogulec 1995) and invertebrate faunas (Buszko 1997).

Agroecostems featuring highly valuable natural components have been shaped during the last millennium and they survived in barely modified form till the beginning of the last century, and in many places even till the second part of it. Recently, however, they have been undergoing accelerated degradation. The species structure of plant communities simplifies and be-

Table 1. Number of species of "wild" vascular plants accompanying cereal, and beet and potato crops in the Nadnidziański Landscape Park, SE Poland (after Fu-Dostatny 2000)

Crop	A	B	C	D
Cereals	55	13	32.2	15.9
Beets and potatoes	42	15	26.3	18.2

(A – maximum number of species, B – minimum number of species, C – mean for crops less intensively treated with herbicides, D – mean for crops extensively sprayed with herbicides)

Table 2. Plant associations and the most threatened species of vascular plants in arable agrocoenoses in Poland (after Podyma 2001)

Plant association	Threatened species	Distribution in Poland
Consolido-Brometum	*Consolida regalis, Papaver dubium, P. phoeas, Agrostemma githago, Centaurea cyanus*	Suwalskie lakeland, Przemyśl Foothills
Caucalido-Scandicetum	*Adonis aestivalis, A. flammea, Anagalis coerulea, Bupleurum rotundifolium, Caucalis daucoides, Conringia orientalis, Scandis pectenveneris*	Małopolska Highland, Lubelska Highland, West Wołyń
Spergulo-Lolietum	*Cuscuta epilinum, Camelina alyssum, Lolium remotum, Linum ustatissimum*	Beskidy Mts., North-West Poland

comes poorer (Table 2), and the faunistic data collected in central Poland indicates also a gradual degradation of both biomass and abundance of amphibians in agrocoenoses (Table 3) (Karg and Ryszkowski 1996; Fu-Dostatny 2000). Among invertebrates, particular decreases are noted among the groups which are studied most thoroughly: butterflies (Dąbrowski and Krzywicki 1982; Buszko 1997) and hymenopterans (Banaszak 1990; Kosior 1992).

The phenomena of disappearance of species associated with agro-ecosystems, documented in the above-cited works encourages efforts aimed at compiling lists of vulnerable plant species (Warcholińska 1986), and force the introduction of new methods for their protection (Herbich 1986). These statements have been confirmed by the European network of the Natura 2000, recently developed in Poland (Baranowski et al. 2001, Liro and Dyduch-Falniowska 1999, Witkowski and Dyduch-Falniowska 2000) and in the published list of CORINE natural sites. The network of proposed NATURA 2000 sites (according data from the June 2003), taking into account the increasing danger to species and habitats accompanying agrocoenoses, as well as specially valuable features of nature providing habitats or the actual occurrence of species valuable for the nature of Europe, includes ca. 60% of areas used as farmland (Dyduch-Falniowska et al. 1999).

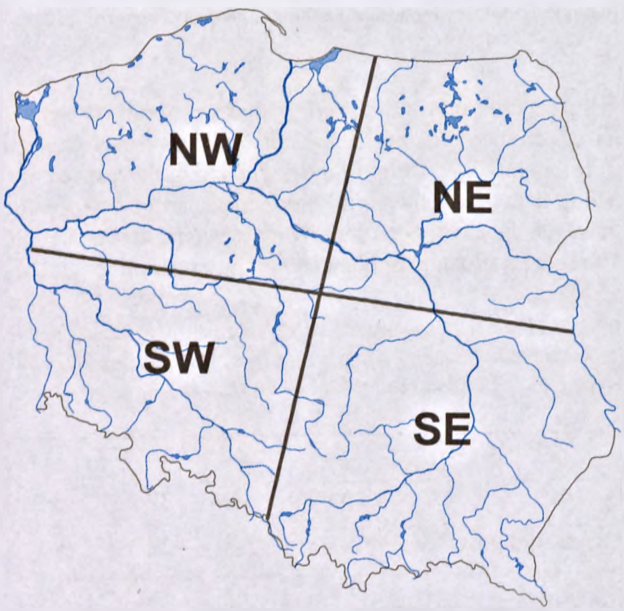

Fig. 1. Division of Poland into 4 sections for butterfly and agriculture investigations

Discussions pertaining to the protection of biodiversity in agriculture in Poland focus on several issues:

1. How to monitor biodiversity and valuable natural features of agrocoenoses and also whether the present system of monitoring is adequate and corresponds to the actual valuable natural features of areas under consideration.

2. Whether there is a system for protection of biodiversity presently in place and if so how does it perform.

3. How to protect species and ecosystems in agrocoenoses.

This paper constitutes an attempt to introduce a certain order in the prevailing situation and to indicate both present and novel solutions for the protection of biodiversity in the areas of agrocoenoses.

ARE RARE AND VANISHING BUTTERFLIES A USEFUL INDICATOR OF TRADITIONAL EXTENSIVE FARMING?

In the case of Poland, the areas under agricultural use constitute an essential element of biodiversity, studies to-date of which have been based almost exclusively on the systematic research of birds and vascular plants. A question hereby arises as to whether, given the difference in scale in which these groups are studied, this method for addressing the valuable features of agrocoenoses is sufficient to rate their importance in maintaining biodiversity. In our opinion, the evaluation exercise based on studies of birds and plants should necessarily be amended with the monitoring of species of butterflies (*Rhopalocera*).

The fauna of butterflies (*Rhopalocera*) occurring permanently within Poland includes some 160 species (Buszko and Masłowski 1993). The adult stages of this group are associated mostly with open spaces, and only single species, e.g. *Quercusia quercus*, do not appear at all outside forested areas. Many

of the species are mono- and oligophagous, which (combined with their occurrence in open areas and relatively easy identification in field conditions) allows recognition of this group as a model index of biodiversity in non-forested areas, particularly agrocoenoses. This value is enhanced still further by the extensive body of knowledge about the distribution of butterfly species in Poland. The butterflies, apart from vascular plants (Zając and Zając 2001) and birds (Walasz and Mielczarek 1992; Gromadzki et al. 1994), are one of the best known systematic groups in Poland (Buszko 1997). In order to highlight the significance of a nationwide evaluation of natural areas based on the atlas of distribution of butterflies (Buszko l.c.), a list of 46 rare (with <50 stations in Poland) and endangered (< 20 stations) species of butterflies, broken down into four regions of Poland and the habitats these species occupy, has been prepared. (Table 4, Figs 1 and 2). The distribution differed significantly between the regions. The largest concentrations of rare species were recorded in south-eastern Poland, the second largest in the north-east. Significantly less rare and endangered species of butterflies were found in the area of western Poland (Fig. 2).

Several characteristic of the use of agricultural space were subjected to similar analyses (Puczyłowska et al. 2002):

1. Effectiveness of agricultural production.

2. Rural inhabitants pursuing employment outside agriculture.

3. Farms < 15 hectares as a percentage of the overall number of farms.

4. Farms < 15 hectares as a percentage of the overall land mass under agricultural use.

5. Number of people working on 100 hectares of land under agricultural use.

The above indices describe the degree of intensification of agriculture and the extent of fragmentation of farms. It is worth noting a certain convergence between the level of farming culture and the fauna of butterflies: the lowest effectiveness of agricultural use characterizes the south-eastern region of Poland. In its eastern part there is generally a lower fraction of village people pursuing non-farming professions. And the highest fragmentation levels, measured both as the percentage of farms smaller than 15 hectares in the overall number of farms, and by the share of arable land used by this category of farms, occur in the south-eastern part of Poland. In the same area,

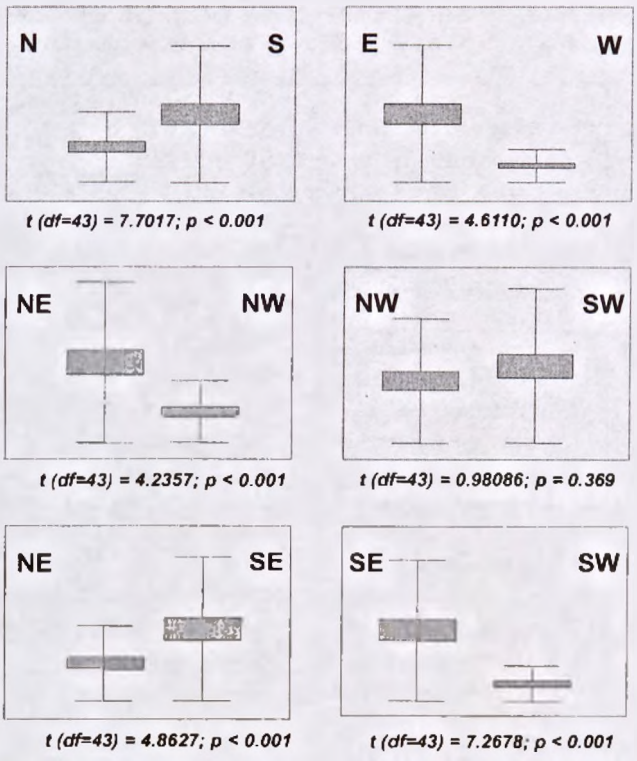

Fig. 2. Comparison of distribution of rare and endangered butterflies among the four sections of Poland

there are highest proportions of people working on each 100 hectares of cultivated land, which is a measure of the so-called "hidden" unemployment.

However, only three among the analysed factors turned out to significantly affect the abundance of butterfly fauna (Fig.3.3):

1. People employed outside the agricultural sector (chi-square = 9.1839, df = 3, p<0.02696).

2. Proportion of farms < 15 hectares on the land under agricultural use (chi square = 14.6105, df = 3, p<0.00218.

3. Number of people working on 100 hectares of the land under agricultural use (chi square = 13.4036, df = 3, p<0.00384.

The comparison of the data on the distribution of rare and endangered butterfly species in Poland with the indices regarding agriculture (Puczyłowska et al. 2002), showed several similarities of pattern:

Table 3. Results of 20. years monitoring of amphibians on agrocenoses in Turew, near to Poznań (according to Karg and Ryszkowski 1996)

Parameters	Years		
	1956-1969	1977-1978	1985
Number of species	12	11	8
Species abundance (ind./ sq. m)	0.025	0.005	0.0035
Biomass (dry mass /sq. m)	0.04	0.009	0.006

Table 4. Number of localities of rare and sparsely distributed butterfly species in Poland, divided into the four quarters of the Polish territory: NE, NW, SE and SW, and their habitats (based on Buszko 1997)

No.	Species name	Distribution in Poland	Total	Rare	Seldom	Habitat
1.	*Iphiclides podalirius*	NE-20 SW-6 SE-28	54		+	Xerothermic shrubs
2.	*Parnassius apollo*	SW-1 SE-2	3	+		Xerothermic grasslands
3.	*Parnassius mnemosyne*	NE-10 SW-1 SE-27	38		+	Forest/meadow ecotone
4.	*Aporia crataegi*	NW-5 NE-11 SW-1 SE-15	32		+	Cultivated/Forests
5.	*Pieris bryoniae*	SE-10	10	+		Mountain meadows
6.	*Colias alfacariensis*	SE-2	2	+		Xerothermic grassland
7.	*Colias palaeno*	NE-14 SW-2 SE-22	38		+	Peatbogs, bog forests
8.	*Nordmannia acaciae*	NE-3 SW-4 SE-12	19		+	Xerothermic shrubs
9.	*Nordmannia spini*	NW-4 NE-8 SW-3 SE-31	46		+	Xerothermic shrubs
10	*Lycaena helle*	NW-2 NE-9 SW-5 SE-15	31		+	Peatbogs, marshes
11.	*Glaucopsyche alexis*	NW-1 NE-6 SW-1 SE-2	10	+		Forest meadows
12.	*Maculinea alcon*	NW-1 NE-1 SE-16	18		+	Turf meadows, marshes
13	*Maculinea arion*	NW-1 NE-20 SW-3 SE-39	63		+	Dry meadows
14.	*Pseudophilotes baton*	NW-1 SE-13	14	+		Dry meadows
15.	*Scolitanides orion*	SE-4	4	+		Xerothermic grasslands
16.	*Vacciniina optilete*	NW-2 NE-6 SW-3 SE-28	39		+	Peat bogs
17.	*Aricia eumedon*	NW-1 NE-4 SW-11 SE-24	40		+	Moist meadows
18.	*Aricia artaxerxes*	NW-2 NE-1	3	+		Dry meadows
19.	*Polyommatus ripartii*	SE-3	3	+		Xerothermic grasslands
20.	*Polyommatus dorylas*	NE-1 SW-2 SE-33	36		+	Xerothermic grasslands
21.	*Polyom. thersites*	SE-8	8	+		Xerothermic grasslands
22.	*Polyom. bellargus*	NE-3 SE-21	24		+	Xerothermic grasslands
23.	*Polyommatus eroides*	NE-4	4	+		Dry meadows
24.	*Neptis rivularis*	SE-16	16		+	Moist meadows and glades
25.	*Brenthis daphne*	NW-1 NE-18 SE-1	20		+	Forest meadows and glades
26.	*Boloria aquilonaris*	NW-3 NE-9 SE-3	15	+		Peat bogs
27.	*Boloria eunomia*	NE-9 SE-7	16	+		Peat bogs, wet meadows
28.	*Euphydryas aurinia*	NE-3 SW-1 SE-9	13	+		Peat bogs, wet meadows
29.	*Euphydryas maturna*	NE-10 SW-10	20		+	Forest meadows and glades
30.	*Hipparchia hermione*	NW-10 NE-8 SW-1 SE-19	38		+	Dry forests, heaths, glades
31.	*Hipparchia statilinus*	NW-8 SE-4	12	+		Dunes, dry forests, heaths
32.	*Chazara briseis*	SE-3	3	+		Xerothermic grasslands
33.	*Oeneis jutta*	NE-3	3	+		Peat bogs
34.	*Minois dryas*	SE-2	2	+		Xerothermic grasslands
35.	*Erebia aethiops*	SE-22	22		+	Glades, mountain meadows
36.	*Erebia euryale*	SW-5 SE-21	26		+	Glades, mountain meadows
37.	*Erebia ligea*	Ne-1 SW-8 SE-35	44		+	Glades, mountain meadows
38.	*Coenonympha hero*	NE-5 SW-1 SE-11	17		+	Moist and wet meadows
39.	*Coenonym. oedippus*	SE-1	1	+		Wet meadows, peat bogs
40.	*Lasiommata petropolitana*	NE-1 SE-4	5	+		Spruce and pine forests
41.	*Lasiommata achine*	NE-14, SW-1 SE-7	22		+	Forest glades and meadows
42.	*Pyrgus alveus*	NW-3 NE-12 SW-5 SE-25	45		+	Forest meadows and glades
43.	*Pyrgus carthami*	NW-5 NE-5 SE-15	25		+	Xerothermic grasslands
44.	*Pyrgus serratulae*	NW-3 SE-10	13	+		Forest meadows and glades
45.	*Carcharodus flocciferus*	NE-2 SE-1	3	+		Forest meadows, glades
46.	*Thymelicus aceton*	NW-4 SW-4 SE-20	28		+	Xerothermic grasslands

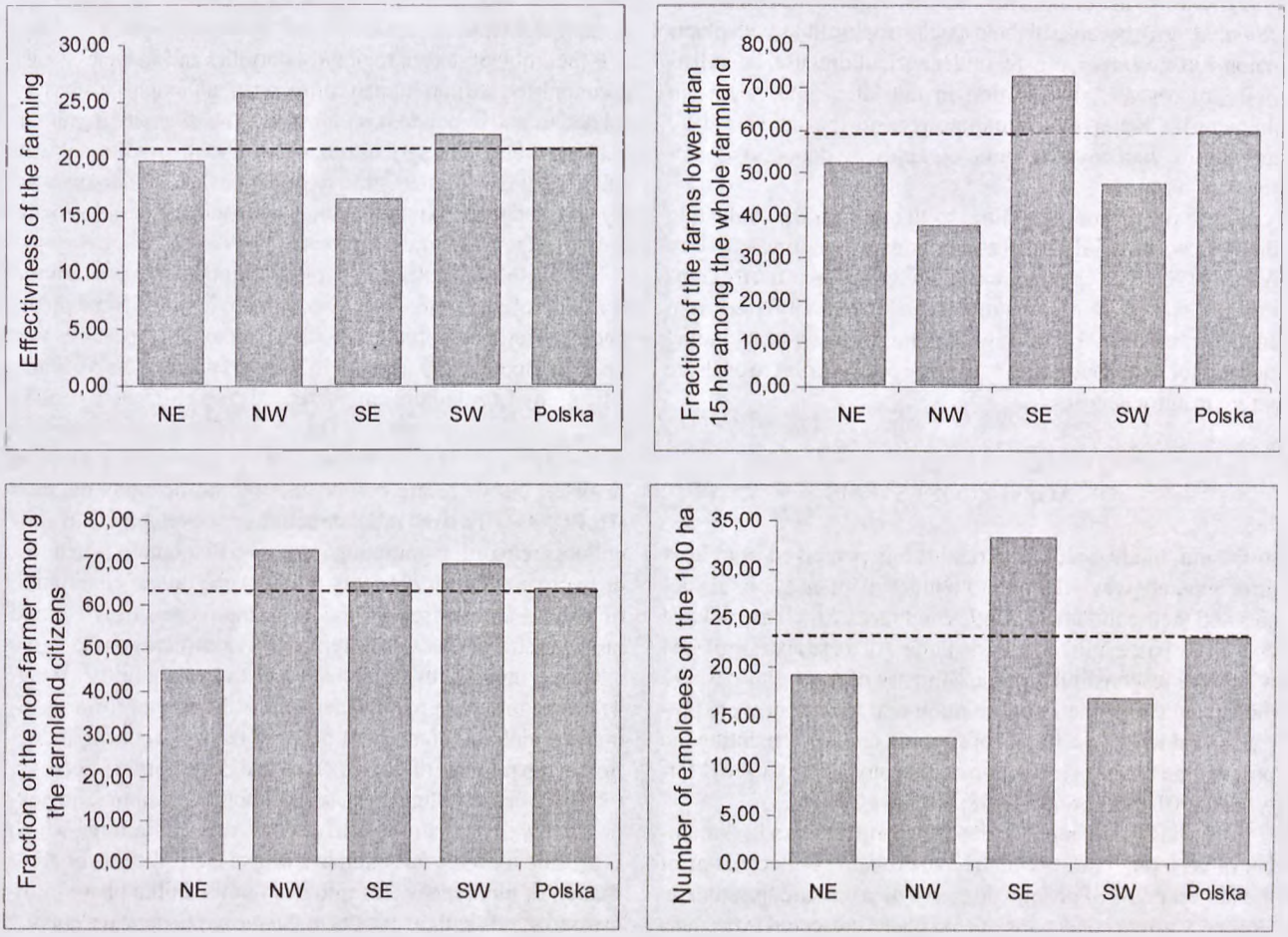

Fig. 3. Comparison of farming intensity indices among the four sections of Poland

1. The concentration of rare and endangered butterflies in Poland is highest in the south-eastern part of Poland where farming is least efficient and farms are smallest.

2. The area of eastern Poland is significantly richer in rare and endangered butterfly species compared with the western part of Poland; this area is also less advanced in terms of the indices of farming mentioned above.

This relationship is not so manifested in the analysis of a nature evaluation based on species of birds (Gromadzki et al. 1994) and plants (Zając and Zając 2001), which also provided the grounds for distribution of valuable natural areas in the CORINE (Dyduch-Falniowska et al. 1999) and ECONET (Liro

Table 5. Assessment of the mean values for economic effectiveness of agriculture in Poland divided into four parts: NE, NW, SE and SW (recalculated after Puczyłowska et al. 2002)

Region of Poland	Farming effectiveness index	Index of non farming workers in a village	Farms smaller than 15 hectares (% of farms)	Farms smaller than 15 hectares (% farmland)	Index of employment on farms per 100 hectares of farmland
NE	19.66	44.84	87.54	51.70	19.25
NW	25.73	72.75	79.41	37.38	12.76
SE	16.27	65.13	92.72	72.41	33.27
SW	21.88	69.71	84.76	47.33	16.91
Poland	20.74	63.68	86.33	59.60	23.10

1995) networks in Poland. This situation suggests that butterflies (*Rhopalocera*), because of their special trophic links with plants in non-forested areas, mostly under agricultural use, as well as their 'microscale' distribution in the landscape, seems to characterize better the valuable areas in the land used by agriculture, than could be done by applying data on vascular plants or birds.

A wide discussion pertaining to the indices for evaluating changes in the wildlife of agrocoenoses was presented by Wascher (2000). A close correlation between the butterfly fauna and the level of farming culture, which can be inferred from the data presented above, indicates the necessity of including the monitoring of butterflies within the overall effort to evaluate nature in agrocoenoses.

CONSERVATION OF BIOLOGICAL DIVERSITY OF AGRO-ECOSYSTEMS

In Poland, biodiversity in agriculture is perceived in at least three separate ways. The first includes plant and animal species and their cultivated varieties and races which are or have been in the past exploited in agriculture. All these taxa are placed within the responsibility of the Ministry of Agriculture where the strategies for their conservation and treatment were prepared, and where the funds for running and implementing the programme for the preservation of diversity were situated (Martyniuk 2001; Nalborczyk 1998; Podyma 2001).

According to Nalborczyk (1996) Poland retains a large number of very small farms which have probably protected one of the largest pools of genetic diversity of crops and livestock in Europe. Current collections of crop plants preserved in the gene banks share as much as 62,303 taxa (species, subspecies and varieties), including 22,850 cereal taxa, 2,928 potato taxa, 2,190 taxa of fruit plants etc. (Nalborczyk l.c.).

The second method of perception of biodiversity in agroecosystems encompasses all wild species, their communities, ecosystems and landscapes. These features of biodiversity in agriculture are placed within the responsibility of the Ministry of Environment. At present, the agroecosystems with all their abundance of wild species are not protected properly. The areas under agricultural use, apart from sporadic agroenvironmental programmes in the framework of SAPARD, are not protected at all in the course of the production process in agriculture. It was only in the last year that this gap was noticed and the Ministry of Environment drafting a programme for protecting wild species and their habitats in agriculture. Completion of this work and preparing an implementation plan is forecast for the end of 2003.

The third approach to biodiversity is to recognize the traditional culture and techniques still used in extensive agriculture where the work of the horse and hand dominate. This form of ancient land use still prevails locally in the south and southeast regions of Poland. It maintains specific and unique forms of culture, social relations and the local economy. These important elements of local "human" diversity are still left outside the ambit of state or regional authorities and agencies which focus only on the non-human components, although it is strongly related to and dependent on humans. The diversity in human activities related to agriculture, especially the traditional way of farming is still interesting to hobbyists and collectors who try here and there to maintain the local memory of old agricultural tools and their descriptions.

It is worth saying that the implementation of the programme for the protection of species accompanying cultivated plants and long-term perennial crops like meadows and pastures will become increasingly difficult in future. The progressive intensification of agriculture and increased crop efficiencies lead to the degradation and phasing out of „wild" nature in agro-ecosystems (Fig. 4). The direction of this relationship cannot be reversed but there are certain likely modifications possible (Holst 2000). Two potential directions of development in agriculture are worth mentioning here. The first option is to introduce organic farming. In this scenario, the rate of elimination of species from agrocoenoses with the increasing yield and profits for the farmer will be remarkably slower (a convex curve – b) from the initially predicted curve (a straight line – a) (Fig. 4) Hence the room for manoeuvre for the former towards increased yields is significant because the co-occurring reduction in the number of wild species and degradation of ecosystems will be only slight. The second option presumes, however, the development of intensive conventional farming, which is the rule for most farmland in Europe. Here, the rate of elimination of biodiversity is rapid even in the initial phase of increased yields and the profits to the farmer (a concave curve – c), and the room for manoeuvre towards retaining the rich com-

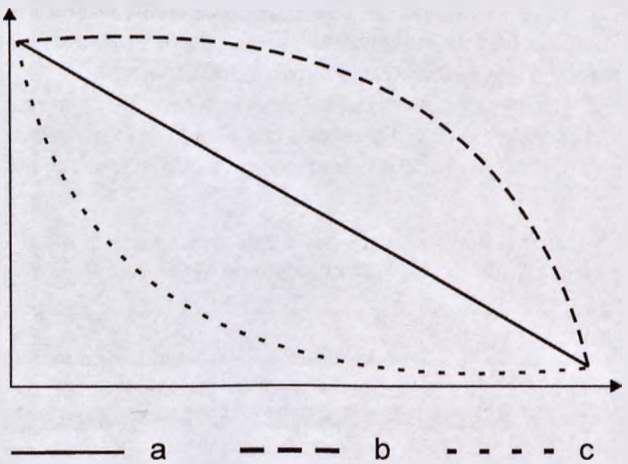

Fig. 4. Theoretical relationships between intensity of farming (X) and biological diversity (Y) of agro-ecosystems: a – basic form of relationship, b – curvilinear relationship for organic eco-farming, c – curvilinear relationship when conventional farming prevails

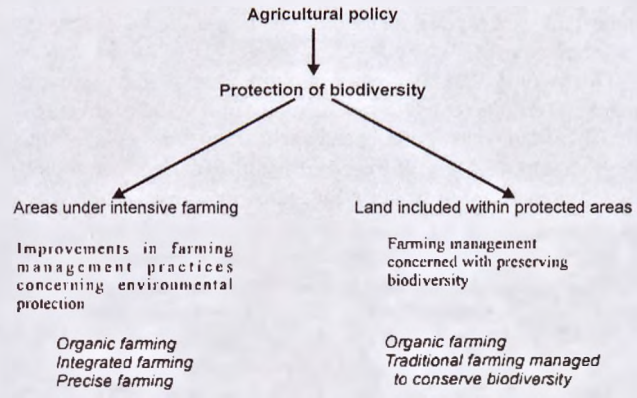

Fig. 5. A policy scheme for a potential stream of interests and financial support of farmland areas between agriculture and conservation authorities

position of species accompanying the crops available to the farmer is almost zero. Any further intensification of economic use only intensifies the adverse status of nature and the environment in the area so used.

In the near future essential support for ecological farming (eco-farms and integrated farms) is expected to come from the consumers. The consumer of foodstuffs, at same time being the consumer of drinking water and the user of agricultural land for recreational purposes, will expect that food, is not only inexpensive, but also healthy; and does not want the cost of food production to be a deferred burden shifted to the environment. The environmental costs are going to be paid sooner or later by the same consumer, as taxes or increased charges for treatment of drinking water or decontamination of soil. In Poland there is currently a discussion on the costs and sources of financing for the clean-up of so-called graveyards of pesticides and other chemicals used in farms that are stored after their expiration date (Pomianowska 2001; see also www.nik.gov.pl/informac). In other European countries there are also discussions on agroenvironmental services like the supply of clean water or unlimited access to private land under extensive agricultural practices, which have retained valuable natural attractions.

HOW TO PROTECT ECOSYSTEMS AND SPECIES IN AGROCENOSES?

The division of responsibility for protecting the biodiversity of agroecosystems between two different structures of the administration: the Ministry of Agriculture and the Ministry of Environment, existing in Poland, requires a new inquiry into the protection of the wealth of nature and landscape and biodiversity in agroecoenoses. Considering this division to be a permanent feature of the legal-administrative system, we should look all the more carefully into the harmonisation of efforts undertaken by the administration in this domain. Meanwhile, in connection with the process of accession to the EU, three programmes of little coherence have been created in Poland, which should be closely harmonised with each other from the very beginning:

1. Programme for environmentally concerned development of rural areas and food production till the year 2015 (Michna 1998).

2. National Afforestation Programme (Zając et al. 2000).

3. Programme for harmonization of nature conservation with the European Union programmes known as Natura 2000 (Baranowski et al. 2001).

It must also be remembered that Poland has ratified the Convention on Biodiversity drafted at the Earth Summit in Rio (Krzemiński 1996). The Convention requires that state-signatories come forward with programmes and strategies for protecting biodiversity in agrocoenoses (Buguna-Hoffmann 2001).

The first of the programmes listed above signifies the fact that Poland has a well prepared programme for agriculture (Michna 1998). One of the components of this programme, closely related to the protection of biodiversity, is a postulate to retain the sustainability of the food-producing ecosystem in rural areas. This requires compliance with purity standards for soils, water and plants, and also for the whole surrounding biocoenoses, including forests, rivers and the sea. The authors of the agricultural programme (Michna l.c.) established also the hierarchy of importance and emphasized priority tasks. Within the scope discussed in this paper, these tasks include:

– protecting the most important elements of agroecosystems (the soil – both contamination and erosion),

– protecting agroecosystems from disasters,

– protecting agroecosystems from disturbances of ecological equilibrium.

As can be seen from the description of the Programme (Michna 1998), Polish agriculture does not envisage implementing any programme to protect "wild nature" on the agro-production land. At the same time it should be noted that the Convention on biodiversity lists the following areas of its application in agriculture (Buguna-Hoffmann 2001):

– genetic resources for correct development of agriculture,

– biodiversity components in agricultural areas which are necessary for their proper functions,

– retaining local biological and landscape diversity,

– socioeconomic and cultural factors including local cultural factors, tourism etc.

Elaborating these postulates still further, van Dijk (2001) suggests that European governments should promptly identify the priority areas for protecting biodiversity on agricultural land. Later, two strategies should be applied to these areas: an integration approach involving the management of agricultural land and its biodiversity by farmers or a segregation strategy (management of the area and biodiversity without involvement of farmers). This latter way of management can include, for ex-

ample, maintaining certain species at desirable levels of population numbers or managing areas purchased from farmers, within the borders of national parks.

Referring again to the strategy for biodiversity protection in lands used by agriculture in Poland, it is worth pointing out what should come under the auspices of the Ministry of Environment. Knowing from the Natura 2000 programme, that the valuable natural areas will include no more than 15-20% of the agricultural production land, the experts in natural sciences should strongly advocate inclusion of these most valuable areas in special nature conservation projects which should be funded by the Ministry of Environment. The objective of protection and of subsidies to farmers would be to maintain certain forms of traditional agricultural practices, in order to support the existence of the most valuable natural ecosystems, species and populations which are most endangered elements of nature in Poland.

The remaining, less valuable areas should be financed by the Ministry of Agriculture, but with a presumption that the pro-environmental programme of development in agriculture is augmented by a missing component: protecting living elements of nature broadly associated with the agricultural sector in the economy. Otherwise, on the areas concerned, one fears the progressive deterioration of biodiversity in the course of Poland's accession to the European Union and the rapid intensification of large-scale agriculture.

All the issues addressed above call for the drafting of a long-term strategy and a programme that sets objectives, allocates tasks, defines timeframes and timetables, calculates the costs and that indicates the sources and institutions responsible for their implementation. The authors are of the opinion that the strategy for the protection of biodiversity in agricultural production should be part of governmental strategy for sustainable development in Poland, for which both ministries (agriculture and environment) should be jointly and severally responsible (Fig. 5).

CONCLUSIONS

Over remarkably large areas, Polish agriculture has still retained many valuable species, ecosystems and landscapes which presently are subject to accelerated destruction or degradation because of the intensification of agricultural management. It has been shown, that the occurrence of rare and endangered species of butterflies is a good indicator of the level of natural features retained by agricultural production areas nationwide. The concentration of these species is positively correlated with several indices, which illustrate properly the features of extensive and fragmented farming. Thus, this index of butterfly occurrence should be introduced as a permanent component of a monitoring nature in Polish agricultural production.

In Poland, biodiversity is perceived as two separate domains. The first, managed by the Ministry of Agriculture, pertains solely to varieties of species and races cultivated or bred presently or that will be bred in future. For this group, extended gene banks are organised, together with support plantations or breeding centres.

The second domain is the remaining "wild" species, their associations, and ecosystems, as well as the issue of diversity of the landscape in agrocoenoses, which have been placed under the responsibility of the Ministry of Environment, which began preparing the strategy for managing these components of nature in agrocoenoses one year ago. The international conventions direct Polish agriculture towards environmental sustainability and this approach will have to be adopted by Poland.

The whole area used for agricultural production should be evaluated from the viewpoint of retaining its natural features (which have been partly implemented under the CORINE and Natura 2000 programmes), divided and placed either under the responsibility of the Ministry of Agriculture or the Ministry of Environment in line with its planned use (for production or for preservation purposes, respectively). The areas whose priority role is preservation should be managed by segregation i.e. in accordance with the adopted management planned, by specialised nature protection authorities.

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