Rural Development in the Belarusian Polesie Area

3

CASE STUDY
Belarus

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Ecosystems of the Belarusian Polesie

Geography

The Polesskaya lowland 'Polesie' is situated in Belarus, Ukraine and Poland and has a total area of 13.2 million ha. It is a unique natural region with very rich biological and landscape diversity. There are large forests and bogs preserved in their natural conditions, as well as vast floodplains which are unique in Europe. The rural landscapes of Polesie represent an outstanding combination of ecological, economic, historical and cultural values.

Belarusian Polesie is the largest region in Central and Eastern Europe where natural wetland ecosystems are concentrated, covering a total area of more than 680,000 ha. This is the northern part of the Polesie lowland and constitutes almost 32% of the territory of the Republic of Belarus (Figure 3.1). The core of the region is the Prypyat' river basin. Here 35 regional types of landscapes can be found and they all have various geological features, soil composition, climate and vegetation cover. Wetland ecosystems used to occupy more than 44% of the area. The floodplain in some of the upper parts is as wide as 20-25 km, while the central part and the river mouth is 3-8 km wide.

Figure 3.1. Polesie is the largest natural wetland ecosystem in Central and Eastern Europe covering parts of Northern Ukraine, Western Poland and a large part of Southern Belarus. Source: Author..

The Flora of Forests, Meadows and Mires

The flora of Belarusian Polesie includes a number of rare species. Over 1,400 species of higher vascular plants are found in the region, representing 96% of the whole flora assemblage of the country. More than 60 rare species are included in the Red Data Book of Belarus. The regional isolation of the Polesie flora and the presence of many natural boundaries created by geological water level differences of continuous or insular type are the main causes of the richness of specific regional and even zonal species. The boundaries of the floristic Polesie largely coincide with the borders of the hydrological Polesie. The present plant cover in the Belarusian Polesie consists mainly of forests (42.1%), meadows and mires (23.3%). Forest vegetation includes the following types: coniferous (61.1%), broad-leaved (7.9 %), small-leaved (12.4%) and native larch forests on bogs (18.6%). The most important tree species are: Pine (58.7%), birch (15.3%), black alder (13.5%), oak (7.2%), spruce (2.4%) and aspen (1.2%). Other broad-leaved trees (hornbeam, ash) and broad-leaved/coniferous (broad-leaved/pine, broad-leaved/spruce) species are also noticeable.

These forest types represent formations that have been typical in Western Europe but are rather unique nowadays. There are patches of forest types that are completely different from the Eastern European forests of south-taiga type both when it comes to tree species composition and the structure of the forest under-storey vegetation. The lower percentage of spruce forests and their ecosystem diversity in Polesie is also accompanied by mixtures of spruce with Western European-type species such as oak, alder and other broad-leaved species. Extensive areas are occupied by black alder forests typical of fen mires.

The Polesie area could be classified as steppe meadow. Its meadows are characterised by a great number of steppe grass species (*Agrostis vinealis, Festuca trachyphylla, Koeleria delavignei, Phleum phleoides*). Its special type of raised bogs is also attributed to a particular Polesie landscape type with a distinctive boggy vegetation complex.

The mires in Polesie also display a specific character. They occur over large areas and are occupied mainly by reed, large sedge, *Hypnum*-sedge and grass-sedge communities.

Figure 3.2. The river Ubort. Not far from Chernobyl. Gomel. Of Belarus. Pool Pripyat River. Belarusian Polesie. Photo: Oleg Gritskevich (Belarus).

The Fauna

The fauna is also characterised by a high diversity in these huge wetland areas. All Belarusian amphibians and reptiles, about 80% of all Belarusian birds, and 55% of its mammals are found on this territory. About 100 species of animals are included in the Red Data Book of Belarus.

Influence of Recent Human Activities

Hunting and Deforestation

Humans have only had an impact in the natural ecosystems of the Polesie area over the past 80-100 years. The early changes were mainly caused by timber felling and hunting. As a result, brown bear (*Ursus arctos*), beaver (*Castor fiber*) and lynx (*Lynx lynx*), as well as red deer (*Cervus elaphus*), moose (*Alces alces*) and wild boar (*Sus scrofa*) became almost extinct. However, beaver and ungulate species were successfully restored by the 1950-60s.

Drainage

During the second half of the 20th century, especially during 1966-90, more than 2.6 million ha of wetlands were drained in Belarusian Polesie. Later, reparation work on old drainage systems was carried out on more than 500,000 ha and 1.1 million ha were converted to agricultural use through these amelioration projects. Unfortunately, this led to an ecological catastrophe for plant and animal communities in this region. Fatal changes in different types of wetlands were observed in huge areas (Table 3.1). The whole Pripyat River catchment area was affected by the intensive drainage and land reclamation activities. Around 20% of its total area was drained and most of the small rivers were converted to channels. The dam constructions along the Pripyat River disturbed the natural development of floodplain ecosystems which depended on annual spring floods. In addition, water levels in the Pripyat river have increased. Thus many floodplain areas every year are over-inundated and wet. This causes degradation and destruction of the forest vegetation in some places.

Later there were also many examples of unsuccessful levelling of the bogs to turn them into rationally managed agricultural landscapes. This did not work, since oxidation of the organic matter proceeded very rapidly after lowering of the groundwater. As a result, biological diversity was severely damaged, while the agricultural value of the land diminished quickly.

The agricultural land created now consists of drained peat soils (about 700,000 ha). At first the collective farms set up here had some advantages, mainly because the organic matter of the soils contained more nutrients for crop uptake. However, within a short time it became evident that the drained and farmed peat soils were ecologically unstable. Now the state of the drained peat soils is causing concern because of decreased soil levels, problems with low pH, unavailability of micronutrients, etc. It is estimated that the total loss of organic matter in 1986-2000 was 43 million tonnes. A continuation of rational agriculture on these lands would require additional economic investments, training of farm workers, other agricultural machinery, other fertilisers and micronutrient applications and other measures.

One of the main reasons for the catastrophic impact of drainage in Belarus was the disregard for scientific arguments for conservation of undisturbed natural ecosystems with the purpose of maintaining biodiversity. In total, the agricultural land reclamation project caused a significant decrease in the number of different animal species, especially waterfowl.

Climate Change

Furthermore, the land degradation in Polesie has recently been exacerbated by negative climate changes, such as more frequent and prolonged droughts and other extreme natural phenomena (early frosts, disruption in the hydrological regimes, etc.). During the last 50-year period the number of droughts in the region increased 2.5-fold. The wetlands which were drained during 1960-1990 are most affected by these droughts.

The Chernobyl Radioactive Contamination

On top of this, the Ukrainian Chernobyl nuclear accident in 1986 influenced and is still strongly influencing the

Table 3.1. Changes in wetland area in Belarusian Polesie during 1959-2004. Source: Pikulik and Kozulin, 2000; Yatsukhno, 2006.

Habitat type	1959	2004	% change
Lakes			
Small forest lakes, km²	23	23	0
Low productive lakes, km²	1,117	1,117	0
High productive lakes, km²	162	204	+21
Artificial water bodies			
Fish-farm ponds, km²	24	192	+800
Water reservoirs, km²	65	416	+640
Channels, km²	5,000	32,157	+85
Rivers			
Highly waterlogged floodplains, km²	3,700	688	-82
Moderately waterlogged floodplains, km²	3,000	2,715	-10
Riverbeds, km²	12,000	12,000	0
Small rivers, km²	77,270	62,160	-20
Mires			
Open fen mires, km²	10,765	3,800	-65
Wet mineral lands			
Wetlands with mineral soils	26,800	12,750	-52

Figure 3.3. Bug wetland in Pribuzhskoye-Polesie, Belarus which is a UNESCO biosphere reserve. Photo: Ivan Prakapiuk.

agriculture of Polesie. More than 1.8 million ha of agricultural land are polluted with Cs-137 at densities of over 1 Ci/km^2. As a consequence, 265,400 ha of fields were abandoned from agricultural use. The annual economic loss from agricultural production due to the Chernobyl accident is estimated at about US$ 70 million. The social and environmental costs are of course innumerable. About 70% of the overall radioactive contamination is in the Polesie region, and 88% of the population affected by the fall-out still resides here (1.4 million ha).

Reclamation, Use and Preservation of the Agricultural Landscapes

Implementation Policies

During the implementation of the 'Program on Dealing with the Consequences of the Chernobyl Nuclear Accident', the main attention focused on the radioactively contaminated areas with a dense human population. Agricultural activities were maintained on the 1.36 million ha contaminated by radioactive caesium and on the almost 0.5 million ha contaminated by Sr-90. The main aim of this programme is to produce foodstuffs suitable for human consumption. For this purpose, a special agricultural system has been introduced based on knowledge of radionuclide migration in soil and plants, as well as on how further migration through the food chain reaches humans. This system includes regulation of soil water regimes and use of appropriate crops, fertilisers and plant protection measures.

Principles of Reclamation

As a basis for agricultural production in the contaminated areas, the following principles of construction, formation and utilisation of reclaimed agricultural landscapes are used:

1. Maximal areal distribution of reclamation systems and agricultural land (arable and meadow lands, forest areas and forest belts, water basins, ponds, buffer, soil-saving and water-security zones) in accordance with the natural landscape types and reclamation systems (Yatsukhno, 1995). (Table 3.2) (Romanova and Yatsukhno, 2001). In such agricultural landscapes the proportion of land used for agricultural purposes is 0.7-0.8 70-80%.

2. Anthropogenic ingredients of landscapes (canals, reservoirs, fields, roads etc.) should be harmonised with natural habitats. This means that the landscape should keep its natural diversity factors such as water levels to enhance processes of self-purification and self-regeneration of natural habitats. To reach this goal, transition zones have to be created from agricultural areas to the various natural landscape types – forests, bushes, bogs, river valleys etc.

Table 3.2. Present and proposed optimal land use proportion of rural landscapes in Belarusian Polesie. (Romanova and Yatsukhno, 2001).

Land use	Present proportion, %	Optimal proportion, %	% change
Forests and shrubs	7	10	+3
Arable lands	48	31	-17
Meadows	37	45	+8
Mires	8	14	+6

3. Preventive measures need to be taken in the formation and utilisation of agricultural landscapes, for instance by preventing the lowering of the groundwater level in the adjacent terrains, diminishing contamination of waters through drainage systems, and preserving landscape diversity elements such as environmental niches, hibernation pits, rifts, etc.

4. The measures need to be integrated and compatible with agricultural production. Thus water levels, crop rotations, optimisation of the soil structure under crops, level of fertilisation etc. need to be incorporated into the maintenance of areas outside the actual agricultural areas.

Prospects for Future Sustainable Rural Development

Developing Agriculture

The rural inhabitants in this area have until recently lived in close connection to the natural environment. However, 'agricultural modernisation' has drastically affected the historically inherited values such as traditional ways of living and working, ethnic backgrounds, identity awareness, etc. In addition, it is high on the agenda for the development of Belarusian Polesie to restore the areas contaminated by radioactivity from the Chernobyl power plant catastrophe, both concerning its ecological and socio-economic values. In fact, the biological and landscape diversity in Polesie is a prerequisite for the preservation of its historical and cultural heritage, and for the sustainable development of the region as a whole.

Successful development of the region should be accompanied by reforms of agriculture, creation of a more diverse economy, and the breakup of the monopoly of large state agricultural enterprises. Alternative economic entities such as joint stock companies, cooperative farms, individual farms, share companies, associations, agro firms, holdings etc. should be developed. Crucial tasks in this transformation are land reform, the possibility to buy and sell land, land rental system reform, a reformed loan and credit system, etc. Approximately 30% of the agricultural land today can be expected to be put to uses

Table 3.3. Nature Protected Areas of Belarusian Polesie region, ha (Sheme…2007)

Natural protected area	Land area, ha
National Park	
Prypyatsky	82,254
Reservs	
Polessky radio-ecological	215,500
Zakazniks	
Landscape	
Mozyrskye Ovragi	1,141
Prostyr	3,440
Olmany mires	94,219
Strelsky	12,161
Mid-Pripyat	90,447
Vydritsa	17,560
Smychok	2,635
Biological	
Baranovichsky	29,019
Vetkovsky	5,900
Zhitkovichsky	15,000
Radostovsky	8,657
Shabrinsky	3,300
Babinets	850
Borsky	2,805
Buckchansky	4,915
Yelovsky	963
Falichsky Moh	1,700
Chirkovichsky	463
Buda-Koshelevsky	13,575
Selyava	260
Lukovo	1,523
Tyrvovichi	1,391
Zvanets	10,460
Luninsky	9,283
Buslovka	7,936
Sporovsky	19,384
Dnepro-Sozhsky	14,556
Hydrological	
Vygonoshchanskoye	43,000
Total area	712,497 or 11.7 % of Polesye region

other than agriculture because of its low agricultural productivity, and also because it is situated too far from large settlements (Yatsukhno et al., 1998).

In addition, better and more complex nature protection and management measures need to be introduced This includes restoration of the more traditional farming methods, used before collectivisation of the land and the large drainage schemes. Agricultural and ecological tourism, folk crafts, hunting, fishery, apiculture could be new ways of making a living in the area. However, this would require heavy investment.

Nature Protection

One promising strategy for future natural resource management is the establishment of nature protected areas. Today, the protected areas (zakazniks) of Belarussian Polesie cover 484,500 ha, which is over 11% of the region's area (Table 3.3). This area includes Prypyatski national park (82,200 ha), Polesski radiation-and-ecological reserve (215,500 ha) and 28 national reserves including 7 landscape, 1 hydrological and 20 biological reserves), Mid-Pripyat (90,400 ha), Olmany mires (94,200 ha), Zvanets (10,400 ha) and some smaller areas. However, Belarusian protected areas have to become a part of the European ecological network. The Polesie area would then be connected with its corresponding areas on the other side of the border (Poland, Ukraine, Russia). This would create a large and very valuable continuous area with similar ecologically and socially interesting features. This continuous and interconnected system should be seen as an inheritance given to future European generations.

de Groot, R.S. 1992. *Functions of nature, evaluation of nature in environmental planning, management and decision making*. Groningen: Wolters-Noordhoff.

European Union, *The Sixth Environmental Action Plan* (EAP) 2002-12.

EU Regulation 2078/92

FAOSTAT, 1999. http://faostat.fao.org/?alias=faostat1999. (retrieved 20120903).

Free, J.B. 1993. *Insect pollination of crops*. London: Academic Press.

Guo, Z., Xiao, X. and Li, D. 2000. An assessment of ecosystem services: water flow regulation and hydroelectric power production. In: *Ecological Applications* 10, pp 925–936.

Houlahan, J. and Findlay, C.S. 2004. Estimating the 'critical' distance at which adjacent land-use degrades wetland water and sediment quality. In: *Landscape Ecology* 19, pp 677– 690.

Jackson, J., Kirby, M., Berger,W., Bjorndal, K., Botsford, L., Bourque, B., Bradbury, R., Cooke, R., Erlandson, J., Estes, J., Hughes, T., Kidwell, S., Lange, C., Lenihan, H., Pandolfi, J., Peterson, C., Steneck, R., Tegner, M. and Warner, R. 2001. Historical over fishing and the recent collapse of coastal ecosystems. In: *Science* 293, pp 629–638.

Klein, A., Steffan-Dewenter, I. and Tscharntke, T. 2003. Fruit set of highland coffee increases with the diversity of pollinating bees. Proceedings of the Royal Society of London. Series B 270, pp 955–961.

Klein, A., Vaissière, B.E., Cane, J.H., Steffan-Dewenter, I., Cunningham, S.A., Kremen, C. and Tscharntke, T. 2007. Importance of pollinators in changing landscapes for world crops. In: *Proceedings of the Royal Society of London. B, Biological Sciences* 274 (1608), pp 303–313.

Losey, J.E. and Vaughan, M. 2006. The economic value of ecological services provided by insects. In: *Bioscience* 56 (4), pp 331–323.

Millennium Ecosystem Assessment (MA), 2005. *Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

Myers, R.A. and Worm, B. 2003. Rapid worldwide depletion of predatory fish communities. In: *Nature* 423, pp 280–283.

Naylor, R. and Ehrlich, P. 1997. Natural pest control services and agriculture. In: Daily, G. (ed.) *Nature's services: Societal dependence on natural ecosystems*, pp. 151–174. Washington DC.

Paul, E.A. and Clark, F.E. 1996. *Soil microbiology and biochemistry*. New York: Academic Press.

Ratcliffe, B.C. 1970. Scarab beetles: Dung feeders, jeweled pollinations, and horned giants. In: *University of Nebraska News*, vol. 59. pp. 1– 4.

Roka, F.M. and Palmquist, R.B. 1997. Examining the use of national databases in a hedonic analysis of regional farmland values. In: *American Journal of Agricultural Economics* 79, 1651–1656.

Robertson, G.P., Burger, L.W., Kling, C.L., Lowrance, R. and Mulla, D.J. 2007. New approaches to environmental management research at landscape and watershed scales. In: Schnepf, M. and Cox, C. (eds.), *Managing agricultural landscapes for environmental quality. Soil and water conservation society*. Ankeny, IA, pp. 27–50.

Stoller, E.W., Harrison, S.K., Wax, L.M., Regnier, E.E. and Nafziger, E.D. 1987. Weed interference in soybeans (Glycine max). In: *Reviews of Weed Science* 3, pp 155–181.

Swinton, S.M, Lupi, F., Robertson, G.P. and Hamilton, S.K., 2007. Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits. In: *Ecological Economics*, 64, 245–252.

Thies, C. and Tscharntke, T. 1999. Landscape structure and biological control in agroecosystems. In: *Science* 285 (5429), pp 893–895.

Tilman, D., Cassman K.G., Matson P.A. and Naylor R.L. 2002. Agricultural sustainability and intensive production practices. In: *Nature*, 418, pp 671–77.

USDA, 2007. *Agriculture Secretary Mike Johanns addressed the problem of honeybee colony collapse disorder*. USDA Satellite News Feed July 5, 2007.

Vitousek, P.M., Cassman, K., Cleveland, C., Crews, T., Field, C.B., Grimm, N.B., Howarth, R.W., Marino, R., Martinelli, L., Rastetter, E.B. and Sprent, J.I. 2002. Towards an ecological understanding of biological nitrogen fixation. In: *Biogeochemistry* 57/58 (1), pp 1– 45.

Wandén, S. and Schaber, P. 1998. Understanding Biodiversity. In: Catizzone, M., Larsson, T.B. and Svensson, L. (eds) *European Commission, Ecosystem Research Report No. 25*.

Weibull, A., Ostman, O. and Granqvist, A. 2003. Species richness in agroecosystems: the effect of landscape, habitat and farm management. In: *Biodiversity and Conservation* 12, pp 1335–1355.

Welbank, P.J. 1963. A comparison of competitive effects of some common weed species. In: *Annals of Applied Biology* 51, pp 107–125.

Whitmire, S.L. and Hamilton, S.K. 2005. Rapid removal of nitrate and sulfate by freshwater wetland sediments. In: *Journal of Environmental Quality*, 34, pp 2062–2071.

Wilby, A. and Thomas, M.B. 2002. Natural enemy diversity and pest control: Patterns of pest emergence with agricultural intensification. In: *Ecology Letters* 5, pp 353–360.

Wilkinson, T.K. and Landis, D.A. 2005. Habitat diversification in biological control: The role of plant resources. In: Wackers, F.L., van Rijn, P.C.J. and Bruin, J. (eds.), *Plant provided food and plant-carnivore mutualism*. Cambridge, U.K: Cambridge University Press.

Zhang, W., Ricketts, T.H., Kremen, C., Carney, K., Scott M. and Swinton, S.M. 2007. Ecosystem services and dis-services to agriculture. In: *Ecological Economics*, 64 , pp 253–260.

Chapter 3

Pikulik, M.M. and Kozulin, A.V. 2000. Recent State and significance of vertebrate animal populations of Belarusian Polesie. In: *The ecological and lowlands mires in the Polesie region*. Minsk P. 120-123.

Romanova, T.A. and Yatsukhno, V.M. 2001, Optimal proportion of grounds as a key to sustainable utilization and conservation of agrolandscapes of Polesye. In.: *Belarusian Polesye*. Belarusian Polesye Foundation, Pinsk, p. 38-42. (in Russian).

The scheme of rational distribution of nature protected areas of national importance before January 1, 2015. Minsk, 2007. 17 p.

Yatsukhno, V.M. 2006. Biological and landscape diversity conservationas a key sustainable agricultural development of Belarus of Belarusian Polesie. In: *Environment of Polesie: particularities and perspectives of development*. Vol. 1. Academia. Brest, 2006/ H/ 4-10.

Yatsukhno, V.M. 1995. *Formation of agrolandscapes and environment protection*. Institute of Geology, Minsk, 120 p. (in Russian).

Yatsukhno, V.M., Bambalov, N.N. and Davydik, E.E. 1998. On the necessity of the landscape approach to realization of measures aimed at the conservation of biological diversity in Belarus. In: *Natural resorses*. No. 3. 1998. P. 59-65. (in Russian).