Acta Agrophysica, 2000, 26, 245-253

BELARUSIAN POLESYE: PROBLEMS OF DEVELOPMENT AND PRESERVATION OF ITS NATURAL COMPLEXES

I. Lishtvan, L. Yaroshevich

Institute for Problems of Natural Resources Use and Ecology, Academy of Sciences of Belarus, Staroborisovsky Trakt 10, 220114 Minsk, Belarus

A b s t r a c t. Natural and climatic features of Polesye have been given adequate consideration. The area of bogs and water-logged lands in the Belarusian Polesye constitutes about 44 % of the total area of the region, drained lands exceed 2 million ha of which 1.0 million ha are peat deposits. Negative phenomena and processes which reduce fertility of the reclaimed lands and aggravate ecological situation in the region have been discussed. Phenomena such as non-comprehensive nature of reclamation, lack of balance between nutritive elements of plants, deflation caused by crop production, disability to control ground water level, surface and ground water quality impairment, etc. were discussed. A set of measures to ensure normal efficient use of reclaimed lands in Polesye with due account of environmental functions of waterlogged areas have been examined. Attention should be focused on renovation of obsolete and worn out melioration systems and improvement of productivity of reclaimed peat soils rather than development of new lands. In Polesye, natural complexes of interest for regulation processes at regional, European and global biospheric level are found, i.e., bog complexes that are worthy to be declared protected areas - natural sanctuaries of European importance.

K e y w o r d s: Belarusian Polesye, preservation of natural complexes, peat soils, mire

INTRODUCTION

The paper discusses natural and climatic features of Polesye, its geographical position, climate, flora, fauna, landscapes, advantages and disadvantages of land improvement and use of drained lands.

LOCALISATION

Polesye (Polesskaya Lowland) is an expansive territory in the Central and Eastern Europe, the major part of which is situated in the Pripyat River basin. The lowland covers the area of 13.2 million ha both in Belarus and the Ukraine with the northern part forming the Belarusian Polesye (6.1 million ha) and the southern part

forming the Ukrainian Polesye (7.1 million ha). To the west of the boundaries of Belarus and the Ukraine a large area is occupied by the Polish (Lublin) Polesye.

ENVIRONMENTAL CONDITIONS

Its geographical position and specific natural conditions made Polesye a unique natural region which ecological state has a significant impact on the environment and socio-economical development not only of the Republic of Belarus but the Polesye areas within Ukraine and Poland.

Mild climate, low relief, specific features of top-soil, hydrology and hydrography create extremely favourable conditions for the formation of unique natural complexes with a wide spectrum of biodiversity. In this regard Polesskaya lowland is unique in the world.

Polesye's flora is representative and rich in rare species. More than 1400 higher vascular plants, constituting 96% of Belarus's flora were found in the region. Among rare species more than 60 are exceptionally valuable and included in the Red Data Book of Belarus.

The fauna of the region is diverse and abundant. There are 55 species of mammals (80% of the terrestrial fauna of Belarus), about 270 species of birds (85%), and 37 species of fish dwelling in reservoirs. About 100 species of fauna are included in the Red Data Book of Belarus as unique and rare in the fauna of the republic which need protection.

DRAINAGE PROBLEMS

Bog landscapes of Polesye are of particular value for the all-European and global biospheric processes.

In spite of a large-scale amelioration [4] and peat development, many large natural bogs as well as swamp and waterlogged river floodplains survived. Among all terrestrial habitats of plants such as forests, meadows, agricultural lands, etc., only bogs occupy a special place between the small biogenic and large geological circulation of matter. They bring carbon dioxide and nitrogen from biogenic circulation to geological circulation and efficiently purify atmosphere from excessive carbon dioxide. One hectare of non-drained bog is about 7 to 10 times more efficient in eliminating carbon dioxide from the atmosphere than one hectare of forest. Hence, they perform a very important global and gas regulation function.

Generally, bogs and waterlogged lands in the Belarusian Polesye occupy more than 44% of its total area. The total area of bogs and waterlogged land is 50 to 60% in many administrative districts while in some of them it reaches 80%.

By now, the total area of drained lands in the Belarusian Polesye is about 2 million ha. For comprehensive development of large reclaimed territories, new state farms and fodder production enterprises as well as large-scale animal industry complexes were built.

The necessity for land reclamation by drainage comes from the fact that this eliminates excessive moistening of soil which is the primary cause of its low fertility. This, however, invariably disturbs ecological equilibrium [1].

Economic and social development of the Polesye has been greatly hindered by a large area of swampy land. Due to excessive soil moistening land users usually lose up to 40% of grain yield on lands without water control. At the same time, lengthy rainless periods are typical for Polesye and every fourth year it is drought-afflicted. Therefore, the Belarusian Polesye as a farming area with unstable moisture level calls for hydrotechnical amelioration with bidirectional water control to provide good harvest every year [2].

Reasonable reclamation assures high land productivity and allows to compensate for the withdrawal of agricultural land for industry or road engineering. Neither efficient farming nor improvement of the living conditions of population would be possible without land reclamation in the Polesye.

At the same time, it should be considered that hydrotechnical amelioration of natural components may not only lead to land improvement but drastically impact water, temperature, and farming regimes in the territories and cause far-going changes in the spacial structure and appearance of the landscape.

LAND IMPROVEMENT

In the Polesye, hydrotechnical amelioration has a 125-year long history. Drainage of the area was initiated by the Western Expedition guided by I.I.Zhilinsky and dates back to 1870-1885 when the first project on land improvement and development of advantageous water transport system for floating valuable soft wood from the hard-to-reach parts of the Polesye was implemented.

The second stage of constructing land improvement facilities which is associated with the implementation of the Integrated Scheme of Drainage and Land Development in the Polesskaya Lowland (1954) went on for years. The Scheme aimed at improving 4.8 million ha of bogs and waterlogged lands of which 2.9 and 1.9 million ha, respectively, was in the Belarusian and Ukrainian parts of the Polesye. Land improvement by draining was then applied. In 1970-1971, the Scheme was thoroughly reviewed and a forecast of environment changes and further land improvement in the area worked out. It came to light that implementation of the Scheme had a very

detrimental effect. The Scheme was radically changed with revised principles and practices of land improvement. Since 1975 land improvement in the area has been based on dual water regime control - drainage and moistening- with implemented polder systems particularly in the Pripyat floodplain.

As a result of implementation of the above projects in the Polesye area, total area of drained bogs and waterlogged lands amounts to 3.6 million ha, including more than 2 million ha in the Belarusian Polesye. There is no other case of large-scale land improvement in the world practice than the one implemented in the Polesye.

Drainage applied at the initial stage of land improvement in the Polesye had a pronounced effect on the environment because it had been conducted without any account of ecological conditions and nature preservation requirements. This could be attributed to the deficiency of funds and material, technical resources for constructing ecologically sustainable reclamation systems, on the one hand, and insufficient ecological knowledge about land improvement and use of improved lands on the other. The latter might explain a popular concept that the Polesye is abundant in excessive water to be "spilled" existing for decades. This theory was used as a foundation for design and construction of land improvement systems. To dump "excessive" water rapidly, rivers and brooks that served as water intakes were straightened. To achieve high yield potential without fertilizers, peat decomposition was intensified to liberate nutrients for plants. In the view of these objectives, the concept of deep drainage of bogs had been implemented while moistening of improved lands was considered futile. For a long time, the constructed reclamation systems have not provided for dual soil water regulation thus cereals and intertiled crops were grown on peat soils.

By mid 60s it came to light that those ill-grounded and ungrounded concepts and recommendations for land improvement technology and use of improved land had a number of adverse impacts and triggered detrimental processes both on improved areas and their bordering landscapes thereby causing low agricultural yield and aggravation of ecological situation in the region. In many cases this led to soil overdrainage. Some time later poorly constructed reclamation systems gradually failed. Secondary waterlogging processes started to develop on the drained areas. At present, reclamation systems in the Belarusian Polesye need radical reengineering on the area of more than 500 thousand ha and major repair on the area of about 200 thousand ha.

For many years, drainage of bogs was accompanied by draining and putting into use potentially low-productivity lands that should have been ruled out of reclamation. In a number of cases sandy and sandy-loam soils characteristic of instable

hydrological regime and unfavourable agricultural properties were drained. The area of these lands in the Belarusian Polesye exceeds 300 thousand ha.

A major economic and ecological disadvantage was non-integrity of land improvement which consisted in the fact that agrochemical properties were not optimised in most cases on the drained areas and the optimum ratio between nutrient elements was not maintained. Especially unfavourable conditions of nutrition developed on the improved grasslands because the amount of fertilizers applied there was 2 to 3 times lower than the dose used per 1 ha of arable land. Deficiency of nutrients for plants resulted in lower yields and agricultural products biologically and ecologically deficient because of excessive content of nitrates.

Improper use of improved peaty soils resulted in deflation. Great ecological and economic damage caused by wind erosion was observed in April 1981 when dust storms covered many administrative districts in the Gomel and Brest regions. As evidenced by the data on the cause of dust storms in April 1981, the destructive natural phenomenon was caused primarily by the crop cultivation on peat soils as well as lack of erosion preventive measures against erosion rather than peculiarities of climate and soil.

PRESERVATION OF NATURAL RESOURCES

Another unresolved all-European problem of no less importance is preservation of organogenic layer of the improved peaty soils. Its thickness decreases annually by 1-2 cm because of yielding, mineralization, and deflation. A decrease in the peat layer triggers a number of adverse processes and phenomena on the lands bordering with drained bogs and upsets ecological balance of the environment: underground water level drops, small rivers dry up, valuable plant associations fall out, microclimate is getting worse, eutrophication of waters in rivers and lakes intensifies. A decrease in the underground water level on the territories adjacent to the drained bogs most often involves lower fertility of sandy soils used earlier as arable and appearance of secondary drift sands.

As mineralization processes intensify, water-soluble products of peat decomposition get into water intakes and pollute water for human consumption on the land included in the reclamation projects. The Pripyat and the Dnieper carry about 1.5 million tons of mineral matter and up to 700 thousand tons of aggressive water-soluble organic matter a year.

Total depletion of peat layer on the large areas of drained lands in the Polesye threatens with major climatic changes in Europe and degradation of the whole biodiversity complex [5].

Atmospheric drought has already become typical of the Polesye. General aridization of the Polesskaya Lowland is aggravated by the fact that the number of constructed basins is insufficient; thus, for instance, less that half of the planned water-storage banks and ponds was constructed in Belarus. For this reason a major portion of surface and underground waters was spilled to rivers never to be returned to the Polesye. Hardly any reclamation system has proper rotation working and spills water to water intakes with correct pre-treatment to clear it from biogenic elements and pesticides.

Agricultural landscapes formed by hydrotechnical amelioration are monotonous and make no contribution to the preservation of biodiversity. Hence, they need major reengineering.

Boggy and floodplain landscapes of the Polesye are of particular value for all-European and global biospheric processes. In this region, however, bogs experience significant anthropogenic load due to the expansion of reclamation, mining, road engineering, construction of town and communication systems. Many of them have already lost their biospheric functions [3].

For many years assessment of land improvement in Belarus was based on technical and economic characteristics only without any consideration for its ecological impact. This resulted in straightening and practical extermination of hundreds of small rivers that were converted into banked channels with their floodplains plowed up. The quest for a high rate of land use (0.9 and more) as well as ill-grounded increase in the improved land outlines led to the elimination of many natural meadows, shrubberies and forests in the river floodplains, a habitat for many species of biological diversity. Elimination of floodplains of the Bobrik, the Morocha, the Lan, the Yaselda, the Skripitsa and other rivers can be a good example of the above. As it would be hardly possible to restore these floodplains in the foreseeable future, they should be considered as lost forever. At present no land reclamation in the floodplain of small rivers is performed as it is considered impractical.

At the same time, hydrotechnical amelioration in the large floodplain of the Pripyat is still going on as considerable areas suffer from flood annually. The total flooded area amounts to 579.4 thousand ha of which 425 thousand ha, is in Belarus and 154.4 thousand ha is in Ukraine. There are many sites localities and vast agricultural lands in the area. Long-lasting floods (up to 150 days a year) that totally or partially disrupt crops and inflict heavy damage to population and economy were observed here in spring, summer, and autumn. That is why, construction of flood control dams and banks is obligatory and justified.

The "Belgiprovodhoz" and "Ukrgiprovodhoz" Institutes developed a system for protecting the Pripyat floodplain from flood and reclamation. The area to be

protected covers 381.1 thousand ha, of which 280.8 thousand ha ia in Belarus and 100.3 thousand ha in Ukraine.

The boggy landscape of the Pripyat floodplain is a very complex natural system consisting of bogs, water-logged lands and numerous loop lakes. In the soil structure peat soils dominate accounting for 41.2% of the total floodplain area while sandy soils, sandy-loam soils and loam soils account, respectively, for 28.1, 21.8 and 8.9%. Due to specific geomorphological characteristics of the floodplain in the area, bogs of less than 1 hectare are frequent here. In the Pripyat floodplain, bogs of various sizes often intersperse with meadows on sandy or sandy loam soils and numerous small loop lakes. It is not unusual to come across waterlogged peat and mineral soils of different granulometric composition within a single hectare. Due to regular and lengthy flooding, acquatic, bog, meadow and shrubbery vegetation is growing in abundance in the Pripyat floodplain.

Generally speaking, peat deposits are less than 1 m thick in the valley bogs. The summary area of bogs with low-peat deposits is more than 80% of valley bogs.

In the Pripyat floodplain, bogs and their bordering mineral lands and loop lakes have close hydraulic linkes and function in the same hydrologic rhythms.

Due to the mosaic arrangement of patches of low-power peaty soils, and mineral soils they are difficult to reclaim. In many cases possibility of draining sandy, peaty, and peat-gley soils is doubted. Reclamation of peaty soils with a peat layer of up to 0.5 m and their further use under black cultivation can lead to their fast destruction because peat will mix with sand sublayer within several years which accelerates the process of organic matter mineralization. Combination of sandy and peat soil areas within one field will accelerate wind erosion. In our opinion, reclamation of low-power peat soils shall be abandoned until reliable methods of their biogenic layer preservation have been developed.

Up till now there is no unambiguous answer to the question whether reclamation has an impact on the balance and quality of ground and underground waters in the Polesye. Pursuant to the data obtained by BelNIIM&L (Belarusian Scientific-research Institute of Amelioration and Meadow Management), reclamation has practically zero effect on the annual runoff, while ZNIIKIVR (Central Scientific-Research Institute of Complex Water Resource Use) states that the annual runoff of the Pripyat increased by 35% at the discharge site near the Mozyr the period from 1965 to 1983. Conclusions on the reclamation impact on the yearly regime of the river runoff are also contradictory. Ever-lasting disputes between specialists in water problems point to insufficient knowledge in the field.

Recent estimations of the quality of water in the Pripyat river basin is a straight forward evidence that the concentration of biogenic elements and other chemicals

has increased. However, according to the data, no matter how incomplete they may be, more than 200 tons of phosphorus, about 900 tons of nitrogen, more than 18000 tons of sulphates, and 23000 tons of chlorides are discharged annually to the Pripyat.

There is hardly a water body left unaffected by reclamation on the territory of the Polesye: about 90% of them are outlets for drainage water, about 30% of water bodies are involved in irrigation, and there are pumping stations located on the banks of many lakes to control water inlet and outlet. Due to land reclamation the catchment area of many lakes has been considerably reduced causing drawdown and ensuing fast depletion. Among representative examples there are lakes such as Chervonoje, Oltushskoje, Dikoje, and Mulnoje. For the recent 30 years, total mineralization of lake water increased more than twofold while concentration of chlorides and sulphates increased from 2-3 mg l^{-1} to 20-30 mg l^{-1}.

Studies and estimations state that to significantly improve hydrologic conditions of rivers and their bordering areas in the Belarusian Polesye, it is necessary to construct water reservoirs and ponds with a total water volume of 1.56 km^3. By now, the volume implemented is only 35% of that required. The lag in construction of artificial reservoirs has an adverse effect on both economic and ecological situations in the Polesye.

CONCLUSIONS

It may be said that conversion of large swampy areas into agricultural lands, development of polder systems in the floodplain of the Pripyat involved a noticeable change in the natural complexes and reduction in the diversity of species, population of plants and animals, and replacement of earlier predominant groups with new groups.

The results of long-term studies and analysis of accumulated experience call for revision of land improvement strategy for the Polesye. We have repeatedly raised the need as for banning drainage in the floodplain of Pripyat where adverse impacts such as reduction in the forested area and general aridization of the area caused by ground water runoff have been observed. Ecological situation is dramatic when the consequences of the Chernobyl NPP accident is included in the analysis.

That is why a major focus of attention should be on the rehabilitation of morally obsolete and physically depreciated reclamation systems and improvement of the reclaimed land productivity rather than on the new land improvement projects.

The problem of choice between reclamation and ecology has been raised and is currently under discussion by the scientific community and public in Belarus. Any activities involved in construction and utilization of reclamation systems as well as

agricultural use of improved lands must ensure environmentally sustainable management within the region, catchment areas, individual farms and reclamation entities. In this connection, it would be imperative to implement a range of activities to improve existing agricultural landscapes and increase preserved areas in the Polesye. Unique bog and lake-bog complexes in the Polesye are valuable nature systems which are of vital importance for the regulation of biospheric and other nature-climate processes at regional, all-European and global level and should be preserved as monuments of natural heritage.

REFERENCES

1. **Bambalov N.N., Lishtvan I.I., Yaroshevich L.M.:** Ecological Problems of the Polesskaya Lowland and the Way to Their Solution (in Russian). Problemy Polesya, Issue 13, 1990.
2. **Lihatsevich A.P.:** State and conditions for efficient agricultural use of peat soils (in Russian). Amelioration of Waterlogged Lands, Collection of Research Papers, v.XLV, 3-9, 1998.
3. **Lishtvan I.I., Bambalov N.N., Yaroshevich L.M:** Ecological Consequence of Amelioration. Collection: Modernization of Reclamation Systems and Ways to Improving Efficiency of Drained Land Utilization (in Russian). Minsk, 5-14, 1998.
4. **Skoropanov S.G., Karlovsky V.F., Brezgunov V.S.:** Reclamation of Lands and Environment Conservation(in Russian). Minsk, 166, 1982.
5. **Skoropanov S.G., Okulik N.V.:** Evolution of basic soil properties and its productivity (in Russian). Problemy of Polesya, Minsk, Issue 10, 83-151, 1986.