MINISTRY OF ENVIRONMENTAL PROTECTION, NATURAL RESOURCES AND FORESTRY

CASE STUDY ON THE POLISH EXPERIENCES RELATING TO THE IMPLEMENTATION OF ECONOMIC INCENTIVE MEASURES TO PROMOTE THE CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY IN THE BIEBRZA VALLEY, WITH SPECIAL ATTENTION TO THE BIEBRZA NATIONAL PARK

OECD MATERIALS

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1. GENERAL DESCRIPTION

1.1. Description of the ecosystem

1.1.1. Peatlands of the Biebrza Valley

The proglacial stream valley of the Biebrza river was formed as a result of the last glaciation. Its area reaches 195,000 ha and is visibly delimited by the surrounding high plains. The valley's area is divided into three parts called "basins".

The Upper Basin consists of proglacial stream valley's channels and flat sandr. A flat basin crossed by the tributaries of the Biebrza rivers constitutes the Middle Basin. The Lower Basin is strongly swamped by a depression, into which all the surface and ground waters from the water-bearing layers flow into. The runoff of waters from the Biebrza Valley is restrained by a step formed by the Narew river, resulting in storage of large quantities of waters and creation of large flood-waters.

Small fall of the ground-waters table generates creation of marginal lakes and development of swamping process on those areas. Alimentation of the valley's areas with flow-, ground-, underground- and rain waters results in occurrence of differentiated trophic habitats, which determines types of the existing floral assemblage as well as types of peat being formed. Areas not covered by surficial flood-lands and alimented by ground waters have floral covering, consisting mainly of moss communities, which form a basis for moss peats. A dominating type of peat lands are the low-peat swamps located on the flood-lands with rush-plant and mud-sedge vegetation. On the areas of old river-beds and shallow water basins, the peats of hollow habitat flora can be found. On the flooded areas along the river, the muds were formed.

Moss- and mud-sedge peats dominate in the Upper Basin, covering the area of over 14,000 ha, 3 to 4 m thick.

The Middle Basin, where peats were created as a result of impact of river flooding waters, as well as free and thrusting underground waters, is characterised by rush and mud-sedge vegetation, covering the area of about 45,000 ha with an average thickness of about 2 m.

The Lower Basin is characterised by considerable flooding by the ground- and flooding waters, which created conditions for the growth of floral communities and peats described as rush, mud-sedge, moss, bush and forest assemblages. The area of peat-swamps is about 23,000 ha with the average thickness of 1.5 m.

1.1.2. The Biebrza River

The water conditions in the valley are formed mainly by the Biebrza river, running from the north-east to the south, and its tributaries. The total length of the Biebrza

river is about 170 km and is almost entirely located within the territory of the Biebrza National Park (BNP). The area of the Biebrza river's catchment is 7,051 km^2 and covers 10 major tributaries. Biebrza is a typical lowland driver with an average longitudinal slope reduction of 0.36‰ and an average annual flow of 27.5 $m^3 s^{-1}$. Flows of the river vary from 10 $m^3 s^{-1}$ in the summer periods to about 140 $m^3 s^{-1}$ in the periods of spring thaw.

Three main types of environments can be found within the area of the Biebrza river and the lower parts of its tributaries. The first one occurs in the lower and middle part of the Biebrza river about 30 m wide, as well as the confluence parts of the major Biebrza's tributaries. The average depth of the river is about 2 m, with a hard sand-gravel bottom free from any vegetation. The second type of habitats can be found within the upper part of the Biebrza river and the middle size tributaries about 15 m wide. The average depth of the river in this areas is about 1.5 m with a sand-mud bottom covered with vegetation and ichthyofauna in the amount of some 15 species. The spring parts of Biebrza together with some small tributaries about 5 m wide constitute the third type of habitats. Their average depth reaches 0.7 m, with a sand-gravel bottom. The river channel is slightly covered with vegetation, while ichthyofauna is composed of about 20 species.

1.1.3. The meadow floral assemblage of the Biebrza Valley

The differentiation of the floral assemblage in the Biebrza Valley can be clearly seen in the transversal and longitudinal sections of the Valley. The habitats conditions, starting from the river's channel up to the mineral scarp, are differentiated and one can notice the changes of water conditions, height of the terrain, soil and the change of the floral assemblage resulting from them. Similarly, the differentiation of the habitat conditions and the floral assemblage can be noticed in the longitudinal section of the valley. Different habitat conditions occur in the river-head areas of the Biebrza river and their total change can be noticed in the area of Biebrza's confluence to the Narew river.

The differentiation of the floral assemblage in the longitudinal and transversal section is clear due to the inconsiderable human impact on the natural conditions and processes. Four zones occur on this area: the first one (immersions zone) which is flooded, the second zone where the flooding is either very short or it occurs once in several years, and the third one - where flooding does not exist and the last, bank-zone located on the scarp of the mineral valley.

Occurrence of 794 species of vascular plants, classified into 99 families is recorded on the territory of the Biebrza National Park. The families of *Compositae, Cyperacae, Graminae* are most frequently represented in the flora of the park. Among the recorded species of the vascular plants existing in the park 53 species are completely protected, 13 species are partly protected, 2 are considered as almost extinct (in the Red Book) and 3 species are threatened.

1.1.4. The forest ecosystems of the Biebrza National Park

The area of forests owned by the State Treasury and administered by the Biebrza National Park is 13,369 ha. About 2,000 ha of the forests located within the territory of the Biebrza National Park are privately owned.

The forest habitats occurring here are very differentiated - from alder carrs to dry coniferous forests, as well as large numbers of mixed forests habitats, fresh forests, marshy coniferous forests, fresh-mixed coniferous forests, humid coniferous forests and the habitats of pine forests on dunes and dry-grounds.

Creation of floral assemblages in the forest ecosystems on the marshlands, similarly to the non-forest ecosystems, is mainly dependent on the water alimentation. Method of alimentation influences the habitat and its vegetation. It has been observed that the alder carrs occur in the water seepage areas, birch forests and spruce trees grow on the deep peat-beds fed by the ground waters, while the pine coniferous forests occur on the areas isolated from the alluvial and ground waters, where a habitat is alimented mainly by the rain-fall waters.

1.1.5. Birds of the Biebrza marshlands

Existence of 262 bird species is noted in the Biebrza National park, in which 181 are the breeding species, 4 species are likely to be breeding and 2 species which are occasionally breeding on the area of the Biebrza Valley. According to the criteria used in the Polish Red Book, the birds living here can be divided into several threat categories: 2 species are classified as extinct, 6 species are classified as extinct to the extreme limits or dying out, 15 threatened by extinction, 19 species are classified as rare, 3 species threatened, 3 species are occasionally occurring.

The avian fauna is strongly differentiated by numbers and species in different habitats, which are characterised by specific conditions created as a result of different water conditions, vegetation types and human activity. The following birds habitats can be noted here: the river channel, the flooded and non-flooded part of the valley, vegetation of the marsh meadows, vegetation of the forest communities, extensively utilised peat-swamp meadows and areas where shrubs are growing.

The Biebrza Valley plays a great role in the spring and autumn migrations of birds, as they find a place of rest and feeding here. Attractiveness of the valley is determined by the density of individuals defined during the passage of birds over a chosen stretch of the Biebrza river, in the Lower and Middle Basin. The maximum density in the Middle basin reached the number of 589 individuals per 1 km of the river, and 688 individuals per 1 km in the Lower Basin. The average density are respectively 245 and 298 individuals per 1 km of the river.

The values of the ornithofauna of the Biebrza Valley in comparison with the remaining parts of the country and the Central Europe is illustrated below.

Table 1. Numbers of individuals of a given species on the territory

Species	*Biebrza*	*Poland (the remaining part of the country)*	*Central Europe (excl. Poland)*
Montagu's harrier *(Circus pygargus)*	72	about 40	250 - 300
Dunlin *(Calidris alpina)*	4 - 5	80 - 100	120 - 140
Ruff *(Philomachus pugnax)*	200 - 300	about 20 - 50	about 2,000
Great snipe *(Gallinago minimus)*	about 400	10 - 50	-
Jack snipe *(Lymnocryptes minimus)*	>= 2	-	-
White-winged tern *(Chlidonias leucopterus)*	420	80	300
Little gull *(Larus minutus)*	55	1 - 5	-

The above table shows that the Biebrza Valley constitutes a very important area in view of the birds conservation not only in Poland, but in the Central Europe as well.

1.1.6. Mammals of the Biebrza Valley

14 species of big mammals and 17 species of small mammals exist in the Biebrza Valley. Among the big mammals, the most numerous are: elk deer, deer, roe deer, beaver, wolf, fox, racoon dog, hare, European polecat, pine marten, otter, ermine, badger. The small mammals live in groups characteristic for certain biotopic types.

The population of big mammals, including predatory mammals, should be properly protected. The issue causing problems is the creation of proper relations between elk deer and deer. Another controversial matter is the conservation or reduction of racoon dog and American mink. The proper population of wild hog should be determined as well. In view of the above, species should be protected until relations between the species are stabilised.

1.2. Detailed identification of impacts on the ecosystems

External impacts on the ecosystem of the Biebrza Marshland may be divided into to groups: environmental and human. The environmental impacts are usually independent from man, or may result from his activities far from the Biebrza Valley which effects can be seen in the valley in the form of disturbances of the natural phenomena which cause changes in the marsh ecosystems.

The external impacts resulting from the man's activity are: intentional transformation of environment causing further changes in the ecosystems, or activities influencing only one of the ecosystem's elements, however again resulting in changes in the ecosystem as a whole, or even in several closely dependent ecosystems.

1.2.1. Impacts on the peatlands of the Biebrza Valley

Peat-swamps of the Biebrza Valley are dependent on water, i.e. its quantities, quality and ways the habitat is being alimented.

The peat-swamps will be created or at least maintained in the same form if the quantity of water reaching the habitat is equal or higher than the quantities distributed within a given habitat, ensuring its high hydration level. The water may come from the accumulated rain-waters, inflow of free ground waters and water under hydrostatic pressure, as well as surface waters.

Depending on which of the above types of waters is feeding a given habitat, different types of peat-swamps will be created, i.e. low, temporary or high. Quality of water, and content of mineral and organic ingredients in particular, results in modifications of the vegetation cover, and therefore results in creation of different types of peat.

The above method of formation of peat-swamps and peats may be changed by man's activity, as he can impact the quantities of water reaching the habitat as well as its quality. Human activity may result in change of method of habitat's feeding and impact the peat creation process at the same time. Disturbances of relation between the inflowing water and water distributed resulting in decrease of the inflow, may result in reversal of the environmental process. In case a negative water balance occurs, the drainage of marsh habitats will take place, the deepening process will be stopped and the mineralisation of the organic mass will begin, which will result in disappearance of peat-swamps. Self-ignition of peat and total destruction of the area will be the end result.

1.2.2. Impacts on the river

Water resources of the Biebrza river - characteristic flows, states and quality of water, are dependent on the structure of different factors, which in majority influence the Biebrza Valley outside of it. The state of the river is directly dependent on its tributaries from the area of the catchment. Inflow of the ground waters constitutes an important element as well.

Each of the 10 major tributaries of Biebrza is feeding the river during a certain period of time with a certain quantity of water having determined quality parameters. If in the areas of catchments of those tributaries any activities are conducted, which have an impact on the quantity of waters and their distribution in time, then the flows of Biebrza may be stabilised during a year, with an exception of the spring thaw. In case of similar utilisation of water resources in partial catchments, the increase of such effect may take place in the form of flood waves culmination or low-flow periods of the Biebrza river.

Similar dependence applies in case of the ground waters, even though the man's activities in this field are limited to decrease of the water resources through deep-well drilling and water intake for economic purposes. Man's activities have a crucial impact on the amount of water in the water-courses, their distribution in time and their quality.

Agriculture constitutes a very important element on the areas directly adhering to the valley and in the valley itself. The problem of municipal sewage from villages and big towns located on a high scarp of the Middle and Lower Basin is an important one, as the sewage, only very slightly treated, reach the river in a very short period of time. Agricultural wastes are a dominating element in the Upper Basin of Biebrza due to utilisation of land directly adjacent to the channel of the river.

1.2.3. Impacts on the meadow ecosystems

Dewatering works, conducted in the 19th century had a huge impact on differentiation of the flora vegetation in the valley. Construction of three big channels resulted in the drainage of considerable amounts of water, in particular from the Middle Basin of the Biebrza Valley. Drainage progressing for over one hundred years resulted in holding peatogeny processes, therefore the fauna vegetation in significant areas of the Basin was changed. Species of peat vegetation were extinct, later replaced by new species existing on dry and nitrogenphilous habitats. The drying process of muds resulted in speeding the process of bush and tree succession on the open areas of natural marsh meadows. Succession of bushes can be also observed in the Middle and Lower Basing of the Biebrza river. The Upper Basin has been considerably changed due to agricultural activities of man. The meadows ecosystems located there are changed through drainage of the area, artificial humidity regulation and application of artificial fertilisers.

1.2.4. Impacts on the forest ecosystems

The major threats to the forest ecosystems result from the habitat changes and mainly human activities. Such activities have different forms depending on the legal status of the area and ownership types. Ecosystems located on the areas which are not protected in any way are utilised in a different way than those located on the protected areas. Therefore their function varies from a typically economic utilisation to habitats. Methods and intensity of utilisation depends mainly on forms of ownership of land. In the private forests incorrect implementation of maintenance measures can be observed, resulting in destruction of ecosystems. Different methods are being applied in the State Forests and in the National Park, where the methods are dictated by the functions played by ecosystems.

1.2.5. Impacts on the fauna

Fauna is mainly dependent on biotopic conditions. Each change of habitat results in changes in fauna species composition. There are very tight relations between birds

and small mammals, which constitute their food base, therefore changes in species and numerical composition of small mammals directly impact on species and numbers of birds. State of population of small mammals is directly dependent on a habitat where they live. Population of water and mud birds is dependent on hydrological conditions of the area, i.e. level of ground waters, spring thaws, old river-beds and water pockets in the flooding area. Changes in hydrological conditions results in changes of bird-fauna.

The big mammals population is determined by biotopic conditions, however man has the major impact on their composition due to interference in decreasing or increasing of the species population.

1.3. Economic sectors and human activities creating pressures on ecosystem

The most environmentally valuable parts of the Biebrza Valley are situated within the borders of the Biebrza National Park. The area of the park is 59,223 ha, while the protection area created around the park covers the area of 66,824 ha. The park is located within the territory of 14 communes and three voivodeships: Lomza, Bialystok and Suwalki. Participation of the communes' area in the park is very differentiated and varies from 1% to 59%. Where a commune's area is less than 10%, the relations between the park and the commune are not very strong due to very slight mutual functional connections. In case of Goniadz commune - 59.3% of its area is located within the park's borders, in case of Trzcianne commune - 50.5% of its area is located there. 14 communes, where parts of their area are situated in the park, have over 112,000 residents (data from 1994 - 1996).

125 farms are located on the territory of the park, and 5,000 are situated within the buffer zone. All the communes are considered as agricultural. Contribution of agricultural areas in the total areas of communes is 43% to 86%. The area of forests in the total area of communes varies from 0% to 19% - in three of the 14 communes forests do not exist.

Proportion of agricultural land of a given commune to its total area varies from 1% to over 25%. In four communes it significantly exceeds 10%.

Proportion of mud areas in the communes located within the park's area to the total area of communes varies from 0% to over 32%. In nine communes there are no mud areas at all. In the Goniadz commune participation of the mud area reaches over 32%, in the Trzcianne commune it is over 27%. In other communes participation of such areas is very small.

Private lands constitute 46% of the total area of the park. Of the total area of about 32,000 ha owned by the State Treasury and administered by the Biebrza National Park, about 1,200 ha are agricultural lands, about 13,700 are forests, over 500 ha are waters, mud areas constitute about 15,300 ha, municipal and settlement areas - about 400 ha.

Private areas located in the park are mainly extensively utilised meadows, set aside meadows and small areas of intensively utilised meadows, and about 3,000 ha of forests.

There is no heavy industry on the territories of communes having their participation in the Park's area - those communes have only servicing works and processing industry (mainly agricultural products).

1.4. Identification of economic impacts on ecosystem

7 communes of the Lomza voivodeship are located within the park's area. The total number of residents of those communes is 62,356. Out of this number only 7,572 are employed outside of agriculture: over 1,900 in processing industry, 400 in construction industry, 650 - trade, transport and telecommunication - about 37, administration - about 840, education - 1,250 and health care - about 1,250. Residents employed outside of agriculture constitute only about 8% of the total residents number, which confirms agricultural character of the area, but also impacts resulting from agricultural activities.

4 communes of the Bialystok voivodeship have their areas within the borders of the Biebrza National Park. Those communes have 31,531 residents, from which 2,659 are employed outside of agriculture - 520 in industry, 90 - construction, 328 - trade, 210 - transport, over 180 in administration, over 680 - education, healthcare - over 370. Residents employed outside of agriculture constitute 11% of the total number of residents of the communes. The above data show that these communes can be considered as agricultural as well, and therefore impacts of the environment will result from their type.

3 communes of the Suwalki voivodeship are situated in the park. They are inhabited by 18,373 people, out of which 1,200 are employed outside of agriculture (113 - industry, 26 - construction, telecommunication - over 50, 130 - trade, and about 700 residents employed outside of production industry). The above data show that about 15% of the total residents number are employed outside of agriculture.

We may generally state that threats to the environmental values result from agricultural activities conducted on the park's area and the surrounding areas. Improper condition of agricultural activity on the open areas of mud meadows through their fertilisation will constitute a threat as well. Local changes of water conditions allowing for intensification of agricultural activity will also result in ecosystems changes. Incorrect agricultural activities in forest ecosystems will have negative impact on ecosystems biodiversity.

The adhering terrain impact the Poland's territory as well. Agricultural and sewage pollution coming from those areas are the main threat. Majority of communes' towns have their own sewage treatment plants, however the problem still exists as

far as the villages located on the park's territory and the areas around the valley are concerned. Those villages have no sewage treatment systems, and only very small quantities of sewage are delivered to the commune's sewage treatment plants. The remainings are taken to the agricultural lands. Part of sewage is poured out in accidental places and creates a threat of pollution to the ground and surface waters. Huge threat comes from the over-build high scarps of the valley - due to considerable longitudinal slopes of this area sewage may get directly to the Biebrza river through surface downflows and fast soil downflows of the first water-bearing layer.

Investigation of threats resulting from human activity on the park's territory and areas surrounding the park do not show the entire problem. The problem exists on the distant area, i.e. in the catchment of the Biebrza river since the pollution created there reaches the river through its tributaries. Exceeded utilisation of the ground waters (deep-well drilling) results in decrease of ground water inflow to the valley. Improper utilisation structure of the area generates wrong seasonal distribution of water flows, which causes huge flows and long water deficit periods.

Threats to environmental values of the Biebrza Valley should be considered in the catchment, not only within the park and its protection zone.

2. IDENTIFICATION OF IMPACTS ON ENVIRONMENT AND ECONOMIC ADVERSE INCENTIVES

2.1. Detailed identification of impacts on the ecosystem

2.1.1. Impacts on genetic and species diversity

2.1.1.1.Impacts on diversity of peatlands

There are three types of peat-swamps in the Biebrza Valley: low, transitional, high. Huge species differentiation of peats resulting from different water alimentation and floral assemblage diversity can be noticed as well. On the low peat-swamps the alder-carr peats, the sedge peats and rushes peats constitute dominating types, while on the high peat-swamps the moss peats dominate. On the dehydrated parts of the valley soils of I and II rotting phase can be seen. Slime soil occur on the areas located near the river's channel and old river-beds.

Improper water relations considerably decrease species diversity, limiting them to rotting soils with different phases of rotting process (I, II, III). During the rotting process any differences between the peat types disappear. The whole organic mass is gradually mineralised, changing physical, chemical and retention features in the direction of their unification. The end result is a friable mass in the form of hard lumps or grains, resistant to repeated saturation with water. It is the third phase of the rotting process, during which fauna species are eliminated and different areas free of any vegetation are created. Peat species diversity before dehydration

impacts only the mineralisation process rate. The fastest degradation process applies in case of alder-carr peat, the slowest one - in case of moss-peats.

2.1.1.2.Impacts on the Biebrza river

In its natural state the Biebrza river constitutes a very differentiated ecosystem, which should be considered together with its old river-beds, water pockets and flood waters. The level of knowledge about this ecosystem is yet insufficient as it is full of considerable variations of fauna, microfauna and flora.

Decrease of quantities of Biebrza waters will cause decrease of flows and conditions, cut-off of old river-beds from the main channel as well as decrease of number - or even disappearance of floods. This will generate unification of vegetation species composition and decrease of the number of fauna species. The population of individual species is decreased as well.

Artificial "improvement" of hydro-conditions results in decrease of species diversity. The number of individuals or mass - in case of vegetation - is increased, however this applied only in some cases, while the remaining species die out due to inappropriate biotopic conditions.

2.1.1.3.Impacts on genetic and species diversity of natural meadows

Species diversity of the marshland flora can be confirmed by including in the Red Plant Book 2 taxa considered as dying-out and 3 taxa threatened by extinction. In the total number of 794 species - 53 species are completely protected in Poland. So far existence of endemic plants has not been confirmed, however a numerous group of relicts (14 species) confirms the biodiversity. These are mainly the glacial relicts and some of them occur in the island populations, therefore we may assume that they have some special genetic resources. This matter will be gradually investigated.

Change of water conditions by man, generating unification of the habitats, generates decrease of species and genetic diversity. Similar situation may be caused by trees and bushes growing on the dehydrated areas.

Unification of the biotopic conditions, which means decrease of species diversity, is generated by intensified agricultural activities - fertilising, cutting and artificial regulation of water conditions. However, cutting can be considered as an element stopping the process of bushes and trees growth, which decrease the biodiversity. Extensive utilisation of the meadow ecosystems is positive in view of the biodiversity, however intensified utilisation is considered as negative.

2.1.1.4.Impacts on species diversity of forest ecosystems

Natural forest ecosystems of the marshlands are very difficult for economic utilisation. During a major part of the year they are inaccessible and often the winter conditions do not allow the access either. Tree species diversity, their age diversity, irregular shapes, well-stocked and differentiated undergrowth, stocking density of trees and bushes and flooding of the area constitutes sufficient barriers for the economic utilisation of ecosystems. On mineral soils, dry and easier to access, utilisation is more intensified - here one can find monocultures of single tree species, which are remainings of the earlier, improper human activity in the forest. Today such forests are reconstructed and their species diversity is improved with broad-leaved species. Natural reconstruction are preferred to artificial afforestation.

2.1.1.5.Impacts on species diversity of fauna

Apart from big mammals described above, there is a significant diversity of the marshland fauna. Among known species living in the Biebrza Valley, the following are protected in different ways: 6 species of fish and lamprey, 12 species of amphibians, 5 reptile species, 25 mammals species, leech and 4 species of night lepidopterans. In the course of preliminary examinations existence of 194 night lepidopterans species and 86 day lepidopterans species was confirmed. Among day lepidopterans, 21 are included in the list of dying-out and threatened species. From the entire list of bird, 48 species are protected in various ways according to the IUCN classification.

The species diversity presented above results from the biotic diversity. Any human activities generating decrease of biotic diversity will simultaneously generate decrease of species diversity of fauna, including the most precious and characteristic to the natural marshland species.

2.1.2. Impacts on ecosystem in general

2.1.2.1Impact of negative factors on sedgelands of the Biebrza Valley

The state of sedgelands of the Biebrza Valley is mainly dependent on feeding them with water in a way which generated their creation. Each change of the feeding method results in changes of plants vegetation and types of peat as well. Decrease of quantities of water may cause stopping of the peat-creation process or even periodic mineralisation of peat layers located over the ground water table level. Changes of feeding a given area with water may be generated by several factors.

Moss-sedges emerging on areas fed by underground waters flowing out under pressure will be stopped if the inflow of underground waters is limited. Reasons for such situation may exist even outside the park's borders, e.g. deep-well drilling taking water from the waterbearing layer feeding the sedge.

2.1.2.2.Impact of external factors on the Biebrza river

Threats to the Biebrza river are mainly concentrated in two groups. One group of threats consists of factors which influence the quantity and level of water in the river. The second one consists of factors having impact on the quality of the Biebrza waters.

Human activities conducted outside the Biebrza Valley have major impact on the quantity and level of waters in Biebrza, as such activities are not allowed in the valley itself. Biebrza receives surface and ground waters from the catchment. 10 watercourses of different size flow into the Biebrza river. Numerous changes of tributaries will have a direct impact on the quantity of waters flowing in Biebrza. Periodic changes in the tributaries: high waters, low waters will generate high or very low levels of water in Biebrza. High waters are usually generated on water courses on areas where spring thaws are not stopped or retentioned, but flow down the terrain's surface and very quickly reach the water course, creating the high waters. The reason may lay with the improper utilisation structure of a given area, or dense network of dewatering melioration objects.

The low water levels may result from a too intensive intake of water from the water courses or improper utilisation structure, or even entirely wrong utilisation through melioration.

Majority of Biebrza river's waters originate from ground waters. Biebrza and its tributaries receive ground water from the water bearing layers cut through by the river channel, or originating from the valley and getting to the channel in the form of surface flows. Water bearing layers, feeding water courses, take the waters from the areas outside of the valley in many cases. They are, however, subject of human interest. All types of wells take water from shallow and deeper water bearing layers, simultaneously limiting feeding river with the ground waters.

The second group of threats to the Biebrza river are the factors influencing the quality of waters. Human activities conducted outside of the valley have an impact on the quality of waters and their quantity. Quality of water is understood as mineral and organic substances content. Today the developing agricultural activities generate water pollution with biogenes and pesticides. Improper fertilising leads to rinsing them out and distribution in the river waters. Increased outflow of fertilisers and plant protection chemicals is carried though the incorrectly utilised melioration systems. Agricultural economy in the catchments of the Biebrza's tributaries determines quality of water in the tributaries, which further impact the quality of water in the Biebrza river.

The sewage economy of the villages and towns located around the valley is another significant threat. Majority of sewage from the villages situated on the high scarp of the valley flow to the river, which is one of the most urgent matters to be solved. Sewage from the villages located far from the valley or situated on flat areas are less threatening due to treatment of sewage in the soil or through vegetation in the ditches via which they flow to the river. Majority of commune localities situated around the

valley are equipped with the sewage treatment plants, therefore threat from their side is less important.

2.1.2.3.Threats to the meadow floral assemblage

The meadow ecosystems on large areas of the Biebrza Valley have been transformed to a large extent and such transformations are still dangerous, if the three factors generating their degradation are not eliminated, i.e. change of waters relations, bush succession and improper human economy.

The important factor which generated the negative changes on large area of the valley is the water factor. The construction of three big channels in the 19th century - Augustowski Channel, Woznawiejski Channel and Rudzki Channel - resulted in considerable depression of the ground water table by several dozen centimetres. This factor is modified during the cycles of dry and wet years. The channels also changed the natural hydrographic network, taking over water from three rivers: Netta, Jerzgnia and Elk. In case of Jerzgnia and Elk they generated complete disappearance of flow on significant parts of the rivers, overgrowth of the rivers' channels and their siltation. The channels also caused acceleration of spring water drainage from the swamps and their dehydration in summer periods through drainage of ground waters. In the dry years the level of ground waters was lowered in parts of the Middle Basin area down to 80-100 cm from the surface. Such process results in intensified mineralisation of organic mass (rotting process of peat), and therefore resulted in the change of vegetation. Swamp habitats vegetation is dying out, replaced xerophilous species and species of nitrogen-reach habitats. If soil is transformed though the rotting process, than the soil and vegetation transformation rate will be accelerated as well. Such process is finally leading to complete destruction of flora assemblage, spreading of the top peat layer and self-ignition of peat. Such situation ought not to be allowed, however it is absolutely real in case the swamp dewatering process is not stopped.

Growth of bushes and trees of sedge areas is negative as well due to dehydrating trees function (Birch in particular), and significant decrease of environmental resources relating to biodiversity. The numbers of fauna and flora species are decreasing. Due to intake of huge quantities of water from soil, very fast mineralisation of peat's organic mass takes place. Birch forests generate disappearance of about 20-25 mm of peat layer annually, therefore one can easily foresee when the final wastage is to take place. On the areas where bushes stocking density is very tight, the number of birds and mammals species is decreasing, small mammals in particular. Rate of spreading of bushes is highly dependent upon water conditions - lowering of ground waters level and decrease of humidity of the top layer of soil significantly accelerates the bushes growth process. Another factor which causes spreading of bushes is a fact that cutting of swamp meadows has been stopped. Bushes covered major area of the Middle and Lower Basin of Biebrza. Works aiming at detailed investigation of bushes growth area as well as their characteristics are to be conducted.

2.1.2.4.Impact of external factors on forest ecosystems

Forest ecosystems are threatened by two most crucial groups of factors influencing their state, i.e. environmental factors and human activities extremely important for those ecosystems. Environmental factors impact in a similar way as in case of meadows ecosystems, and relate mainly to the impact on a habitat. Disturbance of hydrological network and method of feeding the habitat with water constitute elements which may generate changes of the ecosystems. Such changes can result in dying out of some tree species and growth of other species, appropriate for the new water conditions.

Another factor influencing the state of ecosystem is the development of various pests and diseases. Depending on the legal and protection status of a given area, such threats can be eliminated or left in the nature's hands.

Human activities in the forest ecosystems of the Biebrza Valley are very differentiated in view of their intensity in several parts of the area. The ownership status is an important issue as well. Different types of activities were conducted in the forests owned by the State Treasury or the forests administered by the State Forests, and on areas owned by individual farmers. Destruction of those areas has significantly increased within the last years since conducting some activities in the forests does not require a permit, any more.

2.1.2.5.Impact on external factors on ornithofauna

All factors generating biotopic changes constitute threat to ornithofauna. These are the environmental factors and human activity relating to methods of utilisation of the area. The Biebrza river, together with its old river-beds, water pockets in the flooding area is a very important habitat for the water-mud birds. It is also an important place of rest and feeding during spring and autumn passages of birds. Man, through implementation of other utilisation forms of the area, may cause liquidation of the traditional breeding and feeding places. Implementation of intensified utilisation methods, dispensing of mineral fertilisers, usage of technical equipment may generate abandonment of this area by existing species and occurrence of other species. If such activities cause decrease of the terrain's area appropriate for the existing fauna, then the numbers of species as well as number of birds of the same species will be changed, leading to decrease of biodiversity.

2.1.2.6. Impact of external factors on the Biebrza Valley's mammals

If we are to investigate influence of external factors on mammals, we must divide them into two groups: small mammals and big mammals.

Threats to small mammals result mainly from changes in their living area. Changes of this environment may force them to abandon the area or - if it is not possible - may

lead to decrease of the number of individuals of given species, decrease of number of existing species or even - in case of very dramatic changes - to their complete disappearance and, after some time, taking this area over by other species. Small mammals are food for a number of bird species and predatory mammals. Factors generating environmental changes have been presented in chapters relating to changes in meadow and forest environment, as well as water ecosystems.

Big mammals are also very sensitive to environmental changes since these result in food and its accessibility changes. Human has a direct impact on them as well. His activities can support or limit development of species.

Supervision of a given area, i.e. legal and ownership status, is very important issue, too. Different type of activities are conducted on private areas or those administered by the State Forests, and on areas within the National park. The same species existing on areas having different legal or administration status may be influenced by different factors.

2.1.3. Identification of keystone species

Changes of water conditions can be noticed very clearly in the fauna assemblages. Cessation of extensive utilisation and cutting of peat meadows resulted in transformation of bushy willow-birch areas into birch forests.

Introduction of agricultural utilisation and fertilisation in the Upper Basin changed the communities into assemblages with increased number of limestonephilous species.

Certain habitats are characterised by existence of some fauna species adapted to most common biotopic conditions. Some small mammals living in certain vegetation zones can be characteristic, i.e. some bird species (aquatic warbler) and butterflies.

2.1.4. Impacts on ecosystem resilience

The swamp ecosystem is not resilient to changes of the basic factor determining ecosystem, which is water, its quality and methods of feeding the habitat with water.

Decrease of water resources in a habitat is very clearly seen in the landscape of the valley. The floods are smaller or disappearing. Water pockets and old river-beds have only periodic contact with the main current. General view of the bushes on open spaces of mud areas is changing as well. Within the period of 20-30 years the area of open swamp meadows will be transformed into afforested area.

Apart from changes in the valley's landscape, changes of several environmental values can be noticed. Even periodic lowering of ground water levels generated mineralisation of organic mass (rotting of peats), which can be easily noticed in the soil's profile. The soil profile from areas constantly located below the ground water table are very different from the profiles of the peat layer permanently located above the ground water table.

Fast changes are noticed in the flora assemblage. The peat flora species are disappearing, replaced by species characteristic to dry locations. Significant area of the Middle Basin of the Biebrza Valley can be an example of reaction to water condition changes.

Butterflies react to any type of biotopic changes very quickly. They constitute a very important element in observation of environmental changes.

Microflora and water ecosystem fauna are characterised by very low tolerance to changes. Each water quality change has a direct impact on the species diversity.

There are all types of mutual relations and interdependence between all elements of peat ecosystems, therefore it is difficult to clearly determine them as this matter requires detailed analyses.

2.1.5. Damage to resource base

Dewatering conducted in the 19th century led to the lowering of the water table on large areas of the Middle Basin of Biebrza and generated processes of mineralisation of the peat organic mass. Hydration of deposits decreased. Vegetation assemblages were changed as well. Huge forest complex of 900 ha was destroyed (Brzeziny Ciszewskie). Birch forests of dehydrated peats are very quickly declined (trees drying, development of diseases, pests and lack of natural renewals).

Lowering of the ground waters level generated accelerated succession of bushes and trees on the open peat areas. Preliminary research shows that a few thousand hectares of peat-land have been degraded.

Dehydration and management of part of the Upper Basin of the Biebrza Valley changed its landscape and natural resources. Permanently utilised meadows and pastures were created, resulting in changes of vegetation. Simultaneously new fauna species, never existing on these areas, occurred. This relates especially to birds. Extensive utilisation does not generate environmental losses while intensive utilisation, with the use of chemical means, results in decrease of environmental diversity.

The three channels constructed in the 19th century - Augustowski, Woznawiejski and Rudzki changed the natural hydrologic network of the area, as they took over the waters of three rives - Netta, Jerzgnia and Elk, generating their siltation and overgrowth and therefore resulting in periodic occurrence of flows in springs and autumn, when the water level is high. Biological life previously existing was distracted, so was life on areas directly adhering to the natural water courses. In the artificial channels biological life is significantly changed. Major longitudinal slope reductions generate acceleration of flooding speed, which makes a given water course useless for species characteristic to lowland rivers, especially peat-rivers with low water speed, different water oxygenation and different micro-organism composition.

2.1.6. Economic valuation of damages

Environmental damages cannot always be estimated in a direct way. Parts of damages are not possible to be determined at all, other can be valuated through indirect methods. Generally only parts of the damaged ecosystems can be evaluated. Each valuation presented here shall be partial only. In the Biebrza National Park evaluation of damages has not been conducted, therefore we propose description of the scope and methods of calculations.

Hydrotechnical works presented above, i.e. digging of artificial channels and liquidation of huge parts of natural rivers, generated major damages to the nature resulting from changes of the natural hydrologic network and lowering of ground

water levels, particularly in the Middle Basin of the Biebrza Valley. Those damages can be evaluated in the indirect way. We can estimate costs of liquidation of artificial channels and making the former beds of natural rivers permeable. There is also a possibility to determine costs necessary to supply adequate quantities of water to a given area, which would further result in lifting the ground water table to the appropriate level.

The project of such works in the Biebrza Valley is under preparation, furthermore some tasks included in this project are already in the implementation phase, i.e. liquidation of the Woznawiejski channel through acceleration of natural siltation and growth-over processes, with simultaneous reconstruction of flows in the former river-bed of the Jerzgnia river. It is possible to determine the costs of such investment, as it is in case of implementation of another investments, aiming at cessation of flows via the Rudzki Channel through building it over and setting off the dead part of the Elk river. It is necessary to prepare an analysis and model works enabling analysis of water and environmental conditions which can occur after the works are executed.

Damages generated by improper human activities in the forest ecosystems can be evaluated, however such a possibility relates only to losses in the forest stands as evaluation of losses in the forest fauna cannot be conducted. Damages generated from the human activities in the meadow ecosystems are difficult to be determined.

Human management on the valley's fringes and in the catchment relates to discharge of different types of sewage to the Biebrza river, generating decrease of water quality. These elements can be evaluated since the quality parameters of the natural mud river's waters are known and the costs of construction of necessary number of water treatment plants, which would take over the additional sewage, can be determined. Sewage treatment plants for towns located around the valley - which construction in some cases already reached the implementation stage, sewage treatment plants for villages and sewage treatment points or filters catching the surface flows sewage should be included in such programme.

Retaining the primary relations of waters flowing into the Biebrza river is theoretically possible to be realised through the construction of network of small retention reservoirs, responsible for taking over the thaw waters and their proper distribution, corresponding to the parameters existing in the natural conditions. Evaluation of construction of such hydrotechnical system can be conducted, however it has not been done in the past.

As it is clearly seen from the examples presented above, some elements of the ecosystem can be evaluated, however there are no ready standards for evaluation of changes in the ecosystems of the valley resulting from changes of the biotic conditions or extinction of some groups of vegetation and bird species.

2.2. Identification of sectoral activities and resulting pressures on ecosystem

2.2.1. Pressures through pollution

The threats described in the former chapters are shown in the laboratory analyses conducted to determine water quality. Quality of water in the Biebrza river is controlled by the Voivodeship Inspectorate of Environmental Protection in Lomza and Suwalki. Samples of water regularly taken from the same points are analysed. On the total length of the Biebrza river (168 km), one part of 18 km has waters which do not meet the quality requirements accepted in the Polish classification. The remaining part of the Biebrza river is classified as the 3rd purity class. Short parts where waters do not meet the standard's requirements, occur by the confluence of big tributaries(taking waters from the intensively utilised agricultural areas) to Biebrza. These are: Kropiwna, Kamienna, Netta and Brzozówka river in the Upper Basin of the Biebrza Valley. The main factors determining their classification in this purity group are: quantity of phosphorus and the biological criteria, i.e. coli count.

The remaining parts of the Biebrza river conducts waters of the 3rd purity class. Intake of agricultural sewage form the areas adhering to the valley through rivers flowing into Biebrza is clearly seen here, as is the intake of sewage reaching the river through the surface flows and ground waters from the inhabited areas located on the high scarp of the valley. The sewage in the Middle and Lower Basin of Biebrza are different from the sewage from the intensively utilised Upper Basin. The Middle and Lowers basin are classified as the 3rd class due to low content of soluble oxygen and existence of Cola bacteria.

In the Lower Basin, where the Biebrza river flows below the high Valley's scarp, excess of phosphorus occurs.

All the data presented above show a very important problem caused by agricultural constraints and lack of investments which would lead to elimination of the factors aggravating the quality of water. Almost all the commune's towns have their sewage treatment plants, however contribution of that sewage in the total quantity of sewage coming from the whole area is very small and does not change the bad picture of the quality of waters in the valley.

2.2.2. Impact of changes of utilisation methods on the environmental values

Utilisation structure of the areas located within the park and communes included in the park has been already presented. It is a typical agricultural utilisation, where meadows utilisation is dominant. In some communes over half of the commune's areas consist of peat meadows. Other areas consist of arable lands and afforested or bushy land. At the moment there is no threat from intentions to change the meadows utilisation into arable one, even though there is a pressure to conduct

maintenance works on melioration systems already existing and construction of new dewatering networks.

There is also a pressure to change the farmlands into building plots for summer and recreation buildings. This cannot be considered a significant threat, nevertheless such cases occur. This problem relates mainly to areas on the high scarp of the valley as the panorama of the whole valley and spring thaws can be seen from there. Not only the individual land-owners are willing to use such places for recreation purposes, but also the communes through changes of spatial management plans. Such pressure should be liquidated by preparation of a spatial management plan, aimed mainly at tourism, for the whole Biebrza Valley. It is an organisational and financial matter which must be solved, paying attention to proper usage of the natural values of the valley.

2.2.3. Non-sustainable use of biological diversity

Majority of the negative results of improper management are visible on the private areas. This relates mainly to management of forest resources and peat resources. Management of meadows and arable areas adhering to the valley is harmful as well, which is confirmed by the low quality of the Biebrza river waters (described above).

There are also cases of peat digging on private plots for individual use. Economic-scale exploitation is legally prohibited, however even this kind of activities conducted by individual farmers generate significant environmental losses. Holes created as a result of peat digging turn into animal traps. Some obligatory reclamation works should be introduced, however there are some problems of formal and legal nature relating to enforcement of the reclamation obligations.

The problem of improvement and protection of the quality of the Biebrza river waters is connected with the financial difficulties of individual farmers and legal matters relating to granting of subsidies for such investments from the State Budget. There is also lack of legal regulations which would enforce proper sewage management. The formal and legal gaps as well as financial problems result in a situation where management of nature's values on this areas is not always proper, therefore some steps should be taken so that the individual interest does not diminish natural resources and values of the Biebrza Valley.

2.3. Identification of underlying causes of biodiversity loss

2.3.1. Missing proper markets

Lack of economic incentives generating people's interest in maintaining the primary natural marsh conditions in the valley is one of the reasons for improper human management of this area.

The natural marsh vegetation assemblages of the valley, with their longitudinal and transversal zones, are very interesting for botanists. The enormous bird species diversity, including water-mud birds, is a subject of ornithologists' research in Poland and Europe. Differentiation of peats, mainly low-peat species and environmental conditions allowing their preservation and development are being investigated by soil-scientists, hydrologists and ecologists. The landscape of the valley with the spring thaws are subject of many nature lovers interest.

The above values may generate intense tourists interest. At the moment tourism is not well developed due to lack of proper accommodation and catering facilities, as well as technical facilities serving tourists. This area is being penetrated by specialists in different fields of environmental science. Small tourist traffic neither creates the necessity to invest in tourism by individual residents, nor willingness to preserve the natural values being the reason for the development of tourism. There are no incentives resulting in conscientiousness about quality of water, construction of sewage treatment plants or proper utilisation of forests and meadows. Such processes are likely to begin in the near future, however at the moment they only reached an initial stage.

The process of purchase of areas beneficial for the future tourism bases from the private owners and purchase of the whole farms has started. Purchases are made by major towns located far from the Biebrza Valley, conscious of the future role of the valley. The local residents do not yet see the possibilities which may arise if the areas surrounding the valley are properly managed, and they do not see the necessity for investment either.

The area constitutes a huge potential base for healthy food production Individual farming concentrated on ecologically pure food production could generate significant income. Small food production economy connected with their sales could also be developed.

Tourism and ecological agriculture could generate huge income for the local residents if the proper preparation and investment activities were conducted.

2.3.2. Information failure

Getting the society acquainted with the potential tourism possibilities of the valley's area, as well as informing about necessity of its preservation is very successful mainly among the school teenagers. Organisation of science camps, tours, knowledge contests significantly increase the consciousness of school teenagers on this area.

It is more difficult to convince the local residents and create the necessary reactions. The small tourist traffic does not generate huge income and does not create any investment activities; lack of proper tourism base stops its development. Inconsiderable tourist traffic and lack of markets do not create farmers' interest in

healthy food production, which undoubtedly would be very popular. Lack of financial means constitutes a very effective restraint on the agricultural production development and search for markets on other territories.

2.3.3. Institutional failure

Small financial means in possession of the local residents do not allow a dynamic development of this area. Municipal authorities (communes) do not have necessary means at their disposal. The existing income is directed to support and modernise the infrastructure, i.e. roads, telecommunication network, schools, health-care. Development of tourism and new agriculture branches is being postponed due to lack of financial means, even though the consciousness of the necessity of such investment exists.

Outside capital could create a tourism basis and generate its development to a profitable level, moreover it could result in the local residents' interest in investing and obtaining local funds for this type of activity

Creation of some basis for food production and organisation of sales for healthy food would support interests in this field of agricultural production. It would also contribute to increase of environmental consciousness, implementation of pro-ecological investments and generate interest in preservation of natural values of the valley.

The ownership structure of this area constitutes a restraint on implementation of active conservation of nature in the valley. On private areas such activities require obtaining permission from the owner. Lack of clear borders between the plots does not allow this type of negotiations. Regulation of ownership status would require significant financial inputs, exceeding current abilities of the public budgets.

2.3.4. Enforcement failure

All the restraints presented above create a situation when all the protective and investment activities are limited to areas owned by the State Treasury. Requirements of this area are huge, therefore development will be proportional to financial abilities. Further fast development and preservation of the whole area, including private areas and those adhering to the valley, will be possible if all the formal, legal and financial difficulties are overcome.

2.4. Identification of adverse incentives

2.4.1. Direct subsidies

Subsidies obtained by the municipal authorities (commune) from the State budget are not sufficient to encourage the local authorities to preserve the environmentally valuable areas. Currently the more interesting parts of the areas, characterised by nice views, water located near-by and forests, are threatened by summer-resorts structures, all types of tourist objects. Some efforts are made to change the local spatial management plans as these aimed at assignment of these areas to tourist and resort structures. The foreseen profits from sale of plots and tourism are the major

factor resulting in such attitude, which do not take the environmental protection issues into consideration. Such activities of the communes show lack or very small role of subsidies directed for environmental protection in the commune's budget.

Table 2. Income of communes which territory is included in the Biebrza National Park in 1996 (in '000 zloty)

No	*Commune*	*Total*	*Local taxes*	*Share in taxes being the State's income*	*Subsidies from the State budget*	*General subsidies*
1.	Grajewo	6708.1	2891.1	1471.2	1146.2	486.0
2.	Goniadz	1263.7	374.8	235.8	204.5	156.2
3.	Jedwabne	1248.4	327.6	256.5	292.7	269.3
4.	Radzilów	1066.7	242.0	236.7	270.1	267.2
5.	Rajgród	1462.3	443.9	235.8	620.5	61.4
6.	Trzcianne	1158.8	256.7	213.8	358.9	239.4
7.	Wizna	978.8	270.9	201.2	231.2	208.7
8.	Sztabin	1617.8	291.9	212.9	160.4	817.2
9.	Lipsk	1137.9	224.7	224.7	410.5	179.9
10.	Bargów Koscielny	969.7	214.9	214.9	167.2	151.0
11.	Suchowola	2404.7	712.8	679.1	388.9	305.7
12.	Dabrowa Bialostocka	4058.1	1251.2	1174.8	773.7	388.9
13.	Jaswily	1666.3	560.0	500.0	232.9	115.1
14.	Nowy Dwór	881.6	255.7	281.1	197.4	130.5

Subsidies obtained from the State budget consist mainly of special funds directed to education, culture, heat-care and social welfare. Subsidies constitute a small part of the total communes income.

The existing legal regulations do not impose an obligation to execute the spatial management plan of the whole commune's area. Plans prepared in the past are sufficient and are updated only in those parts, where it is necessary to compile a very detailed documentation relating to the investment process or changes in destination of a given area.

In case the spatial management plan of communes located within the borders of the national park is executed, 50% of costs will be borne by the national park. Such mechanism will allow for joint decision making process concerning management plans. Communes which areas are located in the protection zone of the park are required to obtain the park's opinion in case of any changes made in the management plans of investment implementation. Other changes to special management plan have to pass a judgement as well. Such opinions are not binding for the municipal authorities. Preparation of partial plans for communes is disadvantageous from the environmental protection's point of view. With a properly

prepared spatial management plan, limiting works to some small parts is sufficient. If any new protected areas are created, such scheme allows proper general solutions.

2.4.2. Other financial supports

Significant support to communes to implement to pro-ecological investment is provided by the National Fund for Environmental Protection and Water Management and its local counterpart - Voivodeship Fund, as well as subsidies from the EcoFund Foundation. Some loans are granted by the Environmental Protection Bank on preferential terms for investments relating to environmental protection.

Communes having protected areas within their territories have more possibilities to obtain subsidies for pro-ecological investments within the communes as well as activities directly related to protection on areas preserved in different ways.

Obtaining subsidies is a lot easier if a long-term program covering area larger than one commune is prepared. Implementation of a program concerning improvement of water quality in the Biebrza Valley (construction of sewage treatment plant in commune settlements located around the valley) can be a good example here. This programme is implemented by the EcoFund Foundation and it shall be finished soon.

Another programme concerning construction of sewage treatment works on farms, waste dumping sites and replacement of the existing heating systems with pro-ecological ones. The granted subsidies and preferential loans encourage to undertake this type of investments, however in all cases participation of the communes in necessary. Lack of means in their disposal results in postponing of such activities for the future.

2.4.3. Tax incentives

The current taxation system is not conducive to protection of environmentally valuable areas. Taxes are paid to the commune for arable lands, forests and other lands utilised in different ways. Set-aside lands and crop lands of 5th and 6th class are excluded from taxation. Swamp areas are usually classified as set-aside lands, therefore farmers do not pay taxes and all communes having such areas within their territories become financially impoverished. For example, in Goniadz and Trzcianne communes areas excluded from taxation constitute about 50% of the total communes' area. Those areas are owned by private farmers and therefore cannot be included in any existing protection categories as any activities of this type require the owners' permission. This would be also connected with financial compensations.

Lack of charges for sewage discharge from individual farms results in their dumping into surface and ground waters, generating pollution of Biebrza.

Lack of penal law sanctions for improper forest management generates their massive degradation in the whole country. Such devastation results from the fact that the private afforested areas have not got so called management assessments, showing

methods of maintenance. Sometimes the management assessments are out of date, therefore any works are conducted in a very accidental way or are not conducted at all. Such situation such be changed.

Improvement of the existing mechanisms and introduction of new schemes in the field of hunting utilisation of the area and compensations for damages done by wild animals will allow for better management of wild chase game populations. Currently the hunting organisations pay taxes for the leased areas and pay compensations for crops damaged by wild animals to the farmers. The existing payments schedule does not solve the conflict between the necessity to maintain the game population on the level determined by ecosystems protection and the hunting economics interests.

2.5. Other effect of adverse economic incentives

2.5.1. Effects on budget

The current payments and taxes schedule and lack of possibilities to charge for improper activities described above create a situation, when the contribution of taxes and subsidies in profits is similar in many communes.

In the national park there are three income items: income from the central budget, income of the park's auxiliary activities and subsidies from external institutions. The list of income (Table 3) and the list of expenditures (Table 4) are presented below. Note that there is some difference between incomes and expenditures which is due to accounting rules.

Table 3. Income of the Biebrza National Park in 1994-1996 (in zloty)

Source of income	*1994*	*1995*	*1996*
Budget - means received from the Ministry of Environmental Protection, Natural Resources and Forestry	1 268 371	1 563 389	2 124 045
Subsidy from the National Fund of Environmental Protection and Water Management	166 371	463 643	710 466
Subsidy from EcoFund	54 305	22 800	-
Subsidy from the Voivodeship Fund of Environmental Protection and Water Management in Bialystok	3 000	-	-
Subsidy from STIFTELSEN VARLDSNATURFONDEN WWF, Sweden	-	31 889	-
Income of the auxiliary unit of the Biebrza National Park, of this from (%):	209 842	543 312	605 539
- timber sales	71.65%	81.01%	81.44%
- game animals' carcass sales	18.58%	6.18%	2.32%

- publications sales	1.88%	0.54%	1.30%
- bank interests	0.51%	0.20%	0.25%
- entrance tickets	5.99%	9.87%	11.60%
- rental payments	0.11%	1.00%	1.00%
- indemnification	1.28%	-	2.09%
TOTAL	**1 701 889**	**2 679 722**	**3 440 050**

Table 4. Expenditure of the Biebrza National Park in 1994-1996 (in zloty)

Specification	*1994*	*1995*	*1996*
Budget - expenditure executed	1 268 371	1 590 467	2 124 045
Costs of the auxiliary unit of the Biebrza National Park	209 842	664 410	677 986
of which (%):			
I. Environmental protection	-	3.49%	1.94%
II. Reserve management	63.89%	34.57%	17.12%
III. Education and tourism	6.34%	6.50%	2.79%
IV. Other activities	14.80%	25.07%	50.47%
V. Management costs	14.97%	30.37%	29.25%
TOTAL	**1 478 213**	**2 254 877**	**2 802 031**

2.5.2. Effects on economic efficiency

Existence of very rare natural areas does not have to result in decrease of the communes' and individual residents' income. It may occur in cases where environmental values are not properly utilised. In the Biebrza Valley the preservation limits are not balanced by other income. If a major part of the commune's area is not economically utilised resulting in lack of taxes, and subsidies from the State budget are very small, then the natural conditions have a negative impact on the budget and economic efficiency of the area. Decrease of income from the agricultural activities should be compensated by income from tourism and ecological agriculture.

2.5.3. Effect on employment

The current operations on the natural areas do not have a huge impact on the employment structure of the local residents. Employment level in the park is quite low, and people travel daily from places outside of the valley to work here. Activities of the local residents in the field of tourism are still inconsiderable, and are not important for the total employment structure. Employment in the agricultural sector dominates and only 10-15% of residents are employed in other sectors. Such proportions will be changed depending on financial abilities. We may foresee that this area will be gradually supported by capital from different parts of Poland interested in tourism, ecological agriculture and food production.

3. IMPLEMENTATION OF INCENTIVE MEASURES AND CONTEXT

3.1. Identification of existing or planned incentive measures

3.1.1. Category of measure (legal regulations, market incentive, property rights definition)

Two directions of activities must be implemented in the Biebrza Valley. One of them must preserve the nature in its natural state, and gradually retain its natural state where it is changed. The second one should utilise the existing natural conditions and create economic development of the area in the environmentally safe way.

The preservation activities will be realised as soon as proper legal regulations allowing active preservation on private areas. Some regulations concerning control of water management within the whole catchment area of Biebrza are necessary. Conduction of such activities will also require financial means.

In the second field of activities relating to the regional development, two types of incentives - market and financial - will be necessary. If the tourism will be developed to a certain profitability level, then the market mechanisms will be set off. Such development can be also accelerated through foreign capital and creation of a basis for further development. Tourism and popularity of region will generate market conditions for healthy food production. Agriculture, currently constituting a basis for the local residents' existence, will have chances for a fast development if some necessary conditions are fulfilled. Development of a production basis will generate development of food processing and increase of positive economic effects of the agricultural activity.

3.1.2. Objective of incentive measure

Two groups of economic and social incentives can be considered. One of them will allow active protection where it is necessary, regardless of the ownership status.

The second group consists of factors resulting in the regional economic development. The natural values, even though they are the basic factor, do not generate fast tourism development since lack of tourism, catering and resort base will stop further development. Lack of well organised market for food products manufactured with the use of ecological methods and lack of processing base will not allow development of this agricultural production either.

The incentive measures are aimed at generation of economic development of the region and preservation of the existing natural values, constituting the basis and condition for such development.

3.1.3. Reason for choosing the economic measure

There is a necessity to preserve huge areas on which the human activity did not create damages or where deformations are only slight and possible to be repaired. The Biebrza Valley is the biggest low-peat complex of such considerable peat-species diversity in Poland and Europe. It also constitutes an object where the sedge vegetation assemblages can be examined in their natural habitats. It is the refuge of the rare and extinct bird species which cannot find other habitats meeting their requirements.

The legal and organisational factors, possibility to obtain the necessary financial means for implementation of tasks only theoretically developed will constitute a cohesive mechanism protecting the existence of natural values on this area. Such measures should be created in the future as currently they exist only in a very basic form. Preservation activities are conducted in the park only on areas owned by the State Treasury. The private areas are excluded from the active protection, which acts against the successful environmental preservation. There are no structures making supervision and impact on common decisions relating to natural valley's values possible. This issue relates mainly to water and sewage management in the catchment of the Biebrza river. Activities conducted far from the Biebrza Valley influence the levels and quantities of water in the river.

The natural values should constitute motive power for the economic development but it such a way that the basis, i.e. natural resources, is not destroyed. Such mechanism should be developed for the whole area of the Biebrza Valley as the current co-operation rules relate only to some issues and they are different in each commune. One common programme for all the 14 communes having their territories within the national park should be prepared. A unified spatial management plan relating to functions and investments should constitute one of the most important elements of such programme, moreover it should not base only on the separate communes' aims. Such activities would support creation of some organisational structure, i.e. "Communes Association", and disposal of some financial means enabling activities exceeding financial and organisation abilities of separate communes.

3.2. Identification of stakeholders

3.2.1. Winners and losers before implementation of the incentive measure

Prior to development of mechanisms protecting the natural values of the valley and accelerating the economic development of the region based on the natural factors, everybody loses. The nature is a loser as the current structures cannot fulfil the protective functions due to legal and financial limitations. The local authorities (communes) and private land owners can be called losers as well. Communes which major parts are located within the park's borders and are excluded from the land tax (due to their classification to the worse soil class), and their subsidies from

the State budget do not constitute a significant item in the list of their income, search other possibilities to obtain some income, even at the sacrifice of the nature.

The private owners do not benefit from the fact that they live in areas with a huge potential. The land is profitless due to location and water conditions. Tourism business is at the very initial stage and absence of investments in this area restrains its further development. Agriculture, in its current condition, does not create any hopes for the increase of income. It requires transformations in organisational part, social consciousness and investment means.

3.2.2. Winners and losers after implementation of the incentive measure

Launching the two main groups of factors described above will generate results: the nature, and its preservation in particular, will not be considered as the development restraints, but as the element intensifying economic development of the region. Such mechanisms will be interrelated in such a way that effects obtain from one type of activity will have a positive impact on the other types. Preservation of the natural values - improvement of water quality, increase of biodiversity - means increase of attractiveness of the region, the number of visitors and people interested in the region at the same time. The reputation of the area and pro-ecological agricultural production methods will generate the development of sales market for the food products. This will further have a direct impact on the individual farmers' income.

The feedback reaction should generate flow of profits from the economic sphere to environmental protection. Such mechanism should be developed as there are no such organisational and legal solutions at the moment. When such structures and economic incentives are developed and implemented, the nature and the region will form a whole, and not two separated spheres of economic and social life.

3.3. Framework and context of implementation

3.3.1. Explicit legal framework and property rights

The existing land ownership structure, as well as the relevant legal regulations restrain the protective actives in this area. Difficulties are also generated by the financial limitations. Agreements relating to forms and methods of utilisation of this area should be reached with the private farmers in order to conduct conservation activities on the whole park's area, as they own 46% of the total park's area. Such legal regulations with the connected with financial compensations for which there are no means at the moment.

Absence of legal regulations in the field of water and sewage management on private land, especially on areas without any water supply and sewage systems constitutes a very negative element. Lack of legal regulations in the scope of proper management of private forests in a constrain as well.

The functioning system of charges of game management does not guarantee maintaining the proper level of game animals.

Subsidies form the State budget support creation of the general guidelines for environmental protection for the local authorities. The protected areas should constitute an element which significantly increases the subsidies level and should also be an important item of the communes income structure.

Guidelines for co-operation with the authorities from the area of the catchment of the Biebrza river should be prepared, with special attention paid to water and sewage management. The financial and legal problems relating to agricultural sewage from the park and its adhering areas must be solved.

Preparation of a coherent development plant for the whole valley, including the spatial development plan, is a very important element in the process of programme implementation.

3.3.2. Cultural, historical and social context

Implementation of the programme will encounter several obstacles arising from traditions, ways of understanding of changes, involvement in the process of regional development, environmental protection, education and other factors, hardly noticeable before. The existing valuation criteria relating to this area will have to be changed. The natural peatlands are treated as areas of low value which should be developed through dewatering, management and building over. Lack of structures supporting economic activity generated an expectant attitude of the residents. Such attitude results from lack of means for investments, population structure, qualifications, employment and professional abilities.

The young generation of residents is open to changes, however absence of standards which they could accept and implement creates lack of activities in this field, therefore some promotional and informative activities should be developed in order to change the expectant attitudes and include them in the fast development programme.

3.3.3. Institutions concerned

Involvement of all levels of State administration and local authorities will be required in the course of the implementation process. The central State administration would be included in the early stage of the process relating to legal regulations.

Administration of the voivodeship and local level would be involved in creation of the necessary organisational structures, ensuring implementation of the development mechanism. The local authorities would constitute a realisation and co-authorship unit concentrating on detailed solutions. Such process is very complex and requires prior agreements and discussions of different type of specialist, as well as

informative action preparing the basis for implementation of the programme in certain communes, taking the social conditions into consideration.

3.4. The role of information

3.4.1. Information about biodiversity

Such information is regularly provided at the local authorities meetings, different kinds of festive occasions and to the primary and high school teenagers. Co-operation with the school teenagers is best developed, with permanent structures and forms of activities. Biebrza National Park contests are organised every year, so are the outdoor lessons, visits to the park, works for the benefit of environmental protection in the park, exhibitions. College students are being informed about the values of the valley through summer training, scientific camps, master's theses relating the environmental issues.

3.4.2. Technical information

Protection activities programmes and investment activities concerning ecological education are the basis of the technical information. The local education centres, paths, points of ornithological observations, view points etc. are being created.

There are also some activities relating to the improvement of water conditions of the areas of the valley as well as activities aiming at limitation of bush growth on the open peat meadows. The local residents are involved in such activities and therefore they are acquainted with the environmental issues. Tourist tracks are prepared to present information though information boards, guides and leaflets.

3.5. Process of implementation

The local authorities are aware of the necessity to implement some economic development structures on the basis of the existing natural values. We may presume that good conditions for negotiations concerning new co-operation guidelines and necessary organisational structures will occur, however the issues relating to relations between the social and individual interests may create some conflicts.

Co-ordination of activities relating to the protection of level and quality of waters in the catchment will generate problems as well since the decision making authorities are not always aware of the tight relations between the areas located far from the valley and in the Valley of Biebrza. Guidelines for co-existence of intensively utilised agricultural areas and the protected areas may create difficulties, too.

Case study and project analysis, constituting the basis for discussions and development or organisational structures, will be necessary in view of the economic development of the region as proper determination of functions of the valley's parts. The proportion and implementation process will require financing, which cannot be provided from the communes' budgets. Basing only on the existing budgets, such processes will be long-lasting which could result in a failure of the concept.

The implementation activities are necessary as the protection of natural values separated from the local conditions and relations with the regional development is difficult, or even impossible in a long-term. The activities direction is determined by harmonious coexistence of the nature, people and the developed region.

4. ENVIRONMENTAL PROTECTION POLICY RELEVANT CONCLUSIONS

4.1. Lessons learned

The collated information about the Biebrza National Park does not allow far-reaching conclusions concerning importance of the presented economic tools in Poland and in other countries. The significant differentiation of Polish national parks certainly requires individual research - separately for each park. Review of the income and expenditures of nearly half of the Polish national parks in 1994 showed significant variations in total values and sources of income, as well as subsidies received from the budgets and environmental protection funds.

Experiences of the Biebrza National Park relating to economic mechanisms are quite typical for the biodiversity protection in Poland and may be interesting for other countries. Existence of the park itself is wholly financed from the State budget. Abilities of that budget as well as impact of the park on the local economy and population create a necessity for stronger integration of the protective and economic activities. In the Biebrza Valley, similarly to the other environmentally valuable areas in Poland, a substantial part of the park's expenditures (about 40% in 1995 - 96) originated from extra-budgetary sources. Major part of the protective activities was financed by the Polish ecological funds, foreign subsidies and income form the auxiliary unit, which performs some services for the visitors and through such activity is able to ensure additional income for the local residents.

4.2. Evaluation of the experience

Apart from the central budget which constitutes about 60% of the Biebrza National Park's income, the leading financing role belongs to the National Fund for Environmental Protection and Water Management and voivodeship funds for environmental protection. The auxiliary unit of the park may generate income which - in the light of Polish legal regulations - does not have to be directed to the State budget. Such income is gained through the sales of tourist and education services, and will be utilised by the park, allowing for additional protective activities and creating additional places of employment, improving the economic conditions of the residents at the same time. The existing dualism of financing of environmental protection is seen as beneficial in Poland and is likely to be maintained in the future regardless of any changes in the State budget situation.

In comparison to other countries of this region and the Western Europe, the key role of the Polish funds for environmental protection in the national environmental

protection system is exceptional. Such funds cover expenditures necessary for some significant protective tasks, not included in the State budget financing schedule. The environmental protection funds collate revenues for economic utilisation of environment all over country and direct them to investments in the field of environmental protection and other investments relating to broadly understood field of environmental protection. The national park do not occupy the most exposed places on the fund's expenditures lists, however amounts of subsidies are important from the majority of parks' budgets point of view. In the period of 1995-1996 subsidies obtained from the funds presented above constituted about 20% of Biebrza National Park's income.

EcoFund's role is similar to the role of environmental protection funds. On a European scale it is an exceptional initiative of replacing the external debts with environmental protection investments. EcoFund is in possession of financial means from debts swapped by some creditor-countries and directed to international projects, including biodiversity protection related programmes. Subsidies for the national parks are included in this category. The importance of the EcoFund in the Biebrza National Park's budget is not significant.

The national parks, in particular the auxiliary unit, have some freedom as far as settlement of new, non-conventional means are concerned, which usually relate to forms of payment for tourist utilisation of parks and preserved areas, licence charges for some limited commercial activities conducted within the park, hunting charges, etc. In case of the Biebrza National Park contribution of administration charges in the total budget, in particular charges relating to timber sales, is small. In the 1995-96 period contribution of income from entrance tickets in the total income of auxiliary unit increased from the level of 6% to 12%.

We should only hope that, as time passes by, the Biebrza National Park structure will be firmly established and will be noticed by tourists and nature lovers. If the plans presented above are successful, the Biebrza National Park will be able to advertise and sell the exceptional natural values without any damage to the natural resources. There is no doubt, however, that the peatland of the park will never be as attractive and profitable, as the seaside dunes or bison reserve.

Table 5. Classification of Incentive Measures based on the "Saving Biological Diversity: Economic Incentives" and their role to nature of the Biebrza National Park

Incentives

	Type of measure	*Role in the Biebrza National Park*
1.	Agricultural land set-aside schemes	-
2.	Public land purchase	Applied on a very small scale
3.	Creation of wetland reserves	Applied on a large scale
4.	Covenant/conservation easements	-
5.	Costs-sharing/management agreements	Financing of protective activities on private land
6.	Species enhancement schemes	-
7.	Customary cultivation of biodiversity	-
8.	International biodiversity transfers	-
9.	Incentive payments for organic farming	-
10.	Taxation and fiscal measures	Exemption from the forest tax of some categories of protected area; 0% farm tax on the low-fertile water-mud areas; environmental charges; subsidies from environmental funds.

Disincentives

	Type of measure	*Role in the Biebrza National Park*
1.	User fees	Fees for entering the park
2.	Non-compliance fees	According to general regulations
3.	Fines for damages	For unauthorised hunting or other offences
4.	Environmental liability	Applicable on a very small scale
5.	Performance bonds	-
6.	Habitat mitigation schemes	-
7.	Marine pollution liability	-

Indirect Incentives

	Type of measure	*Role in the Biebrza National Park*
1.	Individual transferable fishing quotas	-
2.	Tradable development rights	-
3.	Property rights mechanisms	High share of private lands in the park's area
4.	Species commercialisation	-
5.	Biodiversity prospecting deals	-
6.	Forestry offsets	Obligation of afforestations compensating felling
7.	Air-emission trading	-
8.	Effluent discharge trading	-

9.	Tradable water entitlements	-
10.	Wetland mitigation banking	-
11.	Joint implementation	-
12.	Debt-for-nature swamps	Biebrza National Park as priority area for the EcoFund
13.	International franchise agreements	-
14.	Eco-labelling	-

Removal of Perverse Incentives

	Type of measure	*Role in the Biebrza National Park*
1.	Reduction and restructuring of agricultural support harmful to biodiversity	-
2.	Introduction of agricultural conservation compliance measures	On the basis of general regulations concerning management on protected areas
3.	Reform of public forestry concessions pricing, licence, fees, reforestation fees, and royalties	-
4.	Full appraisal of forest benefits	-
5.	Discontinuation of below-cost timbers sales	-
6.	Reform of tax structures	Modification of forest tax
7.	Full cost pricing for water services	-
8.	Appraisal of biodiversity impacts in the transport sector	Appraisal of impact of the planned road construction on the national park's integrity
9.	Road pricing	-
10.	Costing of biodiversity loss in energy investment appraisal	-

4.3. Recommendations for environmental protection policy

The example of the Biebrza National Park confirms the general conclusion that the environmental protection funds should be supported as the significant part of the environmental protection financing. There is no doubt as to their value in the period of economic transformation. Moreover they may also be very important in the conditions of developed market economy. There are many reasons why the subsidies, so unpopular among the competitive markets theorists, have a very important role in the field of financing of the environmental protection projects. The environmental protection projects where high costs are connected with huge economic benefits, are very rare. Generally the investor cannot independently bear the costs of protective activities. Often the benefits resulting from the protective activities are shared by the whole society or at least its significant part - as in case of the Biebrza National Park, however it is very difficult to find an investor ready to bear costs allowing such benefits. This area is limited to public financing, which level it determined by the environmental consciousness of the society and deficiency of the market allocation.

Among different forms of subsidies we can find subsidies, preferential loans and other facilitating forms of loans, credit guarantees, equity investments etc. Specific character of the national park confirms that the subsidies must be treated as financial instrument used most often and most efficient. Obtaining means for subsidies, originated outside of the State budget, requires efficient operation of the environmental protection funds. Financing through the funds generates problems of different kind, i.e. proper priorities selection or efficiency of subsidies directed to implementation of certain preservation projects.

It must be emphasised that the existence and proper operations of the environmental protection funds should not weaken activities aimed at accelerated activation of the private sector and, where possible, creation of chances for implementation of beneficial protective activities. It seems that neither private business nor auxiliary unit exhaust all the economically profitable possibilities relating to tourist traffic services, creation of tourist infrastructure or promoting the new, ecologically sustainable management forms on the adhering area.