MAINTENANCE PECULIARITIES OF POLDER SYSTEMS IN LITHUANIA DURING THE LAST DECADE

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Abstract

Basing on the economic, ecological and social points of view, the polder systems in the Nemunas lowland are considered as unique, requiring a great deal of annual state subsidies. According to the land-improvement programme, during the period of 2006-2008, Lithuanian polder system are planned to be yearly granted 2.15 million euros from the State budget, whereas the local administration of Silute district, which is exploiting the polders of the Lower Nemunas - more than half of the sum (63%).

The article includes the analysis of exploitation expenses and statistical estimation of the Lower Nemunas' polders during the period of 1996-2006 as well as the investigation of the funds distribution on routine repairs, reconstruction and maintenance work. The average annual expenses on the pump stations, dikes, ditches and roads during the research period were determined. The analysis of the previous decade's expenses shows that the statistical average of the expenditure on the polder systems of Silute district amounts to 0.68±0.13 million euros a year. The yearly renovation of polders depreciation should be obviously awarded a grant of the amount not less than 0.72 million euros.

Keywords: polder systems, maintenance expenses, state subsidies.

Introduction

Rehabilitation of the inherited polder systems and their employment for the future needs have proved to be one of the main goals of European countries around the region of the Baltic Sea. In Dutch where more than 2500 km of dikes have been constructed to protect the polders against floods, a maintenance decision model has been developed for the optimization of the cost–optimal dike repairs (Speijker et al., 2000). Van Overloop (2006) analyzed the water management peculiarities of polders in the Netherlands and presented a control method to avoid drainage problems. Since 1996, the experts from Lithuania and Germany had been cooperatively working on the development of a sustainable rehabilitation concept for the polder systems on the rivers Older and Nemunas (Quast and Lukianas, 1999). They concluded that the future agricultural employment of the polders requires special socio-economic conceptions based on practice and scientifically proved rehabilitation solutions.

In Lithuania, polder systems cover the area of 50972 ha. At the beginning of the year of 2005, Lithuanian's separate areas were protected from the flooding during the periods of floods by the 464.37 km of dikes. A total of 94 drainage pump stations are constantly in operation in order to remove the water out of them. Those sorts of constructions have already depreciated approximately by 50% (the dikes – by 47%, the pump stations – by 54%) and have lost around half of the balance value. At the moment their residual value amounts to 9.2 million euros.

Approximately 82% of the polders are concentrated in the Lower Nemunas. There have been constructed two types of polder systems (summer polders and winter ones). The dikes of the length of 302 km protect the total area of 42 000 ha. The winter polders are employed to protect settlements and cultivated areas from flooding throughout the area of 10.6 thousand ha. The summer polders are usually overflowed during the time of spring floods. The flooded area varies from 30 to 55 thousand ha according to the flood intensity. In the springtime after the snow melt the flood runoff lasts approximately 30 days.

During the soviet period, the summer polders provided the development of an intensive industrial production of vitamin grass flour. After regaining its independence, Lithuania undertook the privatization of its lands. The polder land employment under the new farming conditions is gradually changing due to the reduced demand for fodder. The degradation of the polder systems in the Nemunas delta has resulted in a decreased intensity of the draining (the major part of the automatized pump stations was damaged, and the repairs of the pump stations, dikes and electricity intake have faced the shortage in payment). Progressively, denaturalization of summer polder

landscape started and the areas of the meadows were reconverted into swamps (Mališauskas and Morkunas, 2004). However, the flooded meadows have been a valuable sort of the semi–natural landscape that is expected to have been retained, leastwise in some summer polders. Therefore, the vision of water resources for the year of 2025, has intended to withdraw the part of summer polder systems from the agricultural practice (Rekomendacijos..., 2000).

The intensity of alterations in farming has been negligible in the winter polders during the last decade. Despite the holdings of arable lands are small (1-1.5 ha), the process of the land privatisation has been rapid here. The winter polders employment has been comparatively intensive. Therefore water-operating conditions must be applied not only to the needs of the grassland but to any sort of the plants under the cultivation. In such case, water operating conditions control is conditioned by the changes in farming and land tenure (Juškauskas and Balodis, 1999; Ascila et al., 2001).

In the year of 1992, most of the polders were integrated into the Nemunas Delta Regional Park, some areas being attributed to the territories of 'Nature 2000'. A. Dumbrauskas and P. Punys (1999) proposed that water regime control in those areas should be coordinated with the demands of the parks – the different kinds of biotops necessary for the environment might be protected and developed under the conditions of water meadows with the possibilities of limited usage.

Intensive agricultural activities in the polder systems stimulate the sedimentation and pollution processes in Curonian Lagoon. A.P. Mališauskas (2000) determined that the loads of nitrogen and phosphorus from the polders reach 5-12 and 0.5-1.0 kg ha^{-1} respectively. Therefore the attention to ecology and environment requirements must be concentrated. Thus the ecological and environmental requirements should be awarded a far greater attention.

The implementation and maintenance of the polder systems are rather expensive. Although the land in the polders is owned or leased to private farmers, cooperatives or agro-firms, its structures (the dikes, pump stations, and drainage systems) are lawfully considered to be included in the possession of the State. Irrespective of the land usage, the repairs of the damages caused by floods are yearly financed by the State funds. In spite of the constant increase of the budget subsidies of special purposive assignation for the polder exploitation, their stable functioning cannot be ensured. Besides that, the absence of the scientifically based distribution of means has been noticed. At the moment the financing of the polder systems exploitation on the contrary to the financing of the land-improvement works is not based on the function dependence on the residual value of the constructions under their exploitation (Šaulys and Bastienė, 2004). The amount of the polder subsidies is decided by some other accidental factors. Such practice is considered to be economically inefficient. Therefore it is important to determine the ways for the decrease of the expenses on the polders drainage. In order to optimize the exploitation of the land and nature in the Nemunas delta as well as to save up the limited energetic and financial resources, the new standards of the exploitation of the polders systems are necessarily to be prepared.

The main aim of those investigations includes the analysis of the exploitation expenses on the polders during the last decade and the determination of the optimal needs of the means to support stable conditions of the hydrotechnical constructions of polders.

Materials and Methods

The area of the Lower Nemunas, constantly suffering from the regular river floods, is provided with a wide scale system of the summer and winter polders (Fig. 1). The great part of these areas is protected from the summer and autumn floods and only a minor part, including settlements (for example, Rusne) and other constructions or arable land, is under a constant protection all year round. Most polders were constructed in the years 1960-1971. The winter polder of Uostadvaris constructed in 1907 and the summer polder of the Sysa built in 1912 are considered undoubtedly as out-of-date. The most out-of-date polders, which were constructed during the prewar period, include the summer polders of the Pakalne, Minija, and Stankiskes. Some out-of-date polders have been under repairs twice. The last reconstruction of the year 1986 involved the summer polder of the Vorusne.

The water-polder area differs from some tens to some thousands of hectares. The calculation reveals that the water-area of Silute district amounts to over 25 thousand hectares. The Alka (4887 ha), Verze (3625 ha), and Sysa (3095 ha) summer polders are considered as the greatest according with the water-area of the river basin. The areas of the winter polders are far smaller, including Uostadvaris (35 ha) and Vorusne (40 ha) polders as the smallest ones. The total

length of all polder dikes amount to 213.5 km (183.5 km of summer polders and 30 km of winter polders). The Alka summer polder (27.6 km) and the Rusne winter polder (13.1 km) are undoubtedly considered to be the longest. Some dikes are only 2-3 km long, for example, the winter polders of Uostadvaris and Vorusne. Each polder is supplied by a corresponding network of ditch approaches and local roads. The Alka summer polder, which occupies the greatest area, is supplied by four effective pump stations. Three pump stations are under exploitation in the Ruguliai winter polder. As the pump stations have been under exploitation for many years, their mechanisms have been depreciated. They should be replaced by newer according to the advanced appreciation of the farming level and all economic and ecological aspects.

Grassland and pastures predominate in the polders of the Lower Nemunas. They include 84% of the total 24 232 ha area. The arable land covers 7%, but swamps include only 0.7% of the total area (Fig. 2). The Alka summer polders include the most share of the farming land - even 3327 ha as well as the greatest part of the arable land – 459 ha. The Rusne winter polders cover a sufficiently great share (third part of the total area) of the arable land. The winter polders of the Rusne, Vorusne, and Uostadvaris include the relatively greater amount of arable land than meadows, and the winter polder of Ruguliai does not have arable land at all. Grassland and pastures (88.5%) dominate in the summer polders, and arable land covers only the 6% of the total area. The investigation includes the period of 1996-2006. The expenses on the exploitation of the Lower Nemunas polders have been calculated according to the statements and estimates of the fulfilled works of the joint-stock company 'Silute polders'. The article includes the data of the Ministry of Agriculture of Lithuania and the Department of the infrastructure, land reclamation and cooperation. The reliability of the results was determined by processing them using mathematical-statistical methods, using the MS Excel 2000 Data Analysis Tool Pack. The mean of expenses was calculated at significant level $P = 0.05$.

Results and Discussion

For the purpose of the polder maintenance, a joint-stock company 'Silute polders' has been

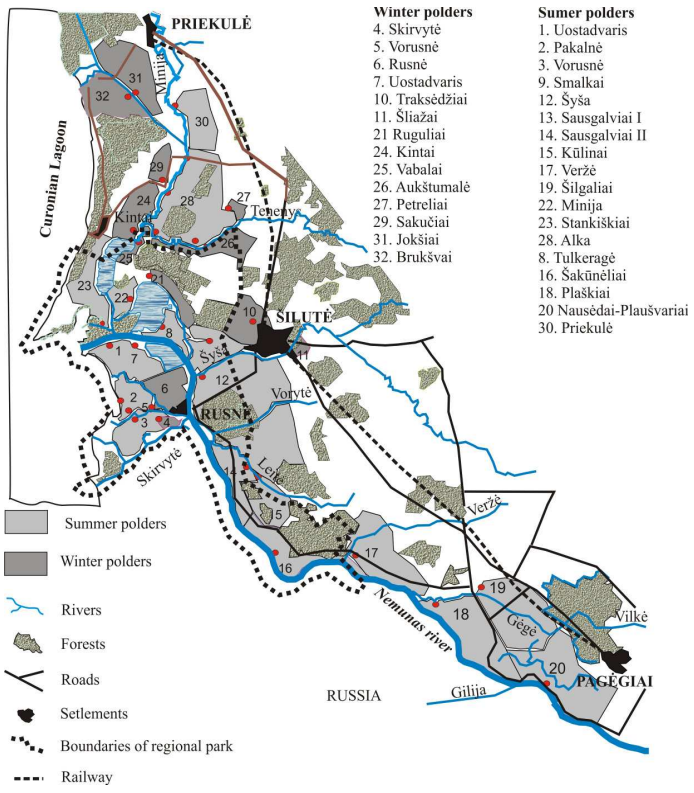

Figure 1. The location of polders in the Nemunas Lowland.

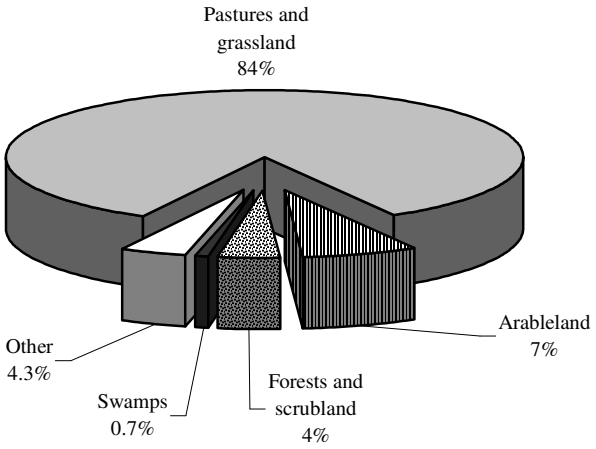

Figure 2. Distribution of the land usage in Silute polders.

established. The polder area covers 30 thousand ha and is under the service of the joint-stock company. It maintains 38 pump stations.

During the last decade (1996-2006), the joint-stock company 'Silute polders' maintained the polder systems and concluded labour contracts for 7.5 million euros. The average annual expenses reach 678±134 thousand euros (the relative error of the means – 10%), varying from 345 to 1150 thousand euros depending on particular years (the coefficient of the variation – 34%). The analysis of the expenses change (Fig. 3) shows that during the period from 1996 to 1999, the expenses were gradually decreasing. In 2000 after the administrative redistribution of Lithuania's territory, the local administration of Pagegiai separated from the Silute district and took some part of the polder systems (Plaskiai, Silgaliai, and Nausedai- Plausvariai summer polders covering area of 5639 ha) at its own disposal. Some part of the financing has been redistributed as well and granted for the local administration of Pagegiai. Thus, in 2000, the State subsidies for the polder exploitation in Silute district were decreased to 440 thousand euros, and in 2001 the district was granted only 345 thousand euros or on average 10.9 euros ha^{-1}. But the technical conditions of the polder implementation under such financing started rapidly to worsen. The granted funds were not sufficient to maintain the stability of the functioning or at least to renovate its depreciation. Thus, the State increased financing for Silute district once again and in 2003 its amount reached the sum of the year 1999, i.e., 678 thousand euros. In 2006, the total expenses of the exploitation of the polder systems increased to a very high level – up to 1.15 million euros. Thus, one hectare of the draining land requires about 36.4 euros.

The diagram of the percentage expenses distribution for various kinds of work in polder systems (Fig. 4) shows, that the repairs, reconstruction and maintenance of the pump stations demand the most share of the means (42%), the repairs, reconstruction and maintenance of the dikes require the third share

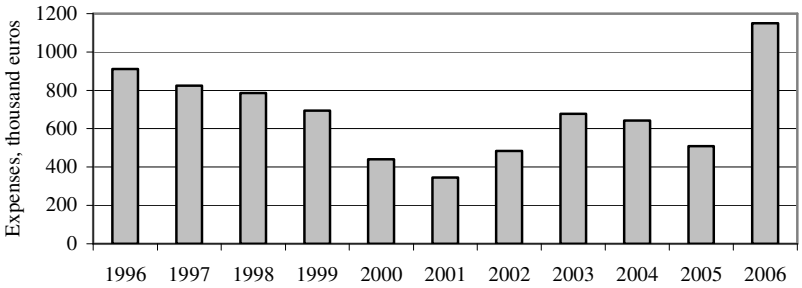

Figure 3. Dynamics of the means allocated for out the maintenance of the polders in Silute municipality during 1996-2006.

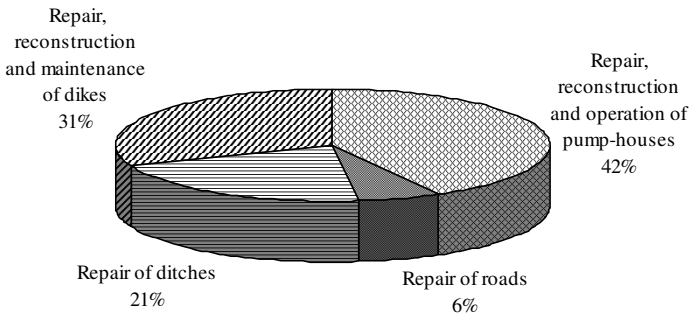

Figure 4. Common distribution of the financial allocation for 'Silute polders' in 1992-2006.

of the means (31%), the repairs of the ditches and their equipment need the fifth share of the funds (21%), and only 6% are spent on the repairs of the local roads and approaches to the pump stations.

Pump stations. During the last decade, for the maintenance of the pump stations operation (repairs, reconstruction and maintenance 262-390 thousand euros were granted, i.e., the average annual expenses reached 326±64 thousand euros. The statistical estimation shows that the calculated average of the expenses on the pump stations exploitation proves to be sufficiently exact (the data variation – 33%, the relative error of the mean – 10%). During the investigation period the pump stations were granted on average 42% of annual funds' of the sum: the least in 1999 – 29%, the most in 2003 – 76%.

Dikes. The repairs, reconstruction and maintenance of the dikes annually need about 239±88 thousand euros (the error of the mean – 18%), when includes the third part of the annual sum granted for polder funds. Due to the equally great data variation (59%), the confidence interval of the expenses average at the 95% confidence level proves to be rather extensive, which means that the range on of the fluctuations of the dike exploitation expenses vary greatly throughout separate years (from 151 to 327 thousand euros). The dike repairs require the most share of the means (approximately 64%), reconstruction - about 20%, whereas the dike maintenance (mowing down of vegetation) are yearly provided 10–33% of the means (the average – 26%).

Fig. 5 presents statistical estimation of annual expenses on the maintenance of pump stations, dikes, ditches and local roads.

Ditches. The repairs of the polder ditches and their equipment were granted from 33 to 275 thousand euros a year. Excluding the data of the year 2002 because of its sufficient separation from the total data range, the calculated expenses on average amounted to 157±57 thousand euros. Statistically it is purposeful to exclude the two periods of the polder ditches exploitation. According to the data, during the period from 1996 to 1999, the ditches were supplied with the means 2.7 times more than during the later years - 2000–2006 (accordingly 251 and 94 thousand

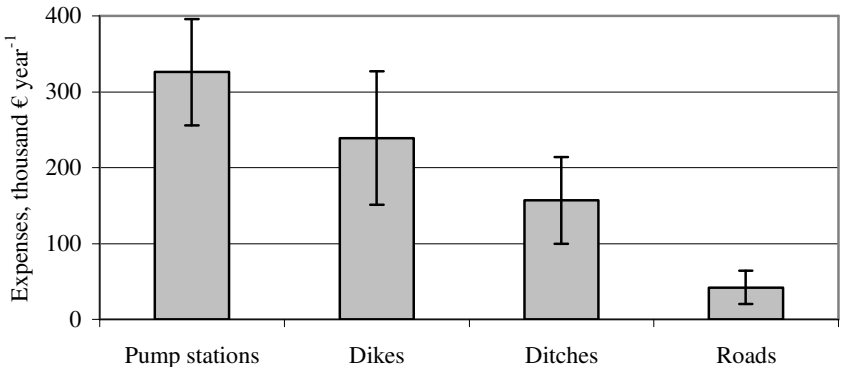

Figure 5. Average annual expenses and its variation during 1996-2006.

euros), which includes 32 and 16 percents of the annual expenses.

Roads. The funds, required for the repairs of the approaches to the pump stations and local polder roads, varied from 3 to 113 thousand euros. Due to an exceptionally great expenses variation (81%), the calculated average (42±22 thousand euros) proves to include a sufficiently great (24%) error of calculation. The road repairs were granted approximately 6% of the total means amount.

The State audit report on the State budget means, spent on the land-improvement in the year 2005, indicates that the planning of the budget funds' needs for the land-improvement and the funds distribution in the State capital investment programme didn't ensure an effective funds employment. For that reason the State control of the Republic of Lithuania applied to the Ministry of Finance with a suggestion to look through the financing order of the land-improvement work (during the preparations for the ratification of the State budget and the financial rates of the local administration budgets in the year 2006) to insure a proper funds planning and their distribution according to the needs of the land-improvement work and the requirements of the Investment Law.

The land reclamation programme for the period of 2006–2008 is granting the funds for the exploitation, repairs and reconstruction of the land reclamation structures, in which the polder funds are excluded into a separate line.

The land reclamation programme provides the polder systems with 2.15 million euros a year. In spite of that, the funds are going to be redistributed for separate kinds of works during the next two years. The means for the maintenance of pump stations (in connection with the increase of energy prices) are going to be increased by 16%, and the total means for the repairs and reconstruction are going to be accordingly less by 30% and 67%. But, in fact, due to the smaller number of the pump stations under repair and reconstruction, the recalculated means for one unit will be the same. Analogically, the total means for the repairs and reconstruction of the dikes are going to increase by 42% and 54%, but calculating per 1 km of the dikes, the means for the repairs will even be less, whereas the means the reconstruction will increase by 19%.

The expenses analysis in Silute district reveals that the statistical average of the expenses on the polder systems amounts to 679 thousand euros a year. The equal division of the average expenses on the total number of stations (326 thousand euros) by all the pump station units on the operation (38 units) concludes that on average 8.6 thousand euros: a year are provided for a pump station. Due to some kind of an error of the calculation of the average being involved, it may change around the limits of 7–10 thousand euros. The calculation of the division of the average of expenses on the dike exploitation (239

Table 1

The State subsidies provided for the maintenance, repairs and reconstruction of the polder systems in 2006 – 2008

Years	Maintenance					
	Pump stations			Dikes		
	number	budget, thousand euros	thousand euros per unit	length, km	budget, thousand euros	thousand euros per km a year
2006	94	740	7.9	378	128	0.3
2007	94	857	9.1	378	128	0.3
2008	94	857	9.1	378	128	0.3
Repair						
2006	33	219	6.6	9.2	369	40.1
2007	10	67	6.7	14.0	522	37.3
2008	10	67	6.7	14.0	522	37.3
Reconstruction						
2006	3	565	188	1.55	132	85.3
2007	2	377	188	2.00	203	101.4
2008	2	377	188	2.00	203	101.4

Table 2

Depreciation of the main hydrotechnical structures in polder systems in Silute district

Hydrotechnical structures	Unit	Number	Balance value, euros	Depreciation, %	Residual value, euros	Yearly depreciation	
						%	euros
Dikes	km	221.7	6754033	46.5	3613408	1.57	106038
Pump stations	unit	38.0	4214983	49.3	2136997	2.35	99052
Ditches	km	988.3	4485013	82.4	789362	2.67	119750
Culverts	unit	922.0	1520610	67.9	488116	3.08	46835
Sluices	unit	35.0	472186	64.8	166210	3.08	14543
Bridges	unit	33.0	362727	46.7	193333	1.18	4280

thousand euros) by the total dike length (213.5 km) shows that the dikes are allocated for about 1.1 thousand euros per km a year. This average may fluctuate from 0.7 to 1.5 thousand euros per km a year. Correspondingly, the total average of the expenses (159 euros per km a year) is calculated after dividing the expenses on the ditches (157 thousand euros) by the total length of ditches (988.3 km) (the average may fluctuate from 100 to 217 euros per km a year. The fact is that the exploitation of the polder roads requires from 46 to 145 euros per km a year and the average reaches 97 euros per km a year.

To secure a stable functioning of the polder systems, they should be granted at least the minor amount of the funds required for the reconstruction of the annual depreciation. The data in Table 2 includes the depreciation and residual value of the main polder systems elements.

The calculation reveals that the equipment of the polder systems depreciates on average by 390.5 thousand euros a year. The addition of the annual exploitation expenses in the area of 14254 ha to this amount concludes that the local administration of Silute should award a grant for the polder exploitation containing the sum not less than 721 thousand euros.

The financing of polder exploitation must be based on the market economy principles and valid not so much by social as by the economic necessity. In this case not only the state but also the local administration and entities, which use the polders of the Lower Nemunas, must take some additional engagements upon themselves as well.

The funds must be differentiated not only according to the area of the polders and their equipment but to the social and economic needs as well. It is namely a district local administration that is responsible for the determination and legalization of the funds redistribution priorities.

Conclusions

1. Throughout the last decade (1996–2006) the exploitation of the polder systems in the local administration of Silute district shows that the joint-stock company 'Silute polders' had completed a 7.46 million euros worth. The average annual expenses during this period amount to 579±138 thousand euros. The repairs, reconstruction and maintenance of the pump stations need the most share of the funds (42%), the repairs, reconstruction and maintenance of the dikes need the third part of the means (31%), the fifth part (21%) are spent on the repairs of the ditches and their equipment, and only 6% are necessary for the repairs of local roads and approaches to the pump stations.
2. The analysis of the expenses in the local administration of Silute district reveals that the statistical average of the exploitation expenses on the polder systems (679 thousand euros a year) is less than that to be provided for annual renovation of equipment depreciation, i.e., 721 thousand euros a year.
3. Due to optimization of the exploitation of the lands and nature in the Nemunas delta, the polder funds should be differentiated not only according to the area of the polders and their equipment but to the social, economic and ecological needs as well.

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