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Klaudyán: internetový časopis pro historickou geografii a environmentální dějiny

Klaudyán: Internet Journal of Historical Geography and Environmental History

Ročník 5/2008, č. 1, s. 14–29 *Volume 5/2008, No. 1, pp. 14–29*

The environmental impact and economic consequences of agricultural land drainage in Czechia: 1960–1989

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Abstract:
N. Orsillo: *The environmental impact and economic consequences of agricultural land drainage in Czechia: 1960–1989.* – Klaudyán, 5, No. 1, pp. 14–29. During the communist era agricultural intensification efforts had a strong negative impact on the environment. Agricultural land drainage, as one specific intensification factor is examined in detail. Interviews were held with individuals involved in agricultural land drainage during the communist regime in order to create an oral history of drainage. On the basis of these interviews, supporting literature, and statistical information it was determined that five primarily socioeconomic factors contributed to agricultural land drainage's environmental impact during this period: 1) differential premiums helped expand drainage to more ecologically susceptible land at higher elevations, 2) physical changes in the landscape required excessive drainage, 3) the technical aspects of drainage were emphasized over its biological aspects, 4) farmers were in favor of drainage as it helped improved crop yields and was completely state subsidized as well, and 5) there was no pressure on drainage design and construction engineers to improve economic efficiency.

Key words:
agricultural land drainage – communist era – oral history – environmental impact – Czechia

1. Introduction

This study is based on a section of my Master's thesis "Agricultural Intensification in Communist Czechoslovakia and Its Impact on the Environment" defended at the Department of Environmental Studies at the Faculty of Social Studies of Masaryk University in June 2008. The aim of my thesis was twofold. First it was necessary to examine the political and socioeconomic factors that led to the implementation of agricultural policy and intensification measures that had a strong negative environmental impact during the communist era. Then I examined one specific aspect of agricultural intensification in detail: agricultural land drainage. Large-scale agricultural land drainage in Czechia traces it roots to the second half of the nineteenth century, when constant capital started to be invested in agriculture in order to increase natural soil fertility. Increased soil fertility leads to better agricultural economic output. Interviews were held with people who worked in agricultural land drainage in the period 1960-1989 to create an oral history. In this study I focus on the socioeconomic factors that led to excessive, and often environmentally harmful agricultural land drainage.

The environmental and economic consequences of agricultural land drainage in this period are also examined in relation to the agricultural policy of the Communist Party of Czechoslovakia. It is based on the study of primary sources, primarily documents of the Central Committee of the Communist Party of Czechoslovakia pertaining to agricultural policy. Communist agricultural policy was focused on achieving agricultural self-sufficiency at any environmental or economic cost.

2. A brief history of drainage in Czechia

2.1. 1848–1948

Agricultural land drainage has a relatively long history in Czechia. Ceramic tile drainage was developed in England and displayed at the London World Fair in 1851. In Czechia subsidies for regulating water courses and the subsequent conversion of gained lands to agricultural land were introduced in 1853. The first large-scale drainage project in the entire Austrian empire was implemented in the Třeboň region in 1854. However, the further development of land drainage in Czechia was slow, as there were not enough trained experts in the field. Although many measures were taken by the government to expand drainage, the first truly effective measure was implemented in 1884 with the establishment of a land amelioration fund from which amelioration cooperatives could request money. In 1893 another fund was established to support smaller amelioration companies. In 1906 the Amelioration Union was founded (Jeleček 1985). At the same time academic programs in land amelioration were established at universities in Prague, Brno and Bratislava (Jůva 1978).

Between 1884 and 1914 2 704 km of water courses were regulated, thus gaining 74 000 ha of land. Before Word War I the most drainage and water course regulation took place in Eastern Bohemia where there was a great proportion of high-yielding meadows and very wet, but fertile soil (Jeleček 1985). Before World War II about 750 000 ha had been drained in connection with regulating water courses, whereas only 18 000 ha had been irrigated (Jůva 1978).

Although in the interwar period the landscape was in a state of secondary homeostasis and overall the negative environmental impact of agriculture was low that does not mean that environmental impact was completely avoided. V. Úlehla noted in 1947 that drainage was particularly damaging in this period:

> *"Within the memory span of today's oldest living people our landscape has changed the most within the last thousand years. In our day, in the last seventy-five years, amelioration companies, amelioration meaning "improving", have caused this. Truly they do not improve soil, nor the vegetation on it, nor our prospects for the future. They dry up the soil, which harmfully interferes with soil chemistry. When they drain any old swamp, ox bow lake, marsh or peat bog in the highlands they help change our climate into a continental climate with contrasting strong winters and summers with less cloud cover as well as separate periods of drought and intense rain. When amelioration allows a peasant to plow up any old pasture or drained lowland area it exposes a layer of topsoil, which is washed away and never to form again*[1]" (p. 30).

2.2. 1948–1989

Indeed if we take the South Moravian region as an example we see that drainage system construction was relatively intense during this period. In these two decades 18,85 % of total drainage in South Moravia was carried out (table 1). This period represents the third most intense period in drainage system construction in South Moravia.

During the period of collectivization the importance of land drainage was emphasized at the highest political levels. However, meaningful investments in drainage were not made until the 1960s. In 1960 new study programs in land amelioration were opened at all Czechoslovak agricultural colleges, which provided a well-educated and skilled drainage labor force. In 1961 the Amelioration Research Institute was founded in Prague (Jůva 1978). In 1969 the State Fund for Soil Improvement

was created by law. With the introduction of this fund, funds for all amelioration procedures including drainage were centralized. It is crucial to note that collective farms and state farms were not responsible for paying for drainage with their own money.

Tab. 1: Drainage construction per district and time period in hectares in the former South Moravian Region (rounded to the nearest whole hectare)

District	To 1918	1919–1938	1939–1945	1946–1950	1951–1960	1961–1970	1971–1980	1981–1990	1991–1996	Total
Blansko	99	2 921	293	3	447	1 421	1 876	925	0	7 986
Brno–město	0	19	0	0	18	157	107	11	0	311
Brno–venkov	672	2 056	13	48	170	1 232	1 507	775	0	6 473
Břeclav	72	5 101	30	50	124	3 479	2 630	1 707	0	13 193
Hodonín	118	818	472	0	205	2 409	1 804	1 907	0	7 735
Jihlava	0	2 345	501	35	331	6 132	8 738	2 384	71	20 991
Kroměříž	996	3 261	42	287	568	3 377	2 352	1 996	98	12 976
Prostějov	75	579	0	22	202	1 863	2 637	931	65	6 316
Třebíč	334	3 268	750	139	330	7 511	12 066	1 988	0	26 384
Uherské Hradiště	159	3 378	354	16	222	4 043	6 498	1 735	23	16 428
Vyškov	10	0	0	0	437	1 867	706	266	0	3 284
Zlín	97	3 210	162	301	389	3 350	4 509	2 161	16	14 195
Znojmo	53	525	353	0	543	3 702	2 838	949	134	9 098
Žďár n. Láz.	85	5086	135	29	325	6 335	11 045	4 102	294	27 435
Total	2 770	3 2567	3 102	928	4 311	46 879	59 310	22 293	643	172 803
Percentage	1,6 %	18,85 %	1,8 %	0,54 %	2,49 %	27,14 %	34,32 %	12,9 %	0,37 %	

Source: Zemědělská vodohospodářská správa – Brno.

Again the figures for the South Moravian region confirm these historical trends (see Table 1). Only 2 49 % of soil drained in South Moravia was drained in the 1950s, which is consistent with the lack of investment in agricultural intensification during collectivization. We see that in the 1960s 27 14 % of all drainage was carried out making it the second most intense period for constructing drainage systems, which corresponds with increasing investments in agriculture at this time.

In the 1970s with the advent of the specialization and concentration and agricultural self-sufficiency policies, there was a strong push to increase agricultural production as much as possible. Economic stimuli such as differential premiums pushed intensive agriculture into ecologically sensitive areas in higher elevations. For the most part the majority of the lowlands had been drained by this point. The self-sufficiency policy in combination with the implementation of differential premiums helped bring drainage projects into sub-mountainous and mountainous areas, where economic viability was questionable and environmental impact high. For example in the sixth five-year plan period 1976–1980 only 46 000 ha (16 %) of agricultural land in lowland corn and beet growing regions was to be drained, whereas as 244 000 ha (84 %) were to be drained in the highland potato growing and mountainous regions (Ungerman 1983). Although drained acreage had always usually been higher in the highland districts of Jihlava, Třebíč and Žďár nad Sázavou in the 1970s the amount of soil drained in these regions jumped significantly especially in comparison with the other districts (table 1).

Towards the end of the 1970s the situation got even worse as drainage climbed into truly absurd mountainous regions. In the 1980s however drainage construction slowed down because there was less land that required draining. However, throughout the 1980s the Communist party was still pushing for more drainage. The statistics for South Moravia confirm this trend as well.

Today there are 1 084 000 ha of drained agricultural land in Czechia, which means that 25,3 % of all agricultural land is drained. Since 1990 this number has barely changed, since nearly all drainage work was stopped with the fall of the Communist regime in 1989. This holds true for the South Moravia region (table 1). However, according to the comprehensive soil survey conducted in Czechoslovakia between 1960 and 1972 there were only 843 781 ha of waterlogged agricultural land in Czechia of which 235 286 ha were permanently waterlogged and 608 495 ha were temporarily waterlogged. Therefore, 240 619 ha of essentially dry land were needlessly drained (Novák, Vopravil, Lagová 2006). It should also be noted that large-scale systematic drainage predominated over other forms of drainage such as open ditch drainage or sporadic drainage. Again if we look at drainage statistics from the South Moravia region (table 2) we see that of the 172 803 ha of drained land 97,4 % is drained by systematic drainage, only 0,7 % by sporadic drainage and 0,3 % by open ditch drainage. The reasons for the excessive drainage and overuse of systematic drainage will be discussed shortly.

Tab. 2: Total drained agricultural land by drainage type for the former South Moravian Region (does not include all drainage types)

District	Total ha	Systematic drainage (ha)	Sporadic drainage (ha)	Open ditch (ha)
Blansko	7 985	7 974	12	0
Brno–město	311	311	0	0
Brno–venkov	6 473	5 969	0	67
Břeclav	13 193	11 509	0	397
Hodonín	7 735	7 488	247	0
Jihlava	20 991	20 959	16	17
Kroměříž	12 976	12 615	0	0
Prostějov	6 316	6 140	32	0
Třebíč	26 384	26 381	0	3
Uherské Hradiště	16 428	16 376	51	0
Vyškov	3 284	0	0	0
Zlín	14 195	14 158	37	0
Znojmo	9 098	8 684	11	13
Žďár n. Sázavou	27 435	26 498	937	0
Total	172 803	168 346	1 342	496
Percentage	100 %	97,4 %	0,7 %	0,3 %

Source: Zemědělská vodohospodářská správa – Brno.

3. The environmental impact of drainage

3.1. Positive environmental impacts of drainage

Drainage is beneficial because it improves certain soil qualities. Drained soils are better aerated, have a higher soil temperature, improved soil structure, and greater water retention capacity. They also have increased soil bearing strength and in many cases can reduce surface runoff and erosion (Spaling, Smit 1995). Besides these physical properties drainage also contributes to creating better biochemical soil conditions for agriculture. Due to the above mentioned physical properties, such as better aeration and increased heat capacity, nutrients are more easily released from fertilizers. Thus both organic and artificial fertilizers work better on drained soils (Jůva, Dvořák, Tlapák 1987).

Enhanced soil properties improve plant growth by promoting germination and increasing root depth. They also extend the growing season and reduce frost heave and winter kill (Spaling, Smit 1995). There is no question that drainage helps improve crop yields. However, there are some deleterious environmental effects of drainage as well.

3.2. Negative environmental impacts of drainage

The environmental impact of drainage can be expressed in relation to its impact on the ecological functions of wetlands. It should be noted that not only wetlands were drained, but also areas that were seasonally waterlogged, especially meadows. However, these temporarily wet areas serve some of the same ecological functions as wetlands. Brinson et al. (1994) has identified four major categories of functions for wetlands: hydrological, biogeochemical, plant community maintenance and animal community maintaining (as cited in Hauer, Smith 1998). Agricultural land drainage interferes with all of these functions.

Wetlands provide habitats for hygrophilic and hydrophilic vegetation and the fauna that rely on them. Thus they are an extremely important source of regional biodiversity. As wetlands disappear from the landscape so do the plant and animal species that depend upon them (Kulhavý et al. 2006). For example Růžička (1977) cites the disappearance of several rare plant species from the landscape as a result of draining peat bogs in the headwater region of the Dyje River such as protected plant species common sundew, western marsh orchid and buck bean. Drainage can also impact aquatic ecosystems as the constant addition of sediment, nutrients and contaminants can change aquatic species composition and habitats (Spalding, Smit 1995).

Hauer et al. (1998, as cited in Hauer, Smith 1998) have identified several hydrological functions of wetlands. They are responsible for dynamic surface, long term surface and subsurface water storage, as well as energy dissipation and moderation of groundwater flow and runoff. Drainage impacts these important landscape functions as well.

Stream flow can change as a result of repeated additions of drain water at time intervals which exceed the period needed for assimilation or recovery. Drainage systems continually remove soil water and therefore the depth of the water table permanently changes as a result (Spalding, Smit 1995). As surface and groundwater supplies shrink, the landscape becomes drier, and therefore more susceptible to drought and resulting wind erosion. Increased runoff from drained agricultural soil has also contributed to more intense flooding in Czechia[2] (Kulhavý et al. 2006).

Hauer et al. (1998) have also determined several biogeochemical functions of wetlands. Wetlands cycle nutrients, remove imported elements and compounds, retain particulates and help export organic carbon. Again agricultural land drainage drastically impacts these functions. Drained soils are drier and therefore heat up sooner. As much drained land is converted into arable land it lacks vegetation for a large part of the year. This reduces overall evapotranspiration. Solar radiation is therefore converted directly into heat. Thus, the landscape can overheat (Kulhavý et al. 2006).

Drainage also allows for larger agricultural production units, which lend themselves to crop monocultures. Increased erosion, runoff and soil leaching often result, which changes the nutrient and organic matter content found in the soil (Spalding, Smit 1995). A related problem prevalent in Czechia was that drained meadows were often plowed and converted into arable land. Thus, the landscape stabilizing features of meadows, such as their water retention and cleaning capabilities were completely lost.

Wetlands are extremely important landscape elements because they are capable of cleaning water of contaminants and other impurities. Although drainage helps aerate soils, it also turns formerly waterlogged anaerobic soils into aerobic environments, thus reducing their denitrification capabilities. However, wet and alluvial soils are capable of this denitrification, which is an important cleansing process in the landscape. The amount of nitrates in soil water, groundwater and surface water increases, which leads to contamination. This often aids in the eutrofication of surface water supplies as well (Kulhavý et al. 2006). Drainage lowers the effects of natural water purification processes. More contaminates such as nitrates find their way into surface and groundwater sources. These contaminated waters move more easily to other geographic locations with increased runoff. Therefore

the environmental impact of drainage is not always registered directly at the source point (Spalding, Smit 1995).

This problem was particularly acute in the headwater regions drained in Czechia starting at the end of the 1960s. During the Communist period often absurdly high amounts of artificial fertilizer were applied to fields and meadows in an attempt to increase yields. Under normal circumstances wetlands and waterlogged meadows would have been able to remove much of these fertilizers from the soil into the biomass of plant communities, as well as having been better able to break down the remaining contaminants in the soil. However, as drainage either permanently disrupted or destroyed these precious ecosystems their ability to remove nitrates from the soil was seriously handicapped. In combination with increased runoff this meant that water contaminated with nitrates was dispersed over a large geographic area, which was of course detrimental in headwater regions.

Runoff water from drained arable land has a higher nitrate concentration than runoff water from other sources. Generally nitrate concentrates change seasonally. However, changes in nitrate concentration are not directly related to the time of fertilizer application. Instead nitrate concentrations are higher at times when more water is introduced into soil systems, usually through increased precipitation. Therefore maximum nitrate concentration is typically in the spring. Although the amount of artificial fertilizer applied to drained agricultural land (as well as non-drained land) steeply dropped at the start of the 1990s, the amount of nitrates present in surface water did not drop significantly. Therefore, nitrate concentration in water does not have a direct relationship with fertilizer application. Drainage plays an important role in nitrate concentration (Novák, Fučík 2007).

Several studies have confirmed this. Nitrate concentrations in drainage water in the Ráčský Stream watershed increased from 10 mg NO^{3-} / liter to 80-100 mg NO^{3-} / liter during the second year of operation of a newly installed drainage system. Nitrate concentrations in the Vočadlo Stream in the Želivka River watershed where also monitored before and after drainage of agricultural soils in the Vočadlo's catchment area. Before 1982 when the drainage system was constructed nitrate concentration averaged 20 mg NO^{3-} / liter. In the period from 1983-1987 maximum nitrate concentrations reached 95 mg NO^{3-} / liter. From 1987 onward the average nitrate concentration dropped to 65 mg NO^{3-} / liter (Novák, Fučík 2007). Land drainage is clearly related to nitrate concentration. In headwater areas this meant that entire watersheds were in danger of nitrate contamination.

3.3. Socioeconomic factors leading to the environmental impact of drainage

Ungerman (1983) noted some of the socioeconomic factors, which led to the already mentioned environmentally dangerous practice of drainage in spring regions:

1) The positive effects of drainage were overemphasized without even considering their possible negative effects. In other words a holistic approach was lacking.

2) Drainage planning and construction companies had no incentive to think beyond increasing their profits and crop yields. Therefore questions of environmental impact and economic efficiency were not considered in drainage practice. Drainage had literally moved to a higher elevation, but the thinking of those doing the drainage had not.

3) Farms were convinced that large-scale drainage would improve crop yields and therefore were in favor of it.

4) Large fields were created to accommodate larger agricultural machines. Water-logged areas were therefore considered barriers and needed to be eliminated for the sake of these machines.

These problems apply to drainage not only in headwaters areas, but to all areas in Czechia. Therefore in this section we shall explore in further detail these four socioeconomic factors of soil drainage: 1) the relationship between landscape structure and drainage, 2) drainage as a scientific discipline, 3) farmers and their relationship to drainage, and 4) the economic efficiency of drainage with an emphasis on drainage design and construction.

3.4. The relationship between landscape structure and drainage

In Czechia certain organizational aspects of the agricultural landscape led to increased drainage during the communist era. Field size increased greatly in the 1970s. In some cases certain areas that may not have been otherwise drained were drained to accommodate the creation of these fields. All wet areas needed to be removed as they were a hindrance to full mechanization. This is one reason why open drainage ditches were uncommon. Underground systematic drainage was preferred because it did not limit the use of farm machinery. Natural streams were often guided into concrete tubes and buried underground for the same reason. In some cases however this too led to more waterlogged areas as soil was no longer naturally drained in these areas (Ungerman 2008).

In other cases the creation of large fields actually led to areas becoming waterlogged, which never had this problem before. V. Tlapák (2008) considers the creation of large fields to be one of the most critical factors in environmental impact caused by drainage during the Communist era:

> *"The creation of large [...] didn't have any logic nor a realistic foundation. They simply created large fields. The agricultural infrastructure was gotten rid of, the grassy field boundaries, the groves, everything that created the landscape really. The landscape actually lost its natural drainage routes, as I have said already. Well and precipitation stayed the same as it had been. Well that understandably led to water logging and that needed to be taken out."* [3]

Several respondents also mentioned that large agricultural vehicles compacted the soil, making it nearly impermeable to water. Therefore, the soil surface would remain water-logged, whereas the compacted sub-surface soil levels remained completely dry. Thus, more drainage was required to remove this water.

4. Drainage as a science

In Czechia drainage belongs to a field known as hydrological land amelioration, which also includes irrigation and stream regulation. As many respondents pointed out land amelioration and drainage in particular have received an unfair rap from Czech society in general since the fall of the Communist regime. In many people's mind the term "amelioration" conjures up images of rural landscapes destroyed by drainage projects. Although all of the respondents admitted that drainage often had large, negative environmental impacts, the majority of them stated that the problem lay not within the scientific discipline of land amelioration, but rather in the poor application of drainage in practice, which was beyond the influence of the academic community.

The study of land amelioration was multidisciplinary and included a mix of technical and biological subjects. Students had a full understanding of the relationship between land drainage and the environment. However, one of the major problems was that in practice the technical aspect of drainage was applied, whereas the ecological aspects remained fully theoretical. As Ungerman (2008) recalled this emphasis was not only prevalent in application, but also in theory. He admitted that the following statement by K. Jůva was a bit of a caricature of the entire situation, and perhaps not to be taken entirely seriously. However, he argued that it holds some essential truths:

> *"[...] I really heard him say with my own ears, that it would actually be ideal if the entire landscape could be drained first, because drainage has other different aspects - there is soil aeration, hydrological regulation, so like really. And then immediately following that to irrigate where it was needed. That is really sort of, really sort of a caricature of the technical approach to these affairs. It was very contrasting, but we as little students, small little students, couldn't quite believe it."* [4]

However, V. Tlapák (2008), a colleague of Jůva, also recalled this same approach and referred to it as a "megalomaniacal idea." Therefore it is questionable just how prevalent the purely technical approach was on the theoretical level. In any case Tlapák confirmed that this idea was predominate among politicians and in practice the technical approach predominated.

J. Pall (2008) agreed that one of the major problems with drainage, and land amelioration in general, which led to environmental problems, was its emphasis on its technical aspects:

> *"Well then, the technical part is more straightforward. There are for example norms on which you can rely and so on, whereas with the biological part it is always a little bit more complicated. Well and let's say considering the enterprise, which I've already named, Zemědělské stavby [Agricultural Constructions], well it was to a certain extent determined by that. A name which is actually about construction."* [5]

In practice to use a more technical approach was easier; it involved less effort than considering all of the biological aspects. As we shall see later those working in land drainage often felt they were under serious time pressure. Therefore, to rely on the simpler technical approach was quicker and would get land drained just as well, even if certain environmental aspects were neglected.

To summarize the science of drainage, as a branch of land amelioration, was not focused exclusively on the technical aspects of drainage. Theoretical knowledge did not neglect the ecological aspects of land drainage for the most part and was well-represented at colleges and universities. However, in practice drainage (not to mention irrigation and stream regulation) often neglected to take into account environmental factors. Using only technical methods was much easier.

5. Farmers and their relationship to drainage

Agricultural workers' general attitudes towards their work and the land had changed significantly as a result of collectivization. H. Librová (1988) postulates that with the elimination of private land ownership, farmers no longer felt a strong connection to the land. She notes, "at the same time it is important that the relationship of farmer to field was above all relationship with his private property" [6] (p. 129). She attributes this previous relationship, in which farmers were extremely dedicated to the careful stewardship of their land, as a source of secondary ecological landscape homeostasis.

Ecologist P. Trpák takes Librová's theory one step further. Whereas farmers were socially disconnected from their land as a result of collectivization in the 1950s, in the 1970s they were physically disconnected from the land. As collective farms grew in size in the 1970s, and cooperation intensified, farmers could find themselves for example working 3 days a week on fields 15 km from their homes, and two days working on fields 30 km from their homes. They soon stopped caring what was going on in the fields around their home village (Vaněk 1996).

Librová (1979) conducted a telling sociological experiment about the rural dweller's and the farmer's view of the practice of draining meadows and then converting them into arable land in the adjacent villages of Kameničky and Chlumětín in the Bohemian-Moravian Highlands. All villagers were posed the question, "You might have heard of the intention to plow the meadows in our village and change them into fields; corn would probably be cultivated here. What is your opinion?" (Librová 1979, p. 259). 52 % of the respondents thought the meadows should remain as is, whereas 32 % where in favor of plowing them. Of those that supported the meadows 50 % expressed aesthetic or ecological reasons, 31 % doubted the prospects of raising corn in the region and 13 % stated that the meadows are necessary for producing livestock fodder. The results showed that respondents who were not financially dependent on the meadows, i.e. not agricultural workers, were more frequently in favor of the meadows. This implies that the farmers were more apt to support the plowing of the meadows.

If agricultural workers' opinions about drainage ranged from neutral to positive, farm management was definitely in favor of drainage, especially in sub-mountainous and mountainous regions. For example in the village of Újezd in the Žďár nad Sázavou district, where 30 % of all agricultural land had been drained by 1973, yields per hectare of almost all major crops had increased markedly in comparison with the 1930s (the interwar years were very productive years): rye by 148 %, flax by 157 %, oat by 159 %, wheat by 162 %, fodder beet by 175 %, barley by 215 % and hay by 319 %. Only potato yields had decreased. Of course these increases could not be attributed to drainage alone. However, drainage allowed other intensification measures, such as artificial fertilizer and pesticide use, to be more productive. These combined factors had the most effect on drained meadows that were subsequently plowed. Due to significant results like this farms were clamoring for soil drainage (Štryncl, Legát 1974).

One interviewee recalled a conversation he had with the chairman of a collective farm about draining and plowing up meadows in which he questioned these practices: "I know that once I had a word with [collective farm] chairman Stejskal from Světnov. He had an argument against which I could hardly say anything. He said to me, 'But sir, but we grow two to three times more fodder crops for the cattle on arable soil than what that meadow would give us'" [7] (Prudký 2008). Based on these examples we can see that farm management saw the positive economic contribution of drainage to their farms. Considering that farms did not have to pay for drainage any increased production was a clean profit for them.

It should also be noted that farm management was responsible for ordering drainage construction through the various branches of the State Amelioration Administration. They would supply a list of areas that needed drainage on their farm. The State Amelioration Administration was required to release funds, conduct a soil survey, get a building permit and contract a design and construction company to carry out the work. Often all of the requested drainage was not done at once, but over time in accordance with the existing five-year plans for land drainage. Essentially there was no way for the State Amelioration Administration to refuse funding to farmers (Janšta 2008).

This process of requesting drainage work was often not based on accurate scientific, technical nor environmental knowledge. For example in the second half of the 1960s district amelioration programs were created, which listed all of the drainage requested by farms, and served as a tool for planning drainage construction:

> *"It was called the amelioration program, which included soil drainage, soil irrigation and maybe some anti-erosion measures, and there was very little time to do it. I don't know if it was because of planning, but sometimes that time simply just got lost. Well a completely clear directive was given. We'd come to a cooperative with a set of 1:5000 scale maps. Those maps were opened up in the office, where the chairman and the plant man, in other words the agronomist, were present. And there they showed which areas were water-logged, or where they wanted irrigation. And he, rather I, as a technical worker, drew it into those maps and then would do a write-up. The chairman of the cooperative, the agronomist and I signed that write-up, and it was taken with the maps to an office, and there they simply [...] Therefore, a creative approach, a discourse about this, and so on. There was no time for that and it wasn't expected at all. Instead it was completely formal, completely based on trivial, pragmatic experiences. Yes, the good experience of the people who worked there on those fields, but who, [didn't ask] why it was water-logged, if drainage would help, what would it be good for, if it can be done there and so on. It didn't work"*[8] (Ungerman 2008).

Therefore we can see that initial drainage construction planning was not based on accurate field surveys by trained experts. Instead, the trained experts merely recorded areas which needed drainage on the basis of the suggestions of agricultural workers, who often did not fully comprehend the science behind water-logging. Granted, accurate soil surveys, and more detailed planning were conducted before construction began, but none-the-less the impetus for all drainage came directly from farms and had the potential to be unintentionally misguided. As it was free however, many farms opted to drain all possible sites to ensure maximum yields.

The fact that drainage construction was fully funded lent it to even worse abuses as this anecdote from near Veselí nad Moravou indicates: "[...] the chairman of a cooperative, an agricultural cooperative, wanted to have some land drained. When we told him it wasn't necessary his argument was that he couldn't get there in his car when he would go and check agricultural work[9]" (Tlapák 2008). In this situation drainage was not intended to increase yields; its sole purpose was to make one of the farm chairman's tasks more comfortable for him. Even though the interviewee refused to do this work, the farm still had the funds available for this work and it was eventually done by someone else.

However, farm management was not always so blind to the natural aspects of the land they were responsible for. The very same chairman who praised the economic advantages of plowed up meadows was also a sometimes ally of nature conservationists in the Žďár region surprisingly enough. When the Žďárské vrchy were declared a protected landscape area in 1970, conservationists gained more authority:

> *"Understandably they recommended us some things that were slightly in conflict with the plan, because that plan involved the liquidation of some solitary trees and some smaller groves. Considering that basically the chairman of the agricultural cooperative in Světnov, where we had our head office, was a hunter he had a pretty good understanding for keeping various refugia for game animals and so on"*[10] (Prudký 2008).

In this case the farm chairman stood up against the excessive removal of semi-natural habitats. As a hunter he understood that they had indirect benefits for the health of the entire landscape. Here we see that direct production increases were not always the top priority of farm management in all situations.

In conclusion the collectivization of agriculture radically changed the relationship of peasant farmers to the land. Peasant farmers were socially and physically dislocated from their land and therefore were no longer stewards who ensured the environmental stability of agriculture. In this period agricultural workers, even private farmers, were generally in favor of drainage.

Farm management was also in favor of drainage particularly in sub-mountainous and mountainous regions as drainage nearly always ensured increased crop yields and thus profits. Farms were responsible for ordering drainage work which was completely state-subsidized. Therefore, farms often either knowingly or unknowingly requested more drainage than was necessary. Had there been more financial pressure on these farms, less drainage systems would have been built and the negative environmental impact would have been less.

6. Economic efficiency – designing and constructing drainage systems

For all drainage projects proof of economic efficiency was officially required. Officially drainage investments were considered to be efficient if the growth of gross crop production was positive. Unofficially drainage was considered economically efficient if gross crop production was increased by 3 000 Kčs/ha. However, there was no exact, appropriate method for calculating economic efficiency, and agricultural economists dealt with this problem throughout the 1970s and 1980s. The environmental aspects of drainage and amelioration were completely overlooked as well. Indeed, drainage was responsible for certain economic losses due to its negative environmental impact. On the other hand carefully planned and carried out land amelioration could have a positive impact on the environment. None of these factors was taken into account when calculating efficiency (Kokoška 1989).

Calculating economic efficiency is not an easy task. However, we can approach the problem from a different angle. Recall that starting in the 1970s the focal point of drainage had shifted to sub-mountainous and mountainous regions. Here the conditions were much less favorable both for agriculture and for efficient drainage. Higher precipitation meant more water-logged areas. There were often many springs and peat bogs in these areas as well to drain. On top of those problems the terrain was generally quite hilly and in many cases needed to be leveled, which was costly.

Although on average drainage costs ranged from about 10 000 to 20 000 Kčs/ha under difficult conditions drainage could cost from 40 000 to 60 000 Kčs/ha when all aspects of construction were figured in. In the worst areas costs could reach up to 100 000 Kčs/ha. On top of this agriculture in these areas itself was neither profitable nor efficient, as it depended upon differential premiums. Therefore in these regions drainage could not have been economically efficient. At the same time these investments were making costly agriculture in these regions even more costly (Kokoška 1989).

For a specific example we can look at the large-scale Velké Dářko project, which was constructed between 1969 and 1973. It is located in a headwaters area and thus contains many springs. Being in a sub-mountainous region (and in parts mountainous) it was eligible for receiving differential payments. 1 524 ha of land were drained. The drainage in combination with other measures such as stream regulation came at an expense of 26,3 million Kčs. The investment turnover was set at 11 years. However, in comparison with surrounding un-drained agricultural land it was shown that this investment did not create markedly improved profits and by the early 1980s the investment had yet to be returned (Ungerman 1983). We see here the effects of differential rent II (DR II) at work: investments in intensification in poor agricultural areas do not produce favorable returns.

Based on these practices and on the interviews it seems that if economic efficiency was not in reality an important part of drainage construction. This in turn had an effect on drainage's environmental impact. There were two main reasons for this. Recall that drainage increases crop yield. As official agriculture policy called for agricultural self-sufficiency economic efficiency was overlooked. Production needed to be increased at any economic cost.

The second reason that contributed to the economic inefficiency of drainage was the fact that there was no incentive for anyone to make it more cost effective. Recall that farms were not required to pay for drainage from their own funds. Instead they received money from a special state fund. As we have just seen the state had very low standards for proving economic efficiency. Finally, planning and construction enterprises were used to receiving this money and therefore had no incentive to change their practices.

Many of the organizations responsible for planning and constructing drainage systems became adept at finding ways to spend all of the money allocated to them, which often equated to wasting money. As one interviewee stated, "The truth is, as I already mentioned last time, as long as there was money you can't wonder when someone spends it if they have it at their disposal" [11] (Pall 2008).

Several interviewees recall being involved in drainage projects that seemed to have been more about spending money than improving agricultural production:

> *"Well then . . . when I was working for Zemědělské stavby in Uherské Hradiště, I was very briefly on a site, but after that I left for the University, a rather large drainage system, where I simply went around thinking and asking myself, "Why?" Because there was no reason to drain anything. It was dry. Well that was done solely for the reason which I've spoken about here, so that they could spend money that was momentarily at their disposal in a clever way"* [12] *(Pall 2008).*

Another interviewee confirmed this idea that enterprises that planned and built drainage systems paid little attention to economic efficiency and were more concerned with making as much money as possible:

> *"But of course we said to ourselves that of course we noticed that the necessity for drainage was often exaggerated. But that was because cost of the project was based on the amount of hectares. My boss tried his best to have project prices as high as possible so that there were the highest possible remunerations"* [13] (Toman 2008).

Therefore in this case we can see that emphasis was placed on draining as much land as possible so that labor productivity quotas could be met and that employees could receive more work and thus money.[14] This type of approach contributed greatly to draining excessive areas of land. This type of exaggeration was prevalent both among planners and construction workers:

> *"There was one bad thing, which we knew about back then, that [...] Well, that it was poorly done. The procedure was flawed by the fact that systematic drainage, or large-scale drainage, was not necessary everywhere, and that quite often sporadic drainage could have dealt with it. Yeah, but they were already, were already... The investors had gotten used to getting such allocations of money. There were design companies that specialized on that type of work. Yeah and there were places like where I was, there were construction companies that had people and machines to do that work. So it had a certain inertia"* [15] (Prudký 2008).

Most interviewees stated that it was important to view the problem of economic effeciency in historical perspective:

> *"Back then when I was with one of my bosses at the Amelioration Institute I used to say I thought that it was just a bunch of money buried in the ground, money that had no meaning. Well he used to always say [...] "Anyway you look at it, it doesn't matter. You can't load it onto a train and ship it off to Černá nad Tisou." Well, maybe you don't understand that, but back then we used to export all kind of things to the Soviet Union via Černá nad Tisou. And my boss would say that at least that money is staying at home, invested with interest in the soil"* [16] (Toman 2008).

Indeed this money was not a good investment in increasing DR II in many areas and from that perspective it was essentially like burying money. However, in the warped logic of life under a totalitarian system, if money was to be spent it was better to spend it at home, than to just give it away to the Soviet Union.

To conclude the attempt to reach agricultural self-sufficiency was the main driving factor for drainage construction in the period 1960–1989. Large amounts of money were granted to collective and state farms to build drainage systems. These funds were used to pay for work done by design and construction enterprises who became accustomed to receiving these steady sources of income. As drainage plan prices were based on acreage drained, design engineers made the plans as large as possible. Construction enterprises followed suite. Generally as design engineers and construction workers had a relatively steady stream of income coming from state subsidies, and the official methodology of determining economic efficiency was quite lax, there was no incentive for them to make drainage systems smaller, more precise and more efficient. These excesses further exasperated the negative environmental impact of drainage. To summarize neatly in the words of one respondent, "so that's how the ecological side fell apart. No one took any notice of it, because it was all about money[17] (Tlapák 2008).

7. Conclusion

There were five main socioeconomic factors, which led to the negative environmental impact of drainage. Four of these factors have been discussed in detail: 1) landscape changes and their relationship to drainage, 2) drainage as a science, 3) farmers and their relationship to drainage, and 4) economic efficiency and the design and construction of drainage systems. The fifth factor which led to the negative environmental impact of drainage was the implementation of differential premiums and the introduction of intensive agriculture to inappropriate regions.

Nearly all of the factors discussed have an overtly economic aspect to them. Differential premiums, which pushed intensive agriculture and drainage to higher elevations, were guided by agricultural economic policy. They contributed greatly to improving production and solved the socioeconomic problems of unemployment in and emigration from poor regions. Drainage in these areas represented a stabilizing social factor.

Drainage construction was completely subsidized. This allowed farms to order excessive amounts of drainage. As drainage was essentially free for the farms it did them no economic harm to order as much acreage as possible drained. For them it was irrelevant if it was not economically efficient or environmentally degrading as long as it improved crop yields and profits.

Drainage design and construction companies were accustomed to receiving these funds as well. For these types of companies that were paid based on acreage it was financially beneficial to plan and construct drainage systems on as large as possible area, as they were paid by the hectare. This contributed to the largest amount of area being drained. This approach was also responsible for the excessive use of systematic drainage instead of sporadic drainage. Systematic drainage was large-scale and therefore covered much more area than sporadic drainage intended to catch springs in the spot of their origin.

Time constraints also seemed to have been a contributing factor. Presumably under the policy of agricultural self-sufficiency as large an increase in production had to be made in as quickly as possible. Taking the solely technical approach to drainage was less complicated and therefore quicker than considering more ecological alternatives as drainage engineers had been taught in school. Although some projects were more environmentally friendly than others this technical approach prevailed.

In many cases there was also no time to examine alternative designs in order to determine which was more economical. Instead drainage systems were designed and built as quickly as possible as long as they actually functioned. There was also no time to conduct accurate soil surveys during the creation of the district amelioration programs. This was done as quickly as possible as well. The political and economic aim was to achieve agricultural self-sufficiency as quickly as possible.

Drainage represents a relatively costly investment with long-term effects on agricultural productivity. The fate of these drainage systems poses a problem today. As the lifetime of drainage systems is estimated to be about thirty to fifty years the question today is what to do with these systems which are at the end of their functional lifetime. Should they be rebuilt, destroyed or left alone? Indeed, the money invested in drainage during the Communist period represented a contribution to the increase of DR II, although often in inappropriate areas. Today under more normal economic conditions a more accurate picture of economic efficiency and the environmental impact of drainage systems built during the communist era is being drawn.

As Kulhavý et al. (2006) write in the fertile lowlands drainage is unnecessary as farmers have the appropriate conditions for high agricultural productivity. Therefore in these regions drainage systems are generally not needed and represent an economic burden to agriculture. Irrigation systems are more appropriate investments here. On the other hand in sub-mountainous and mountainous regions drainage is also useless. With state subsidies for the maintenance of permanent grassland in these regions, much of the drained meadows that were converted into arable land have been since converted back into meadows. Today raising most crops in these regions is economically impossible, which of course has positive implications for the environment. The maintenance and reconstruction of these drainage systems are too costly for farmers.

Therefore, today investments into drainage systems can only represent an increase in DR II in intensive agricultural landscapes in the beet and grain growing regions (Kulhavý et al. 2006). In these regions the increase in DR II is enough to prompt some farmers to consider reconstructing drainage systems. Although costs may be high, improved yields may actually cover these costs in these areas. Currently, subsidies are being arranged, which would help pay for this reconstruction (Janšta 2008; Kulhavý et al. 2007). These subsidies have yet to be implemented. Before they are, it would be wise to examine the economic and environmental impact of drainage subsidies during the Communist regime in order to avoid the mistakes of the past.

Notes

[1)] „ Za paměti dnešních nejstarších žijících lidí se naše krajina proměnila víc než za poslední tisíciletí. V naší době, v posledních pětasedmdesáti letech, přičinily se o to zvláště podniky, kterým se říká meliorační, tj. zlepšující. Jenže po pravdě nezlepšují ani půdu, ani porosty na ni žijící, ani vyhlídky naší existence do budoucna. Půdu vysoušejí, a tím zasahují škodlivě do chemických roztoků půdních. Tím, že odvodňují kdejakou bažinu, staré rameno říční, močál a vrchovisko na výšinách, pomáhají proměnit naše podnebí v pevninské, s protikladem tuhé zimy a léta menší oblačností a s odděleným údobím sucha a lijáků. Tím, že meliorace umožňují rolníkovi poorat kdejakou pastvinu i odvodněnou nížinu, způsobují, že se vrstvy prsti odhalují, odplavují a že se nová prsť netvoří.“

[2)] Other factors, such as increased surface runoff from built up areas and poorly managed forests (i.e. spruce monocultures) to name just two, have also contributed greatly to increased flooding.

[3)] „Vytváření velkých celků […] nemělo to žádnou logiku a žádný ten reálný podklad. Prostě se vytvořily velké lány. Zrušila se ta zemědělská infrastruktura, ty meze, remízky, to co vlastně vytvářelo krajinu. Ta krajina se vlastně tím pádem ztratila i přirozená, už jsem řekl odvodňovací cesty. No a když srážky zůstaly tak jak byly dosud. No tak pochopitelně docházelo k hromadění vody a to se muselo odvést.“

[4)] „[...] to jsem opravdu od něho slyšel na vlastní uši, že ono by bylo vlastně ideální kdyby vlastně celá krajina se mohla nejdřív odvodnit, protože to odvodnění má ještě jiné aspekty, to je provzdušnění půdy, úprava toho vodního režimu, tak jako opravdu. A potom zase následně na to hned zavlažit kde je potřeba. To je opravdu takové, opravdu taková karikatura jako přístupu techniků k této záležitosti. Bylo to velmi kontrastní, ale my jako študentíci, malí študentíci nemohli tomu věřit.“

[5)] „No tak, ta technická stránka je taková přehlednější. Existují třeba normy a tak dál, o které se můžete opřít, což pokud o tu biologickou stránku je vždycky trošičku komplikovanější. No a už s ohledem řekněme na podnik,

který jsem jmenoval, čili Zemědělské stavby, tak i tím to bylo do značné míry určeno. Vlastně tím názvem, kde se jedná o stavby.“

[6] „Důležité přitom je, že vztah zemědělce k polím byl především vztahem k jeho soukromému majetku.“

[7] „Vím, že jsem jednou měl o tomhle řeč s předsedou [JZD] Stejskalem ze Světnova. On argumentoval způsobem proti kterému já jsem těžko mohl říct. On mi říkal “Ale pane inženýre, ale my na orné půdě pícniny vypěstujem pro ten dobytek dvakrát víc nebo třikrát víc, než by co nám dala ta louka.”

[8] „Meliorační programy se to jmenovalo, které obsahovaly odvodnění půdy, závlahy půdy, a možná ještě protierozní opatření, a bylo na to, eh, velice málo času. Nevím jestli kvůli plánování, nebo někdy se ten čas ztratil jednoduše. Takže byla dána zcela jasná direktiva. Přijede se na družstvo se sadou map 1:5000. Tyto mapy se rozloží v kanceláři, kde je přítomen předseda družstva a rostlinář, neboli agronom. A tam oni ukážou, který plochy mají zamokřený, nebo který na který chtějí udělat tu závlahu. A on tedy já,technik, to zamaluje do těch map a sepíše se potom zápis: zápis sepsaný dne toho a toho za přítomnosti a teď se […] k odvodnění je navrhovaná lokalita 1, rozsah, hektary, a tak dále. Tento zápis podepíše předseda družstva, agronom a já a tento zápis s těmi mapami se donese do kanceláře, a tam se to jednoduše […]. Čili nějaká, nějaká, nějaký tvůrčí přistup, nějaká diskuze o tom, a tak dál. Na to nebyly čas a vůbec se s tím nepočítalo. Čili zcela formální, zcela založený na té, na té pragmatické triviální zkuše, zkušenosti. Ano dobré zkušenosti lidí, kteří tam pracovali na těch polích, ale který, proč je to zamokřený, jestli to pomůže, když se to odvodní, k čemu je to dobré, a jestli se tam může, a tak dál. To nefungovalo.“

[9] „[...] jeden předseda družstva, zemědělského družstva, chtěl odvodnit pozemky. Když jsme mu řekli, že to není potřeba, tak nám to zdůvodňoval s tím, že tam neprojede osobním autem, když jede na kontrolu zemědělských prací.“

[10] „Pochopitelně oni nám doporučovali některé věci, které byly mírně v rozporu s tím projektem, protože tam projekt počítal s likvidací nějakých těch solitérních stromů i nějakých menších remízků. A vzhledem k tomu, že v podstatě, že předseda zemědělského družstva Světnov, kde jsme měli to ústředí, byl myslivec, tak měl celkem dobré pochopení pro zachování různých takových těch refugií pro zvěř a podobně.“

[11] „Pravda je, už jsem se o tom zmiňoval posledně, pokud byly peníze tak se nemůžete divit, že někdo neutratí, má-li je k dispozici.“

[12] „No tak ... když jsem dělal u Zemědělských staveb v Uherském Hradišti, tak jsem tam velice krátce byl na stavbě, ale to už potom jsem odcházel na univerzitu, nějakého poměrně rozsáhlého odvodňovacího systému, kde jsem prostě zamyšleně chodil a tázal jsem se, „ Proč?“ Protože tam jaksi nebyl důvod proč odvodňovat. To bylo suché. Čili dělalo se to čistě z toho důvodu o němž jsem tady hovořil, aby se nějakým způsobem šikovně utratily peníze, které byly momentálně k dispozici.“

[13] „Ale akorát jsme si říkali o tom, že samozřejmě jsme vnímali, že ta potřeba odvodnění často byla zveličena. Ale to bylo z důvodů, že cena projektů byla podle hektarů. Ten vedoucí můj se snažil aby co nejvíc, aby ta cena projektu byla co největší, aby byly co největší odměny.“

[14] However, the question of whether or not all of this planned drainage was constructed or not was another issue. Several interviewees (Toman 2008; Prudký 2008) stated that in their personal experiences the construction workers often ended up draining less land than the designs called for. However, all would be paid for as if the planned number of hectares had been drained. Official statistics also represent only the drained acreage called for in the drainage designs. Therefore in reality there may be less drained agricultural land than is officially recorded.

[15] „No, že se dělalo chybně. Chybný postup byl v tom, že ne na všech místech byla nutná systematická drenáž,takzvaná plošná, že dost často se to dalo řešit sporadickou ojednilou drenáží. No, ale už byly, už byly ... investorské firmy zvyklý dostávat takový příděl peněz. Byly projektanské firmy, které byly specializovány na tento druh prací. No a byly tak jak jsem byl já, byly prováděcí firmy, který měly stroje a lidi tady k tomu. Takže to mělo určitou setrvačnost.”

[16] Čierná nad Tisou is a a town on the Slovak – Ukraine border. – „Tenkrát s jedním svým šéfem už v Ústavu meliorace říkám, že si myslím, že je to takové peníze zakopané do země, které nemají význam. To už bylo trošičku později. Tak on mi vždycky říkal takový „To máš jedno. Nedá se to naložit na vagon a odvést do Černé nad Tisou.“ Tak možná tomu nebudete rozumět, ale tenkrát se, jsme do Sovětského svazu leccos nějaký ty výrobky odváželi překladiště Černá nad Tisou. A ten můj šéf říkal, aspoň to zůstane, jak se říká, ty peníze doma v půdě zúročený.“

[17] „Tak tím se odbourávala ta ekologická stránka. Na to nikdo nehleděl, protože to bylo všechno o penězích.”

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UNGERMAN, J. Personal interview conducted by Nicholas Orsillo. Brno, 4.1.2008.

All interviews have been recorded on CD-ROM and are available at the library of the Faculty of Social Studies, Masaryk University, Brno.

Summary

Environmentální důsledky a ekonomické souvislosti meliorací zemědělské půdy v Česku 1960–1989

Článek tématicky spadá do Worsterovy „třetí roviny“ environmentálních dějin, zkoumající odraz interakcí společnosti a přírody v politice, právu, umění, kultuře atd. Je založen na konfrontaci „teorie“, tj. záměrů a cílů zemědělské politiky KSČ a konkrétní praxe jejich dopadů na krajinu, měřených vývojem a vlivem meliorací zemědělské půdy zejména na jižní Moravě. Během období komunistického režimu v Česku měly snahy o intenzifikaci zemědělství značně negativní vliv na životní prostředí. Meliorace zemědělské půdy, jako jeden ze způsobů intenzifikace je zde detailně zkoumána. Studie je založena nejen na literatuře, ale také na řízených rozhovorech se specialisty, kteří ve sledovaném období meliorace zabezpečovali na různých úrovních, příp. se zabývali výzkumem jejich environmentálních důsledků. Dále autor vycházel statistických pramenů a primárních pramenů včetně programových materiálů komunistické strany Československa týkajících se její zemědělské politiky podřízené hlavnímu cíli, dosažení potravinové soběstačnosti Československa. Její dosažení je hodnoceno kladně. Šlo však o to, jakými prostředky a nástroji, za jaké náklady a ztráty ekologické. Autor zejména charakterizuje pět primárních socioekonomických faktorů, které ovlivňovaly environmentální dopady meliorací v období 1960–1989, bylo to: 1) tzv. diferenciální příplatky, které napomáhaly provádět meliorace i ve vyšších polohách, tedy na půdách ekologicky zranitelnějších; 2) fyzikální změny v krajině vyžadující rozsáhlé meliorace; 3) na technické aspekty meliorací byl kladen větší důraz než na jejich aspekty biologické; 4) zemědělci meliorace podporovali, neboť zvyšovaly výnosy přičemž náklady na ně byly kompletně hrazeny státem; 5) nedostatek tlaku na zvyšování kvality melioračních plánů vedoucího ke zlepšování jejich ekonomické efektivnosti.