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Soil and climatic conditions as a main factor of draining meliorations in the Bahna Valley, Ukraine

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Abstract

The article studies the leading factors of influence on draining meliorations in the Bahna Valley, such as soil cover and climatic conditions. The main types of soils are determined: Gleysols Umbric, Gleysols podzolic; Gleysols ferrum (rusty) podzolic; Podzoluvisols Stagnic; Phaeozems, slightly podzolic and sandy; Gleysols Umbric and Fluvisols Umbric and peat; Gleysols podzolic surface-bogged. It is established that the distribution of precipitation, which accounted for the warm season (70-80% of the annual norm), was a key factor among the climatic conditions in the region. It has been found that the valley may have a relative humidity of more than 90% within 100 days of a year and a relative humidity of 30% only within 20 days. The influence of Ukrainian Carpathians and adjoining flat territories results in specific conditions of humidification. It has been discovered that a great amount of precipitation (750-800 mm) and moderate annual temperatures contributed to the accumulation of excessive moisture that led to the boggy pedogenesis. The latter causes the formation of different swamped and boggy soils. The

prevalence of the oversaturated soils in Bahna valley determined the need for drainage reclamation in the region.

Key words: Bahna valley; drainage reclamation; soil and climate conditions.

Relevance of research. Land draining meliorations, along with other agro-technical and science-based measures, plays an extremely important role in providing the population with agricultural produce and improving its overall well-being. This is especially true in the Chernivtsi region, in particular the Bukovina Precarpathian region, where land use in the foothills is complicated by the small contours of the fields, dense hydrographic network and oversaturation of soils. This was the reason why the reclamation system had been established in the territory of Bahna valley, since the reign of Austro-Hungary in Bukovina. The need for its existence and operation has not disappeared so far. Because of this, the study of various conditions and factors that have an undeniable impact on it remains relevant today.

The purpose of the study was to identify the influence of geographical factors, namely soil and climatic conditions of the territory on the formation and functioning of the melioration system in Bahna valley. Based on this goal, the main **task** was to determine the geographical prerequisites, in particular soil and climatic, for the formation of the Bahna reclamation system.

Analysis of the literature. The issue drainage reclamation has been repeatedly covered in the scientific works of researchers of many countries. Most scholars working on this topic are trying to comprehensively approach to the problematic issues based on studies of certain regions, and therefore take into account primarily the regional features of the territories. Among the scientific works, devoted to the issue of drainage reclamation are: Okonov and Dedova (2015), who submitted an assessment of the current state of reclamation regime of natural and anthropogenic complexes of Kalmykia. The water-physical properties of the dried peat soils of the Northern Trans-Ural Forest Steppe Zone are given in the works of Motorin, Bukin, and Iglovikov (2017). Łabaz and Kabala (2016) described the siltation of the soil cover of swamp dry alluvial soils. Gurklys and Kvaraciejus (2013) in their work addressed the issue of reconstruction of drainage systems. Rokochinskiy et al. (2017) gave a comparative assessment of different approaches for determining the parameters of agricultural drainage. The degree of subsidence of peatlands resulting from drainage reclamation is described in Grzywna (2017). The work of Kouid (2019) is about land reclamation in Byelorussian Polissya as a factor of modernization of the Soviet periphery. Šoštarić et al. (2016) described the state of drainage and irrigation systems in Croatia. Shchedrin et al.

(2018) wrote about the reclamation environment as a sphere of public interest. Vikhrov (2011) addressed the issue of modeling and parameters of reclamation of oversaturated soils. Works of Shabanov and Markin (2017) are devoted to the issue of area ranking for integrated land reclamation regulation.

Bahna Valley itself was mentioned in the first geological surveys related to the development of salt springs, which were discovered and investigated in 1876 by Kelb (Kovalevsky, 1949). Bahna Valley was first described as “a dead valley” in 1914 by Pavlovskiy (Pavlovskiy, 1914). Later on, Bratescu (1928), a Romanian researcher, depicted river interceptions in Bucovina where Bahna Valley was also mentioned. In the beginning of 20th century geologic survey in the region was started, aiming at discovery of oil, gas, shale oil, brown coal, gypsum, rock salt, potassium, and mineral waters. In-depth studies of the valley as a unique natural object were started by the researchers of Lviv and Chernivtsi universities and state geological agencies of “Ukrigas”, “Wuhlerozvidka”, and “Naftorozvidka” in the mid of 40s (Kovalevskiy, 1949). Nowadays, researchers of Chernivtsi University pay attention to local geological, geomorphological, and hydroclimatic conditions of the valley landscapes. In particular, Cherneha (1997) proposed the physical and geographical division of Bucovina Carpathians into regions where Bahna Valley is distinguished as a separate unit. Seasonal features of local climate of Bahna Valley are highlighted in the works of Kynal (Kynal & Krogulecz, 2009; Kynal et al., 2011). The assessment of anthropogenic influence on the basin ecosystems on the example of the Siret River is provided by Sukhyi et al. (2012). Hydrological aspects of the water catchments are identified in the work by Yushchenko and Pasichnyk (2012). Tsapok (Tsapok, 2015) recently analysed landscape peculiarities of the region.

Regional setting and methods

Bahna valley is located in the Storozhynets and Vyzhnytsia districts where the issue of drainage reclamation is very relevant. Bahna valley is considered to be an intaken part of an ancient valley of the Cheremosh River that stretches 20 km to the east from the Vyzhnytsia town with the width of 5 km (Herenchuk, 1954, 1956, 1974, 1975; Kozhurina, 1957, 1958; Hoffshstein, 1964; Tsys, 1951, 1954; Lebedev 1957; Prohodskiy, 1956; Kravchuk, 1999). Two insignificant rivers Mihydra and Myhoderka flow on the broad and marshy valley floor, the scale of which does not coincide with the scale of Bahna valley. The 20-30-meter layer of boulder and pebble deposits and the valley shape point to the fluvial genesis (Herenchuk and Mukha, 1974). The latter means that Bahna Valley was formed by a big river with a significant transport power. The valley is distinguished for its flat and slightly wavy

watersheds, almost even with an insignificant slope, slightly drained and broad marshy floor. The valley has an abrupt ending with a precipice toward the Cheremosh River Valley (Hoffshtein, 1964; Hoskomvodkhoz Ukrainy et al., 1994).

The set of methods was applied for the study of given task, in particular: literature review, field observations, geomorphological, lithological, petrographical and mineralogical methods. Besides, geocological and geophysical methods contributed to the detection of relationships between the environmental factors. All the methods are complementary. Consequently, they are used in the combination with each other to enhance the comprehensive analysis of environmental conditions.

Results and discussion

Climatic conditions. The climate in the territory is temperately continental and humid with relatively warm summer and autumn, mild winter (Table 1, Kuchynskyi, 1961; Kynal et al., 2011). In summer the valley gets 1400 mJ/m² of irradiance. The annual sum of incoming solar radiation is 3400 mJ/m² while the annual value of radiation balance reaches 1350 mJ/m². The annual mean value of albedo is 23%.

Wind conditions are caused by the presence of the Carpathian mountain structure and the adjoining flat area. In the cold period of a year air masses from west and southwest are dominant. In the warm period, north-western and south-western winds are the most frequently detected. The average speed in the valley is 3.2 m/s. Cyclonic activity is especially high in the cold season, while anticyclonic types are more frequent in summer.

Thermal regime is primarily caused by the orographic influence of low-mountain ridges of the Bucovina Carpathians and slopes of Brusnytsia and Cheremosh highland and only its general background is determined by radiation and circulation processes of the atmosphere. Annual isotherms coincide with the orographic pattern of front ranges (Kynal & Krogulecz, 2009). The main features of thermal regime in the Bahna Valley are the following: duration of free from frost period reaches 130-150 days per year; number of days with temperature above 0°C is 245-260 days; above +5°C – 195-210; above +10° – 165-180; and above +15°C – 60-100 respectively; sum of active temperatures above 10°C – 2400 °C; average monthly temperature of July – +18...+19°C; in winter months (DJF) average monthly temperatures may be lower than 0°C; average monthly temperature of January – -5°C (Table 1); absolute maximal and minimal temperatures are – +33 and -34°C accordingly (Natsionalnyi atlas Ukrayiny, 2007).

Draining, while being one of the most popular melioration methods, can result in significant changes of microclimatic conditions due to the modification of radiation and heat

balance. The latter means that because of the surface drying and the effective radiation increase, the decrease of evaporation and heat exchange in soil has place (Shcherban, 1980). Alongside, the intensity of turbulent heat exchange with drying surface and atmosphere may increase. It should be noted, that specific peculiarities of microclimatic contrasts can also depend on microrelief and land use (Kuchynskyi, 1961; Kynal & Krogulecz, 2009)].

Distribution of precipitation is congruent to the altitude and relief features. Average annual precipitation is 750-800 mm. An apparent prevalence of precipitation is in the warm period (70-80 % of annual sum). Average precipitation in cold season is 175 mm, warm period – 600 mm. In separate years diurnal precipitation may reach 200 mm. Relative humidity may constitute 90% in the valley during consecutive 100 days. Besides, relative humidity can be 30% only 20 days due to the orographic influence of the Carpathians. Additionally, the significant number of cloudy days (around 150 days) is observed.

Table 1.

Average values of climate parameters in Bahna Valley

Months											
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Air temperature (°C)											
-5.0	-3.5	1.5	8.3	14.3	17.4	18.5	17.9	13.5	8.1	2.0	-2.1
Relative humidity (%)											
84	84	78	69	70	71	72	74	79	82	87	88
Precipitation (mm)											
29	27	87	75	49	110	93	65	58	40	35	31

The next atmospheric phenomena are characteristic for the region: glazed frost, blizzards (10 days per year), thunderstorm (35 days per year), hail (2-3 days per year). Fogs, thaws during foehns, and strong winds during cyclonic weathers are frequent as well. Dew, mist, torrential and durable rains as a result of intensification of atmospheric fronts over mountains is observed in the warm period of year. First frosts start in October and may occur until April.

Cold period of a year starts in the second half of November and finishes in the second decade of March. Winters are, as a rule, unstable: frost days are followed by thaws that sometimes lead to the total melting of snow cover. In average, 20 cloudy days during winter are observed. High relative humidity and frequent fogs are specific for winter. The number of days with snow cover may reach 70 days. Uneven snow distribution is found to cause soil freezing (Kynal, 2011). Maximal depth of soil freezing is 67 cm. Duration of snow cover in

separate years may be several months: from second decade of December till second-third decade of March. Because of frequent thaws snow cover is unstable. 10-15% of winters are detected to be without snow cover at all. Average height of snow cover is 25 cm while maximal may reach 50 cm.

Spring starts in the second decade of March, though it may start 10-12 days later or earlier. Late spring frosts are observed to frequently return.

Summer starts about in the end of May. An average summer temperature ranges from +18 to +20° C. Summer precipitation has a stormy nature.

Autumn starts in the first decade of September. Too clear sunny, calm and warm weather (September and first decade of October) is another apparent feature of autumn. First autumn frosts start in the end of September and in October. So, in general, the area has a moderately warm humid climate.

All the mentioned meteorological features are the evidence of warm and humid climate that is favourable for agricultural use. Agroclimatic resources are the part of climatic resources that determine the agriculture potential of the area and reflect the climate properties significant in farming. Heat and moisture are the key determinants of agriculture production and its zonal specialization. Agroclimatic resources determine location, content and structure of croplands, the list of field, vegetable and fruit crops, their growth, development, and productivity.

The main parameters of agroclimatic resources in Bahna Valley will include *sum of positive temperatures* (average daily temperatures above 0°C) in the warm period of year (from April till October) that reaches 3000 °C, *sum of effective air temperatures* (average diurnal temperature above +5°C) – 1600 °C, *sum of active temperatures* (average diurnal temperature above +10°C) equals 2400 °C. Other agroclimatic characteristics are connected with the start of winter season, in particular *first frost in autumn* (average date) – 15.X, *last frost in the air in spring* (average date) – 20.IV, *fixation of free from frost period in the air* (average duration) – about 170 days, *first frost on the soil surface in autumn* (average date) – 1.X, *last frost on the soil surface* (average date) – 10.V, *free from frost period on the soil surface* (average duration) – 150 days. An important agroclimatic parameter is *duration of vegetation period* with the number of days with average air temperature equal and above +5°C, which reaches 230 days in the region, and *duration of active vegetation period* with the number of days with average air temperature equal or above +10°C which doesn't exceed 170 days. Finally, among other important agroclimatic characteristics we'll mention *precipitation sum during the time of active vegetation* that reaches 420 mm on the territory of Bahna valley,

reserve of productive moisture in soil in autumn (in one-metre layer under winter wheat) that doesn't exceed 180 mm and *reserve of productive moisture in soil in spring* in the first decade of April (in one-metre under ploughing) that is up to 220mm. All data is calculated according to the Natsionalnyi atlas Ukrayiny, 2007.

According to agroclimatic zoning, the area of Bahna Valley goes to the agroclimatic zone of excessive moistening with hydrothermal coefficient – 1.6-2.0 (Natsionalnyi atlas Ukrayiny, 2007). The latter is determined with the ratio of precipitation sum during the period with temperature above +10°C to the sum of positive temperatures.

Soil conditions. The soil cover and its distribution in Bahna Valley are closely related to relief, composition of parent rock material, and precipitation regime and are specific to the natural foreland zone. Alongside, climatic conditions play the determinant role in the formation of soil cover. Because of the significant sum of precipitation and relatively low temperatures during the year, the accumulation of excessive moisture leads to the downward flow of atmospheric waters. The waters penetrate deep in soils and result in dissolution and washing of nutrients out of soil horizons. The conditions form flushing type of water regime that contributes to the development of podzolic processes (Polchyna, Nazarenko et al., 2008). Accordingly, the majority of soils in the region are podzolic. Besides, the excessive moistening of the soil profiles leads to the formation of different types of half-bog and bog soils. Parent rock materials of Bahna Valley are diluvia and alluvial deposits that are formed as a result of accumulation of materials from the Carpathian Mountains, the activity of the ancient Cheremosh River, and modern fluvial processes.

Soil cover of the area is represented with *Gleysols Umbric soils* that are dominant on the flood plains; *Gleysols podzolic soils* mostly occur on the first terraces above the flood plain; *Gleysols ferrum (rusty) podzolic soils* are the feature of the second terraces above the flood plain; *Podzoluvisols Stagnic* are found on the small hilly chains of the second terraces. *Phaeozems, slightly podzolic and sandy* with humus horizon of different depth are prevalent on the second terraces. The depressions of second terraces are covered with *Gleysols Umbric and Fluvisols Umbric* and peat soils (Polchyna et al., 2004). *Gleysols podzolic surface-bogged soils* are found on the third and upper terraces of right and left banks of the Mikhydra and Mikhoderka rivers (Kuchynskyi, 1970).

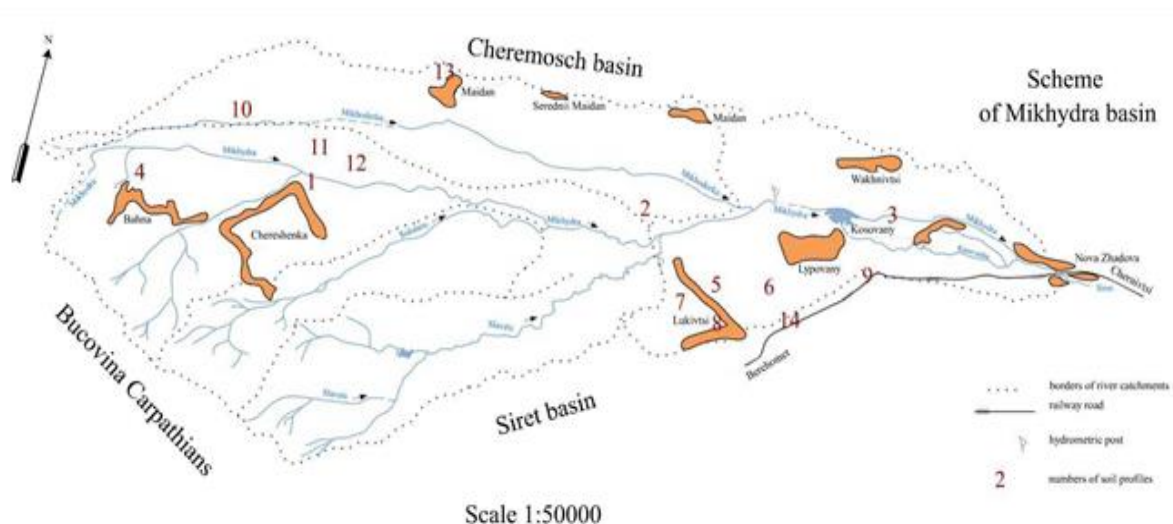


Figure 1. The basin of Mikhydra river and locations of soil profiles

For a complete picture of the representation of the distribution of genetic types of soils, we characterize the soil profiles obtained from the field studies (see Fig. 1). We have described soil profiles from different parts of Bahna valley to cover as much territory of the survey as possible.

Thus, **Profile № 1** located on the flood plain of Kamianyi brook, near the bridge, near the village Cheresenka belongs to Gleysols Umbric soils:

0-16cm – brown and grey humus horizon with sod;

16-45cm – gleyic sandy clay, on the depth of 45cm – topwater.

Profile № 2 is near the road that crosses Mikhydra and Mikhoderka and belongs to Gleysols podzolic soils:

0-6cm – dark grey humus horizon with some sod on the surface;

6-55cm – almost white podzolic horizon with inclusion of small rusty spots, rather solid and unstructured;

55-120cm – ochre and rusty, very solid loam with bright red spots, prismatic and lumpy structure up to the bottom, deeper blue podzolic flows are detected;

120cm – blue gleyic, solid, boggy, rather humid, on the depth of 140cm – groundwater.

Profile № 3 is located between rivers Kosovanka and Mikhydra, to the northeast of village Lypovany, covered with meadows and a lot of equisetum and belongs to Gleysols podzolic soils:

0-64cm – dark grey with brown shade, humus horizon, rather friable, in the upper part – with clods and grains; lower – only clods, in the bottom gley is noticed; there abrupt transit to lower horizons;

64cm – slightly blue, soil, wet gleyic with a significant number of brown spots and equisetum roots.

Profile № 4 is deposited in the village Bahna near the road to the brick factory and belongs to Gleysols ferrum (rusty) podzolic soils:

0-27cm – arable layer, light grey, solid loam;

27-60cm – podzolic horizon, slightly white with some rusty spots; solid loam;

60-130cm – brown and ochre loam with grey flows;

130cm – ochre solid loam with pebbles and gravel.

Profile № 5 is located near the road in village Werkhni Lukavtsi and belongs to Gleysols ferrum (rusty) podzolic soils:

0-25cm – dark grey arable layer with some ferriferous concretions, sealed loam;

25-60cm – slightly white podzolic horizon with a significant number of ochre and rusty spots and black inclusions of manganese oxides, solid loam;

60-85cm – brown and ochre loam with grey flows, solid, prismatic, gleyic;

85cm – rusty and ochre, very solid loam, with black spots, rather gleyic, with lumps.

Profile № 6 is located in the area of villages Nyzhni Lukavtsi and Lypovany and belongs to Gleysols ferrum (rusty) podzolic soils:

0-27cm – grey with brown shade, loamy layer with clods;

27-70cm – grey podzolic horizon with a significant number of rusty spots, flows and inclusions of manganese oxides;

70-100cm – brown and rusty solid loam (clay) with grey flows and black spots;

100cm – ochre and rusty loam, with gleyic spots and flows, very solid.

Profile № 7 is deposited in the village Werkhni Lukavtsi where Podzoluvisols Stagnic soils occur:

0-20cm – light grey with brown shade cropland layer; rather friable, loam with clods;

20-39cm – brown podzolic horizon, sealed loam, rusty spots and few ferriferous concretions are absent;

39-70cm – red and brown solid loam with a nut structure and few manganese spots;

70cm – ochre and yellow solid loam with prismatic structure, gleyic flows and pebbles.

Profile № 8 is located near the highway in the village Werkhni Lukavtsi (arable land, clover), where Phaeozems, slightly podzolic and sandy soils were formed:

0-50cm – grey friable sandy humus horizon with lumpy structure and brown shade;

50-120cm – dark yellow sandy layer, homogenous, with small spots of humus in the upper part;

150cm – sandy layer with pebbles; groundwater is absent.

Profile № 9 is deposited on the right bank of river Siret and between villages Nyzhni Lukavtsi and Zhadova, 300 meters from the river (arable land, corn), where Phaeozems, slightly podzolic and sandy soils were formed:

0-20cm – arable layer with brown shade, friable, sandy, with a low-defined lumpy structure;

20-48cm – brown sandy horizon, with humus flows and spots, undefined structure;

48cm – yellow friable sandy horizon with inclusions of pebbles.

Profile № 10 belongs to the locality Bahna, where Gleysols Umbric and Fluvisols Umbric and peat occur:

0-4cm – forest bedding, mainly moss;

4-25cm – grey podzolic horizon with rusty inclusions, loam;

25cm – rusty and ochre solid, slightly gleyic loam with a large number of black manganese spots; soil water is detected on the depth of 50cm.

Profile № 11 is located in locality Sysna (meadows with grass), where Gleysols Umbric and Fluvisols Umbric and peat occur:

1-11cm – almost black peat horizon with moss cover;

11-18cm – light grey horizon with some humus, with rusty inclusions, loam;

18-40cm – almost white horizon with fluid rusty inclusions; sealed loam;

40cm – grey and blue solid loam with rusty spots; soil water on the depth of 55cm.

Profile № 12 belongs to locality Sysna (pasture) and is represented by Gleysols Umbric and Fluvisols Umbric and peat soils:

0-25cm – black and brown peat horizon with moss cover and a lot of roots;

25-65cm – podzolic horizon, white, with fluid rusty spots; sealed and boggy clay;

65cm – rusty and grey solid clay with a large number of gleyic spots and flows, wet in the bottom.

Profile № 13 is located on the high terrace near village Maidan (areal land), where Gleysols podzolic surface-bogged soils were formed:

0-20cm – arable, light grey with slightly brown shade, sealed loam;

20-35cm – white podzolic horizon with some small ferriferous concretions, sealed loam;

35-95cm – red and brown solid loam with white flows in the upper part and black inclusions of manganese oxides in the lower part; gleyic tracks are absent;

95cm – rusty and brown solid loam, with gleyic flows.

Profile № 14 is deposited on the high terrace with sparse growth of trees, to the east of the village Nyzhni Lukavtsi, where Gleysols podzolic surface-bogged soils occur:

0-3cm – forest leaf litter;

3-26cm – white podzolic horizon with light grey shade, sealed, with some ferriferous concretions;

26-85cm – red and brown solid loam with white silica flows in the upper part; prismatic; black inclusions of manganese oxides in the lower part;

85cm – the same loam, but with a large number of gleyic spots, flows, and black inclusions.

Based on the above characteristics of soil profiles, we first note that the most widespread in Bahna valley are Gleysols ferrum (rusty) podzolic and Gleysols Umbric and Fluvisols Umbric and peat soils (3 soil profiles for each of them). Gleysols podzolic, Phaeozems, slightly podzolic and sandy and Gleysols podzolic surface-bogged soils are slightly less common (2 soil profiles for each). Gleysols Umbric and Podzoluvisols Stagnic soils have an episodic presence (1 soil profile for each).

It should be mentioned, that the main reason for reclamation in Bahna valley are soil and climatic conditions and the drainless character of the area that lead to the worsening of physical and chemical properties of soils. A very solid and waterproof horizon is detected at the surface or at an insignificant depth of 0.5-3.7 m that serves the aquiclude for atmospheric precipitation (Figure 2). The horizon is formed by heavy loam and clay in some sections can be covered with insignificant (up to 0.5 m) soil layer. The lithological and mechanical composition of soils located in the northeastern part of village Lypovany of Bahna valley is shown in Table 2. Thus, having analyzed 14 points within the researched territory, it is detected that on the almost flat surface (angles of bedding range from 1° to 2°) with an absolute altitude 395-400 m the level of groundwater ranges from 1.8 to 2.7 m within the area. The soil cover in this area is characterized by low power. This can be traced from the points 2, 4, 6, 8, 9 and 12. The thickness of the soil layer here varies from 0-0.1m and 0-0.2m at points 2.6.8 to 0-0.5m at points 4 and 12. Eight profiles were found to have no soil layer at all (points 1, 3, 5, 7, 10, 11, 13, 14), and at points 4, 6, 8 and 12 clays are deposited

immediately below an insignificant layer of soil. Consequently, water cannot infiltrate into soil and temporary stagnation of atmospheric waters occurs that results in the formation of gley and water logging of the surface.

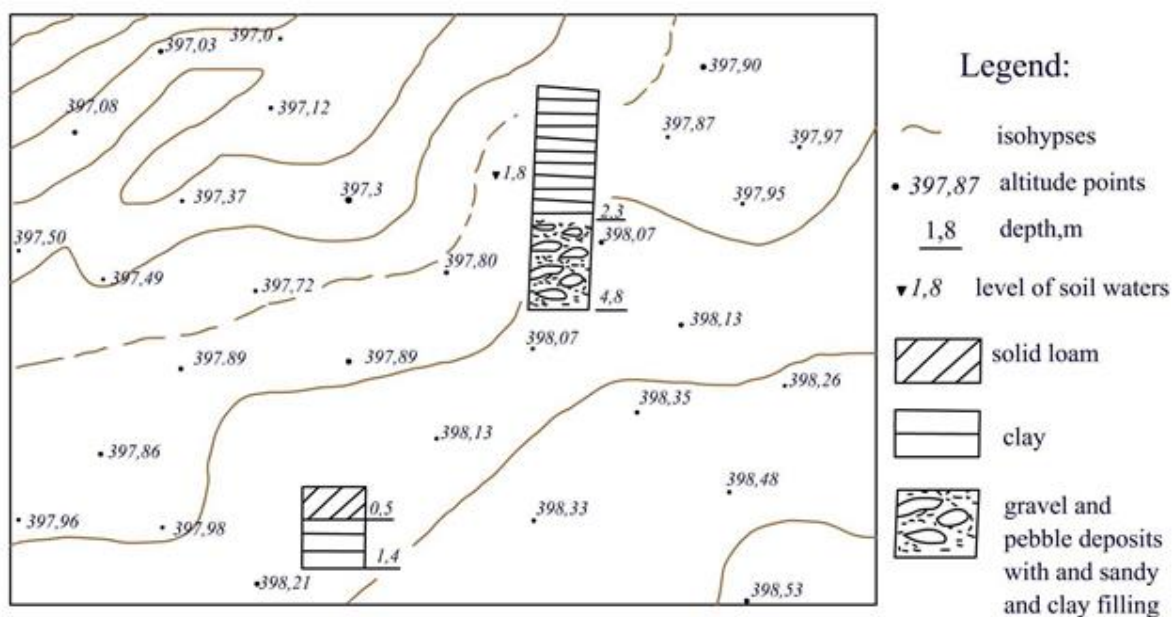


Figure 2 Lithology of surface rocks in the Bahna Valley (north-eastern side of village Lypovany) (fragment)

Table 2

Lithological and mechanical contents of surface rocks in Bahna Valley (north-eastern outskirts of village Lypovany)

№ of site	Absolute altitude, m	Level of ground waters, m	Lithological and mechanical content of soils, m			
			Soil	Heavy loam	Clay	Gravel and pebble layer
1.	396.62	-	-	0-1.3	-	-
2.	396.47	2.1	0-0.1	0-2.2	-	2.4-4.0
3.	395.56	-	-	0-1.0	1-1.3	-
4.	396.16	2.7	0-0.5	-	0.5-3.7	3.7-5.0
5.	396.87	-	-	0-0.5	0.5-1.3	-
6.	398.07	1.8	0-0.2	-	0.2-2.3	2.3-4.0
7.	398.21	-	-	0-0.5	0.5-1.4	-
8.	398.51	2.4	0-0.2	-	0.2-2.2	2.2-4.0
9.	399.31	2.5	0-0.3	0.3-3.3	-	3.3-5.0
10.	399.16	-	-	0-0.1	1.0-1.4	-
11.	398.76	-	-	0-0.3	0.3-1.3	-
12.	399.81	1.9	0-0.5	-	0.5-3.5	3.5-5.0
13.	399.60	-	-	-	0-1.5	-
14.	400.00	-	-	-	0-1.4	-

Conclusions

Bahna Valley drainage reclamation system is the biggest and the most ancient system in Bukovyna Precarpathians. It has a long history of development, specific natural conditions, so it is quite an interesting object of study in both natural and anthropogenic terms.

The area belongs to the agroclimatic zone of excessive moistening with high hydrothermal coefficient. Another negative condition is that physical and chemical properties of the soils that are presented with Gleysols Umbric and Fluvisols Umbric soils are modified with an insufficient natural drainage. Consequently, reclamation measures in Bahna Valley are determined with the soil and climatic conditions. Already on the surface or on the insignificant depth, the dense waterproof layer is formed that serves the aquiclude for atmospheric moisture. The soils are found to be viscous in the humid state while in the continuous dry conditions the soil surface becomes cracked with a solid crust. As a result, the agriculture activities start much later in comparison to the neighbouring regions. The mentioned local soil and climate conditions are found determinant in traditional for the region drainage reclamation to diminish excessive moisturing and improve agriculture properties of soils in Bahna Valley.

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