

**STREAMS AND SALT-WATER SOURCES:
ETHNOMANAGEMENT, CURRENT MANAGEMENT
AND SALTScape IN THE MOLDAVIAN AREA
(CATCHMENTS OF SIRET AND PRUT, ROMANIA)**

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Abstract

This study aims to highlight the importance of water reserves in the life of local communities and to quantify the value of basic elements that can affect their chemical properties (salinity, pH). Most waters in eastern Romania are affected by a relatively high degree of salinity; they are very hard or they are practically polluted. The waters within the Carpathian mountainous and sub-mountainous areas can be influenced directly by the emergence of salt deposits at the surface. Waters in the Moldavian plateau are influenced by the emergence of sources supplying from the water table, which washes out the salinized substrate. There is an obvious difference between the salinity degree of the sources within the salinized areas and that of the corresponding hydrographical arteries. The most salted sources are found in the area of Moldavian Subcarpathians, where the salt deposits emerge at the surface. The low salinity of bigger arteries is provided by the important liquid flows, which dilute the amount of salts. High salinity and pH are recorded mainly in case of small rivers, with low flows. Salt-water sources are used locally; in this respect, there is a traditional folk management (ethnomanagement); they find a positive use in household consumption, in food preservation, in cheese making in isolated mountainous folds, and in protecting fodder against rodents. The ethnoarchaeology of salt-water sources highlights the past and present usage of salt waters in the catchments of Siret and Prut (Moldavia, Romania). Salt waters have contributed to ensuring food (through conservation) during non-productive seasons. Paradoxically, the ethnomanagement of salt waters is a local success, while modern management must further develop in order to ensure a high quality of freshwaters. Soil salinity provides a unique landscape, with specific plants, animals and customs, known as saltscape. This is dominant in areas with excess NaCl or KCl salts.

Keywords: chemistry, ethnoarchaeology, landscape, springs, hydrographical network

INTRODUCTION

Salt deposits in Romania are extremely big and they are cantoned in the Transylvanian depression and in the extra-Carpathian area situated between the Moldavian valley to the

north and the Motru valley to the west (The Moldavian, Curvature and Getian Subcarpathians) [1-6]. These salt deposits were formed in lagoons and epicontinental seas [7-12] (Fig. 1).

The issue of salt genesis and evolution is treated by geology and by geomorphology to the same extent. The geographical literature highlights the origin of the salts within ocean waters: they come from the Earth's crust, as result of dissolution, through streams. On

principle, the primordial water was a freshwater. Consequently, salt follows a geological cycle: it is dissolved from the Earth's crust, transported by rivers, accumulated in seas and oceans, redeposited as deposits, covered by recent sediments. Its emergence on the surface is due to tectonics and to lateral movement because of plasticity. The diapir folds within the Transylvanian Depression can elevate the sedimentary layers on the vertical, because salt seeds migrate.

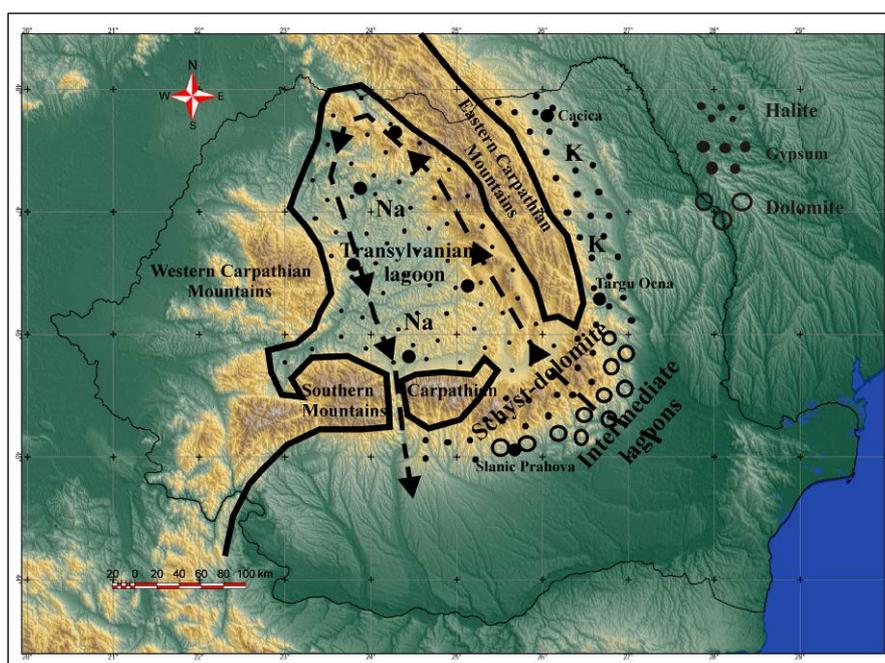


Figure 1. The Vrancea Gate and the Olt Gate as contact sector of the Planetary Ocean with the lagoon of the Transylvanian depression (adaptation after [13]). The existence of intermediate lagoons and of the sea current within the Transylvanian depression

Eocene and Miocene salt deposits are specific to lagoon and coast facies (more rarely to the pelagic one) (Fig. 2). Records clearly indicate the marine origin of an epicontinental sea, such as the Sarmatian one in Eastern Europe [13]. Salt springs are created by the washing and dissolving of (deposit) salt seeds or by the dissolution of salts within sedimentary

deposits (marls, clays, malm-rock sands, sandstones, etc.). The landscape of the Moldavian Plateau is unique because it is dominated by the existence of potassium salts, where organisms adapted of the local conditions (Fig. 3, 4). Only in the Transylvanian depression, in the diapiric area, there are over 800 salt-water sources [13].

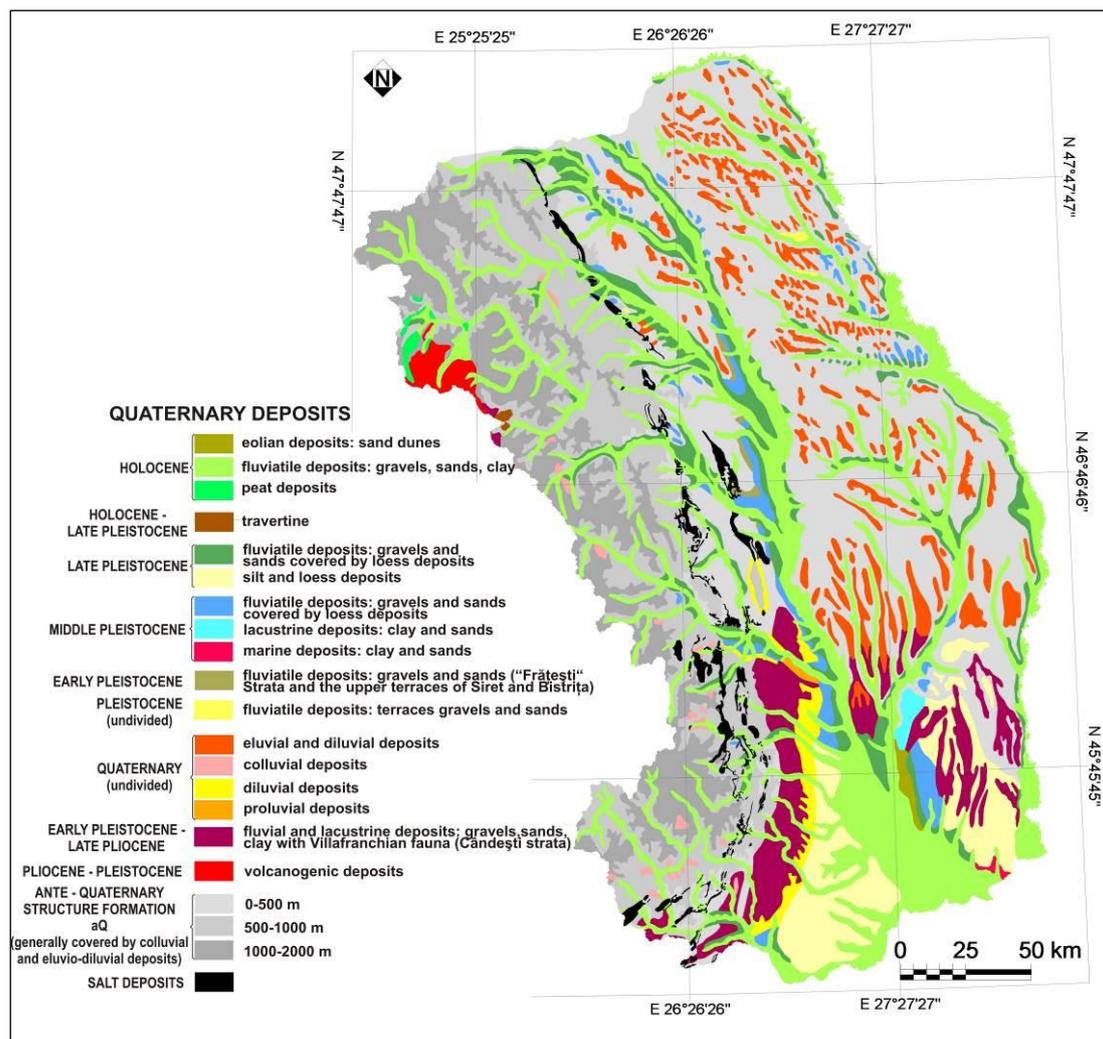


Figure 2. Map of the Quaternary deposits in Moldavia



Figure 3. Potassium salts in the catchment basin of Prut



Figure 4. Plants adapted to the potassium salt fields in the Moldavian Plain

The elevation of salts in the upper part of the crust, through capillarity, makes extended land surfaces in the Moldavian Plateau be affected by the salt field (Fig. 5). Most groundwaters are slightly salinized because the salts deposited in the sedimentation period are dissolved. For this reason, the groundwaters, phreatic and deep waters within the catchment basins of Siret and Prut are affected by mineralization, with negative effects on the economy.

This study analyzes several chemical parameters of superficial waters within the basins of Siret and Prut (Moldavia – Romania) supplying from the groundwaters of the Eastern Carpathians and of the Moldavian Subcarpathians that harbour important deposit salt amounts. Two important parameters were highlighted that can influence, in certain cases of usage, the quality of superficial waters: salinity and pH. At the same time, the study also concerned the methods of exploitation and usage of the salt waters (especially of sources) within the human communities, especially of the rural ones within the Carpathian and sub-Carpathian area. It is an avant-garde study of the ethnoarchaeology of superficial waters in Romania, focusing on the rivers in Moldavia (Siret and Prut). The current ethnomangement as a heritage of the preindustrial one has been highlighted.

The chemical parameters of superficial waters (sources and streams) and of groundwaters were analyzed only on limited areas, most of

the times on the small-sized catchment basins: Suceava, Moldova, Bahlui, Vaslui, Baseu, Barlad, Miletin, Uz, Cujeji [14-21], etc. For Siret and Prut, the physical and geographical parameters were analyzed only for the main stream, without also mentioning the tributaries in the context [14-15]. On physical and geographical units, the papers that analyzed the superficial waters in the Moldavian Plain were underlined [21]. This landform was better studied because water resources are also limited; in this area, the city of Iași – the most important urban centre of Moldavia – develops. At the same time, population density is high and the agricultural exploitation of the field is relatively advanced.

Nationwide, the topic referring to the quality of superficial waters and to genesis or to the distribution of salt deposits is extremely rich [1-4, 6, 22-27]. The one referring to the ethnoarchaeology of the salt-water exploitation is relatively recent [22, 28-35]. Salt has always played a defining role in diet, human and animal health, food conservation for unproductive seasons, the stability and development of human habitat, etc [29, 36-50]. For these reasons, there was a tendency of controlling, even using military forces, the deposit salt within the continental regions [41, 47]. In Romania, mostly in the Moldavian sub-Carpathian area, the traces of the oldest salt exploitations in Europe, starting with the Starčevo-Cris culture, are found [31, 32, 34, 35].

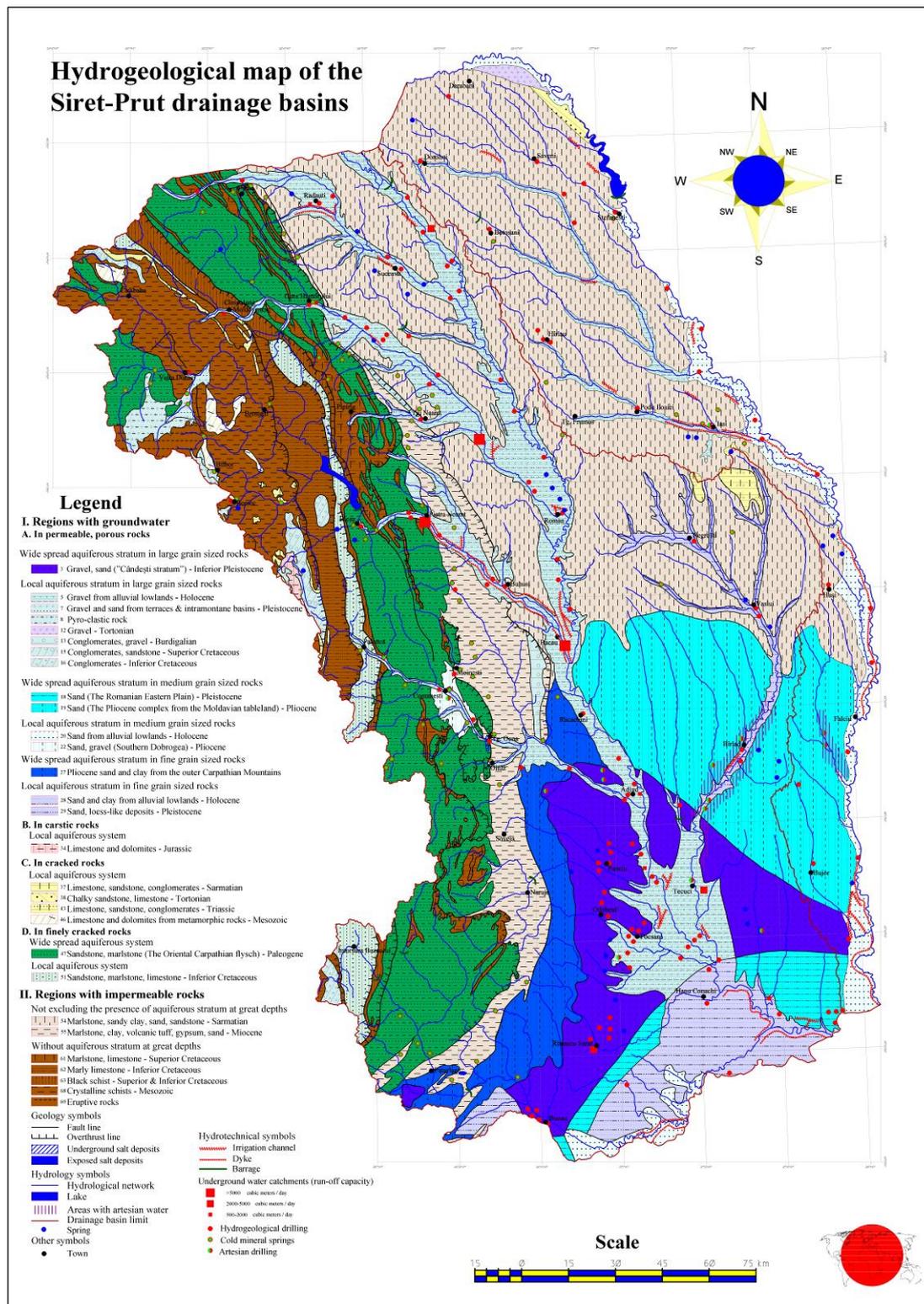


Figure 5. The hydrogeological map of Moldavia

The ethnographical, ethnohistorical and ethnoarchaeological approaches concerning the issue of salt have been studied and notable results have been obtained internationally, too [45, 48, 50]. This study attempts to highlight

the existing relationship between the aquatic environment in Moldavia (superficial waters) and the modality of artisanal use and processing of the salt waters (sources and streams). Because the northeastern region of

Romania is the poorest in the European Community, many of the old crafts are still preserved. Therefore, starting from actuality, the usage of the water resources (in general), mostly of the salt ones (especially) is reconstructed on historical stages. The exploitation traditions of the salt waters were preserved also due to the isolation of the rural communities, in the lack of proper infrastructure, but also due to the special quality of salt spring water. The exploitation of salt waters and the local ethnomangement continues nowadays, too, first of all due to the special sapidity of salt spring water. The notions of ethnomangement and ethnoecology are used successfully to treat the topics related to local production and to the development of communal or regional territories [36-38, 40, 46, 49]. At the same time, there was an attempt to correlate the qualities of the superficial waters (sources and streams) with the geological substrate (mostly with its nature) where the runoff occurs.

REGIONAL SETTING

The waters on the Moldavian territory (Romania) were analyzed. The catchment basins of Siret and Prut, the most important on the Romanian territory, occupy entirely the historical region of Moldavia on the right side of Prut. The left side of the catchment basin of Prut unfolds on the territory of the Republic of Moldova. Both rivers spring from the territory of Ukraine, but most surfaces unfold on the Romanian territory. Within this area, there are several landform subunits: the Eastern Carpathians; the Curvature Carpathians; the Suceava Plateau; the Moldavian Subcarpathians; the Curvature Subcarpathians; the Moldavian Plain; the Barlad Plateau; the Lower Siret Plain (Fig. 6). The Siret River collects the waters of the Eastern Carpathians and of the Moldavian and Curvature Subcarpathians, on the right side, and of the Moldavian Plateau (poorly developed basin), on the left side. The Prut

collects the waters of the Moldavian Plateau and only in the upper sector receives several small tributaries in the Wooded Carpathians of Ukraine. The Siret River is the most important tributary of the Danube (on the Romanian territory). It springs from the Wooded Carpathians (Ukraine) and it unfolds on a length of 559 km within the Moldavian Plateau. The hydrographical network comprises 1013 streams and it measures 15157 km (19.2% of the total in Romania). The surface of the catchment basin is 42890 km², accounting for 18.1% of the Romanian territory. The mean multiannual discharge of Siret is 220 m³/s. The Subcarpathian area analyzed the case study is studied between the Moldavian valley to the north and the Buzau valley to the south. It comprises two subunits of the Subcarpathian landform: the Moldavian Subcarpathians and a part of the Curvature Subcarpathians. In this area, there are salt-water sources and even streams recording a low degree of salinity.

The catchment basin of Prut is located in northeastern Romania. It springs from the territory of Ukraine, from the Wooded Carpathians, and it discharges into the Danube, north from the city of Galati. It covers a total surface of 27500 km², of which 10967 km² on the Romanian territory (4.6% of the Romanian surface). The sources are situated on the northeastern slope of the Cernahora Massif, at an altitude of 1580 m. It discharges into the Danube at an altitude of 2 m. The catchment basin unfolds on the territory of Ukraine, of the Republic of Moldova and of Romania. The Prut River has a length of 952.9 km (the second in Romania) and it unfolds on the Romanian territory on a length of 711 km. It holds a hydrographical network of 1000 km, of which 3000 km with a permanent character (33%) and 8000 with an intermittent character (67%). The mean multiannual discharge is 78.1 m³/s at Radauti Prut, 86.7 m³/s at Ungheni and 93.8 m³/s (period 1950–2008) at the Gauging Station of Oancea (situated at the mouth).



Figure 6. The limits of the investigated area, corresponding to the Siret and the Prut catchment basins, overlapping the historical region of Moldavia: 1–the Eastern Carpathians; 2–the Curvature Carpathians; 3–the Suceava Plateau; 4–the Moldavian Subcarpathians; 5–the Curvature Subcarpathians; 6–the Moldavian Plain; 7–the Barlad Plateau; 8–the Lower Siret Plain.

METHODOLOGY

The field measurements involved summer campaigns in all the landforms and the catchment basins in eastern Romania, overlapping the historical region of Moldavia. They concerned the great catchment basins of Siret and Prut, both allochthonous, with sources on the territory of Ukraine. The sampling campaigns were conducted in the period 2009-2011, in the month of August, when the highest temperatures in Romania are recorded and when the liquid flow (of the sources and the streams) are the lowest. The expeditionary measurements were conducted using the HACH multiparameter and they targeted several parameters: temperature, salinity, pH, total dissolved salts (TDS), turbidity, dissolved oxygen, nitrates, nitrites, etc. In this case, only two qualitative parameters were analyzed: salinity and pH.

The analysis concerned 108 hydrographical arteries of various sizes and 221 sources (salt and freshwater) in the Subcarpathian area. The water samples within the rivers were usually taken from at least three sectors: upper, middle and lower. For the big rivers, samples were

taken from every major confluence. Most sources could be located due to the information provided by the inhabitants. Only a small part was represented by the localization based on the cartographic information. Not all the sources analyzed hold a high degree of salinity. Some of the sources also have freshwater character, being used to this purpose, usually as drinking water for household. Some of pieces of evidence were also analyzed in the lab, especially those with a high degree of salinity, in order to determine chemical composition, on elements.

At the same time, the study also concerned the usage of waters within the human communities, mostly of the rural ones. Taking into account the magnitude of non-industrial use of salt-water sources by the rural communities, it may be considered that ethnomangement is a fully operative concept in this case. It is a complex study of ethnoarchaeology of superficial waters in Romania, focused on the sources and the rivers in Moldavia. In this respect, besides field observations, analyses were also conducted regarding the inquiries on the importance played by the salt waters in the life of the local

communities and on their usage at a local and regional scale [29]. The study states, as the case may be, that some traditional activities, whereas not economically lucrative, they should be preserved in the traditional cultural patrimony of the rural communities. For the case study, the salt-water sources currently used or used in the past by the local human communities were inventoried and analyzed. Only the sources exploited from accessible areas were analyzable. The spatial analysis method specific to the geographical researches with applicability for the ethnoarchaeological field was used. In the future, the plan is to extend this method to the level of the entire Carpathian and extra-Carpathian space.

RESULTS

The hydrographical network within the two basins is extremely rich, but most of it has a temporary character. This analysis also targeted the big hydrographical arteries, important for certain landform units or for certain human communities. To the same extent, the sources with important flows – which can have a special importance in supplying the streams or for the economy of the local communities – were also selected. For this study, only the sources within the

extra-Carpathian eastern area were inventoried and analyzed. This area largely corresponds to the Moldavian and Curvature Subcarpathians (Moldavia); in the future, the other salt-water sources will be studied, too.

For salinity, a clear delimitation was observed between the rivers in the northern half of the Moldavian Plateau (The Moldavian Plain and the Central Moldavian Plateau) and in the southwest of the catchment basin of Siret (The Curvature Subcarpathians). In the rest of the basins, only to small exceptions, there are hydrographical arteries influenced by salinity (Solonet, Sarata and Tazlau). Most rivers are included in the category of freshwater. They are also the biggest hydrographical arteries, with important liquid discharges.

Only six rivers display a salinity that exceeds 0.5 mg/L: Volovat – 0.7 (tributary of Prut), Rosu – 0.7 (tributary of Prut), Cacaina – 0.6 (tributary of Bahlui), Sarata – 7.1 (tributary of Moldova), Sarata – 0.6 (tributary of Susita) and Saratel – 0.8 (tributary of Buzau). Most often, books are strongly influenced by salinity due to the supplying using salt springs (Fig. 7). Unfortunately, because of the continental climate of transition, comprising extended droughts, they often dry out.



Figure 7. Sampling from "salty water" on the upper course of Sarata River - Soveja Depression

The pH is defined as a decimal logarithm with a changeable sign of hydrogen ions concentration. The value of pH indicates the acidic or basic properties of certain fluids; pH does not indicate any water toxicity. It must be mentioned that salinity and pH are not indicators of pollution. They influence only the quality of water, mostly of drinking water. All the rivers within the catchment basins of Siret and Prut are included in the category of alkaline waters. Most rivers are included in the category of highly alkaline and extremely alkaline waters. Most often, alkalinity is provided by the existence of calcareous rocks, rich in calcium carbonate. In the southwestern sector of the catchment basin of Siret, extremely alkaline waters are present. The values recorded for these hydrographical arteries are as follows: Lepsa – 9.3; Nehoiu – 9.4; Buzau – 9.4; Saratel – 9.3; Slanic – 9.1; Ramnic – 9.4; Milcov – 9.2; Putna – 9.6; Bisca Chiojdului – 9.2; Calnau – 9.4; Basca Mare – 9.2; Basca Mica – 9.5. In the Moldavian Plateau, only the Tutova River is included in the extremely alkaline category, with a value of 9.1. In the northern half of the catchment basin of Siret, there are only two arteries: Bistrita Aurie – 9.9; Dragosa – 9. Superficial freshwaters are used in all fields of activity: domestic (drinking water), industry and agriculture. Unfortunately, at the level of Romania, only 4-6% of the groundwaters are used. In the basins of Siret and Prut, their proportion is even lower. The only cities supplying partially from the groundwaters are Iasi, Bacau, Focsani, Barlad and Buzau. In order to meet the water demands, the biggest Moldavian cities (Iasi and Bacau) have a double supply: superficial waters and groundwaters. The municipality of Iasi, the second largest city in Romania (350,000 inhabitants), has two supplying systems: a superficial source, from the lakes of Chirita-Prut and Sorogari-Prut; groundwater source, from the alluvium deposits of the confluence between the rivers of Moldova and Ozana (accumulatively at the feet of the Moldavian Subcarpathians), 110 kilometres away. The municipality of Bacau is supplied from two sources: Poiana Uzului Lake within the Carpathian Mountains (50 km away) and two groundwater-capturing fronts localized approximately 5 km north from the city.

All the great cities that are county centres or municipalities are supplied mainly by superficial waters: Vaslui (the reservoir of Solesti), Barlad (the reservoir of Cuibul Vulturilor), Buzau and Nehoiu (the reservoir of Siriu), Piatra Neamt and Bicaz (the reservoir of Izvorul Muntelui), Suceava (the reservoir of Dragomirna), Botosani and Dorohoi (the reservoir of Bucecea), Harlau (the reservoir of Parcovaci), Husi (directly from the Prut River), Stefanesti (the reservoir of Stanca-Costesti), etc. The management of freshwater (superficial and groundwaters) is modern and it cannot be compared with that of salt waters, which is ancestral. The rural populations within the entire region of Moldavia (mountains, hills, plains) have used the salt-water sources, mostly from springs (Fig. 7). The eastern extra-Carpathian area comprises three landform subunits included in the catchment basin of Siret: the Suceava Plateau (county of Suceava), the Moldavian Subcarpathians (counties of Neamt and Bacau) and partially the Curvature Subcarpathians (county of Vrancea). In the corresponding extra-Carpathian area, 221 salt springs and freshwater springs were identified; they are distributed as follows: 50 in the county of Suceava, 70 in the county of Neamt, 78 in the county of Bacau and 23 in the county of Vrancea [29]. It must be noted that salt springs influence only the salinity of small streams, which most often dry out. The only permanent brooks, influenced strongly by salinity, are Sarata (within the area of the local climacteric resort of Oglinzi, county of Neamt) and Sarata in the Soveja depression (county of Vrancea). Most salt-water sources within the eastern extra-Carpathian belong to the area of deposit salt (NaCl) development; such salt often takes the form of diaper outcrops [6, 7, 24, 25]. There is no industrial exploitation of rock salt around salt-water sources. Industrially, salt deposit is exploited only in mines (Targu Ocna, Cacica, Ocnele Mari, etc). Considering the low discharge of salt springs, there is only an artisanal exploitation of water washing off the salt in the substrate and it emerges on the surface as highly salinized waters. Salt within the eastern extra-Carpathian area has been used in both its solid and its liquid form. From salt in liquid dispersion, by applying the thermal brine processing, people

used to obtain regularly, until the first half of the 20th century what they called *husca*, namely recrystallized salt. Nowadays, this procedure is used only rarely. Brine has been used to prepare all kinds of foods, on household level and on community level (village restaurants, monastic establishments), to make cheese, to conserve animal and vegetal products, to treat sheepskin, etc Brine has also been used for animal nutrition, by sprinkling salt water on the fodder or by adding it to the food for pigs [29, 31]. Haystacks (especially of oat) are often sprinkled with brine to protect them from rodents [29].

There are close connections between the prehistoric habitations of the Starčevo-Cris and Cucuteni cultures (6000-3500 BC) and most salt-water sources. This observation is valid for the Subcarpathian area of the county of Neamt, for the Lunca - Oglinzi - Targu Neamt sector, for the Poduri sector within the county of Bacau and for the Cucuteni-Cetatuia sector with the spring of Bala-Arcaci (Iași) [32, 34]. Spatial relations are supported by the presence of Cucuteni briquetage fragments within high settlements: Oglinzi-Cetatuia and Raucesti-Munteni [32]. It appears that the high Cucuteni settlements – fortified or not – play a central role in salt control and exploitation. They ensure the visual control of the main access ways to salt-water sources and the diffusion of the salt “small breads” produced. By conducting a reverse analysis from that of classical archaeology, the implemented archaeological endeavour is mostly interested in the natural resources, not in vestiges. The purpose is to reconstruct as well as possible the history of prehistoric communities and their sociocultural options, depending on an irreplaceable substance, a condition of life and a source of wealth, whose origin is included among the myths of the first agricultural societies.

In order to determine precisely the exploitation points of the salt waters from sources and their usages, various researchers within Alexandru Ioan Cuza University in Iasi and within the History Museum of Piatra Neamt have conducted field surveys. They involved questioning the subjects living in the vicinity of the sources (58), within the villages around the springs (105) and within sheepfolds (13).

The surveys were conducted in two distinct periods: 2004-2007 and 2008-2011 [29].

The ethnographic researches distinguished three types of zonal distribution of salt springs depending on the spatial extension of the settlements using salt water: village, with sources of local importance, used by three villages at the most situated at a distance of at least 5 km; municipal or over-village, in case of the sources used by four villages situated at a distance of up to 20 km; over-municipal, in case of sources used by numerous human settlements that exercise an attraction from a long distance. In case of political crises or natural disasters, salt water supply is not operative in the true sense of the process. On principle, one can admit the existence of a radial distribution scheme for the water of a salt spring. The ethnographical and archaeological information demonstrates the existence of a simple salt water supply and the production (export) of crystallization salt (*husca*). The salt water supply act generated a distribution network and more rarely a redistribution network. Salt water supply is a large-scale practice and it does not represent an indicator of poverty. It has been used by various categories of population for the conservation of vegetal products, cheese and for lard conservation.

A very important stage in salt production was represented by its recrystallization, by boiling brine within springs. The recrystallization practice involved the following strategies: salt recrystallizes (known as *husca* in folk language) near the Carpathian arch; the production of *husca* in seasonal habitats such as isolated sheepfolds in the mountains; the production of *husca* in villages, mainly in yards and more rarely within dwellings (in cauldrons hanging on pillars). The ethnographic research brought important in what concerns the use of natural brine and of salt in general. There are more usages than those stated by archaeologists thus far. Salt water is still used directly in various types of dishes and foods. Brine is used for both households and collectives (restaurants, monasteries, etc). Brine has a generalized usage in various mixtures of food products, especially for pork products. The fodders used for feeding cattle are sprinkled with brine in the Subcarpathian area. Most often, brine is

used for conserving lard, cheese, vegetables or herbs.

The most surprising results are specific for treating certain illnesses. The villagers of the Moldavian Subcarpathians use a great variety of procedures (some of them unique in the entire European space: warmed stones immersed in salt water to treat rheumatism in wooden baths). Recent studies have shown that many of the halotherapeutic practices in Moldavia are also present in the Greek and Roman world for treating dental issues, skin burns, headaches, angina pectoris, amygdalitis, stomach pain, lumbar and joint diseases, dog or cat bites, frost bites, ear pain or mouth pain, bleedings, etc [39, 42]. The existence of common therapies within these different chronological and cultural spaces implies the fact that salt had a significant therapeutic dimension in prehistory, but archaeologists had often neglected this reality. The streams with high salinity are not used because their concentration is low. Because they have high salinity only in the upper sectors of streams, near the sources, the latter are preferred for usage. People use only the salt crusts left after the summer drought. Only from this perspective, it can be stated that the salts within streams are also used artisanally.

DISCUSSIONS

The largest catchment basins on the Romanian territory are Siret and Prut. At the same time, they represent the most important water sources for the population of these regions [51, 52]. Whereas the liquid discharges of the two arteries are relatively high (related to the other streams in Romania), the resource is low because it is linked with the number of inhabitants. From this perspective, Moldavia is the most populated region, with the highest human densities in Romania.

Most tributaries in the Moldavian Plateau are small and their liquid discharges are extremely low. Most streams of the first, second and third category according to the Horton-Strahler ranking system dry out annually, most of the times during the summer (due to the lack of precipitations and to high evapotranspiration) and during the winter (due to total freeze). In this case, water resources from most areas of the Moldavian Plateau are limited or even absent. The need of water preservation led to

the construction of most reservoirs in the counties of Botosani and Iasi, situated in the Moldavian Plain. Whereas the two counties are among the poorest in water resources, they rank second and third, respectively, in aquatic surfaces. A quick glimpse on the hydrographical map for this region can be deceiving in terms of the water resources. Those lakes were constructed precisely because of water scarcity, not its abundance.

Another deceiving element is the density of the hydrographical network, which is extremely high in this case. It is due to the significant friability of the geological substrate and the massive deforestations in the east of Romania. Most small hydrographical arteries have dried out or they have water only during heavy rainfall. The permanent character of certain autochthonous rivers is provided mainly by groundwater supply. Most large hydrographical arteries have a 30-50% groundwater supply [20].

Significant influences are visible only in case of small rivers. Most of them have freshwaters (high flow determines a significant dilution power). The influence of salt deposits or rock salt is dominant only on the groundwaters, which have a relatively high degree of salts [6, 53, 54]. This high degree is also determined by the slow circulation of groundwater (fine granulometry) or by the reduced pluvial supply. People use the salt waters from springs, scarcely from streams (the salt crusts left after the summer drought). Springs have significantly saltier waters than streams. They represent the main source of river supply. The relatively low salt contents within rivers are due to low groundwater flow and to dilution caused by meteoric waters. The dilution power is apparent in case of large hydrographical arteries.

The nature of geological deposits has a special influence on the salinity and pH of groundwaters and at the same time of superficial waters [26]. Massive rock salt deposits are found in the area of the Moldavian and Curvature Subcarpathians. For this reason, parts of the superficial waters have higher salinity than those in the Moldavian Plateau (Fig. 8). In the Moldavian Plateau, several hydrographical arteries have an important degree of salinity, but it does not exceed the values recorded in the Subcarpathian area. The

Moldavian Plateau does not contain any salt deposits, but only saliferous sandy-clayey deposits (from the waters of epicontinental

seas that covered these surfaces in the past). Salts come from their dissolution due to the circulation of the groundwaters.

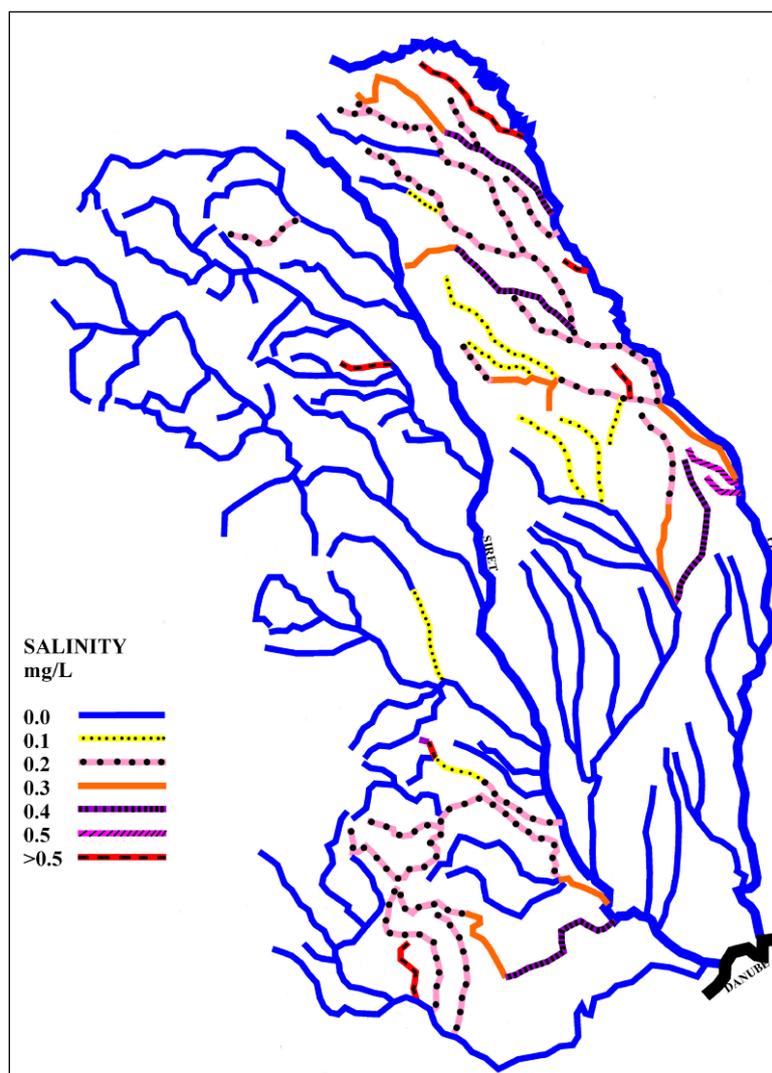


Figure 8. Salinity distribution for the streams within the catchment basins of Siret and Prut

For the superficial waters within the catchment basins of Siret and Prut, a certain correlation may be established between salinity and pH. Many of the superficial waters with high alkalinity overlap those with salinity: Saratel (tributary of Buzau); Sarata (tributary of Moldova); Volovat and Baseu (tributaries of Prut). In the southern half of the Moldavian Plateau, there are several rivers with highly alkaline pH. The existence of calcareous, sandy-clayey and loessoid deposits favour this phenomenon. The highest values of alkaline pH are found in the Curvature Subcarpathians, in the saliferous and volcanic tuff deposits. In

this case, too, the low values of alkalinity are specific to the large hydrographical arteries with high and relatively constant discharges. The low superficial water resources and their over-exploitation lead to a lack of water for many localities during droughty years. Due to the acute lack of water, many reservoirs have been constructed in order to preserve the waters from precipitations. The region of Moldavia comprises the largest number of reservoirs destined to water supply for human settlements. Moldavia is an important agricultural region. For this reason, most superficial waters contain nitrates and nitrites.

The pollution degree of superficial waters is low because the polluting industry (chemical, iron and steel, etc) is no longer active. At the same time, the European Community imposed the cleansing of wastewater, mostly of those within urban centres.

The most important impediment of superficial waters is represented by high hardness, which leads sometimes to the onset of kidney diseases. The new industrial exploitation facilities for freshwater comprise water softening devices. The rural population, most of the times poor, cannot afford such facilities. The rural settlements use only the phreatic groundwaters that are not salinized, but they are influenced by the substances used in agriculture. Deep waters are salinized or hard most of the times. Most often, such properties render them unusable. In order to avoid illnesses or even deaths caused by the pollution of superficial waters of phreatic waters, the State has decided for the capturing of drinking water sources exclusively. In this respect, European funds have been accessed and very soon all the localities in Romania will be supplied with quality water. Most cases of deaths concerned infants under the age of one, who are given water with nitrates and nitrites. The great dams within the mountainous areas led to the creation of lakes with multiple usages: hydroenergy, water supply for the surrounding localities, irrigations, pisciculture, leisure activities, etc. In the area of low landforms, only small earthen dams were built, which can create very small lakes, most often comprising low water volumes. The only big lake was constructed on the Prut River, at Stanca-Costesti, and it ensures the water supply in the northeast of the Moldavian Plateau. The water volume accumulated in this lake could ensure water supply from the entire area of the Moldavian Plain, but the price for building a transport infrastructure is far too high for the financial possibilities of this region.

For the European prehistory, the Moldavian area is particular and it distinguishes clearly from other European or global areas due to the continuous character of the ancestral salt exploitation and usage practices in the absence of mechanization, economic organization and legal regulations [29]. Whereas the refrigeration era reached even the most

isolated places within the Romanian territory, the technique of food conservation persists in the Moldavian Subcarpathian area. In some cases, in the rural setting, the use of both conservation systems has been observed: namely, the lard or ham conserved in brine is placed in a fridge. The point of Poiana Slatinei in Lunca (the commune of Vanatori Neamt in the county of Neamt) constitutes the most representative salt-water exploitation point in Moldavia and at the same time point of reference for European prehistory. In this area, three areas of archaeological depositions were identified. Area A, the most important one, is situated near the current salt-water spring. The archaeological materials belong to the Neolithic and to the Chalcolithic (the Starčevo-Cris culture, the linear pottery culture, Precucuteni, Cucuteni), to the Bronze era (the cultures of Costisa-Komarov, Noua) and to Early Middle Ages (10th-12th centuries and the 19th century [31].

There are two forms of waters management, which coexist in the context of modern technology dominance. The most evolved form belongs to the State or to the private organizations within the local communities. The primitive, ancestral, inherited form is ingenuous and it is not submitted to the State legislation, administration or tax authority. This situation enables the survival of local food conservation traditions or regional food preparing techniques [29]. The taste of certain recipes can only be provided by the type of brine used in the food preparing process. This explains its large-scale dissemination in the rural setting, though salt is very cheap to buy. The current ethnomangement represents a continuation of the preindustrial one. It constitutes the key to understanding the complexity of salt-water sources exploitation since prehistory. In this case, these are the oldest such exploitations on Earth [31]. The natural ecosystem around the salt-water springs has been used in consonance with the unwritten laws of rural ecology (ethnoecology). The territorial structuring of the communities was determined by the existence of freshwater springs and streams that managed to meet the demands of a community (Fig. 9). Most prehistoric settlements within low areas (plateau, hills, plains) were cantoned in the upper part of the

catchment basins, where freshwater sources ensured the supply for the communities. At the same time, settlements were protected against the risk of floods, which were frequent in the lower sectors [55, 56]. In the mountainous area, because of the steep landforms and limited food resources, human settlements chose most of the times areas with salt-water

sources. Hence, two water resources (salt-water and freshwater) were exploited, based on which two types of ethnomangement emerged. The exploitation of salt-water sources may have represented a subsequent developmental phase of prehistoric communities, starting with the Neolithic, more rarely with the Palaeolithic.

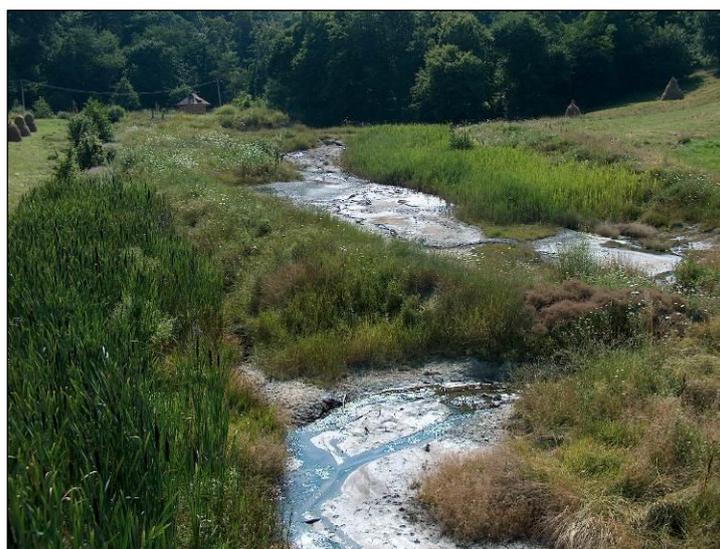


Figure 9. Saltscape in the area of the Oglinzi brook

For the eastern Subcarpathian territory, the following current usages of the salt waters were delimited: human nutrition (private or collective consumption, food conservation – cheese, meat, lard – and the private industrial sector for traditional products); animal nutrition (stock for pigs, fodders sprinkled with brine); protection of fodders, mostly of haystacks, against rodents; human halotherapy (rheumatism, skin disorders, swollen feet, inflammations, open wounds, stings, flu, cold, etc); veterinary halotherapy (arthritis, polyarthritis, sprains); crafts (animal skin processing, stove construction), etc [29].

Salt exploitation in its liquid form still has a strictly local character. Salt recrystallized by the boiling of brine was destined to barter or to remote sale. Barter was disseminated during supply crises, mostly during the Second World War or right after its ending. Nowadays, barter is only practiced within local communities, among those who exploit the deposit and the elderly population, given that they can no longer go to the salt springs [29].

The information concerning the methods applied for the exploitation of the salt waters

and their usage has underlined the ethnoarchaeological potential of Moldavia. The determination of the perimeters corresponding to traditional exploitations and usages of salt-water springs features numerous practical implications from various fields: public health (by the identification of harmful trace elements in the salt waters); halotherapy (contraindications of traditional halotherapeutic practices); rural economy sustainability (determining the parameters of parallel economy); archaeological and ethnographic tourism (which has not been exploited thus far).

From a cultural perspective, this endeavour saves from oblivion the invisible inheritance generated by the existence of salt-water sources. The exploitation of salt-water sources has paradoxically flourished by encouraging private initiative, specific to the capitalist economic system in Romania. Beyond any doubt, this phenomenon will soon disappear, as it happened in the entire European space. From this perspective, it is worth noting the initiative of certain entrepreneurs, who decided to build salt-water pools, small

premises for baths in guesthouses with a climacteric character, to add salt in food for pig farms, to conserve the Romanian feta cheese in brine in micro-factories, etc. The preservation of salt-water exploitation and usage traditions is encouraged nowadays by the “ecologist” current of food consumption. Agrotourism promotes the idea “like your mother’s meals” where food is prepared according to old recipes, often conveyed orally. At first glance, the exploitation of salt springs seems like a characteristic of poor people. The research conducted thus far has demonstrated that consumers who have more than a decent living standard also use salt spring water; its taste qualities play the most important role in the continuation of traditional salt supply practices. This change in values can be encouraged only by governmental measures meant to activate ethnomanagement and ecotourism. In this case, there is also a dispute concerning folk management versus modern management.

Although Romania is currently in the stage of industrial-agrarian development, on its territory there are numerous examples of persistence of traditional behaviours. The manifestation is dominant in the rural setting and almost extinct in the urban setting. From an economic point of view, Moldavia comprises two distinct regions: the eastern extra-Carpathian unit, represented by the Subcarpathian unit (The Moldavian Subcarpathians and the Curvature Subcarpathians, to which the Suceava Plateau can be added), which is more developed; the unit of the Moldavian Plateau (The Moldavian

Plain, the Barlad Plateau and the Lower Siret Plain), which is poorer. Of course, this difference is provided by a cumulus of factors, mostly the existence of natural resources (on the ground and underground), but the transition unit represented by the Subcarpathians is more developed economically also because it has always used two categories of water: freshwater and salt water. The existence of the salt waters has facilitated the local and regional development of certain traditional economic branches based on their exploitation and usage.

CONCLUSIONS

The nature of the geological substrate within the catchment basins of Siret and Prut influences especially the salinity and pH of the groundwaters and the superficial waters. To the same extent, the human activities related to the exploitation of salt resources as salt-water sources are also influenced. There is a relatively close connection between the salinity and alkalinity of superficial waters. Most salt waters and alkaline waters are found in the Moldavian Plain and in the Curvature Subcarpathians. High salinity is specific to springs. Small rivers with low discharges are strongly influenced by salinity (Fig. 10). They lead to the emergence of a specific landscape (saltscape) [57]. The big streams have freshwaters because the dilution power of water is significant. Salinity and pH are not indicators of pollution, but they can alter the chemical properties of waters and at the same time, they can limit their usage.



Figure 10. Salinized soils in the Moldavian Plateau (the catchment basin of Prut)

Freshwaters, mostly the superficial ones, are exploited using modern means and they are used on a large scale in all the economic fields. The population in eastern Romania uses mostly the water or rivers, and to a lower extent the groundwaters. Only the rural population uses on a large scale the phreatic waters, most of the times contaminated with nitrates and nitrites. Over 80% of the water within the Moldavian fountains is not fit for human consumption.

The archaeological traces indicate that the local population has used salt waters since the Neolithic and the Chalcolithic. These are the oldest such records on the European continent and among the oldest in the entire world. The exploitation and usage methods for salt waters are still of actuality in old locations. Unfortunately, due to the modern technique implemented in most industrial and household branches, very soon these ancestral crafts will disappear. The ethnomanagement of salt waters is the heir of preindustrial management. The emergence and development of the human settlements have been influenced by the existence of freshwater sources and streams. A

special development was recorded by the localities that also comprised salt waters, which used to be essential or local and regional economy. The eastern extra-Carpathian region with a Subcarpathian character has developed significantly more than the other regions in eastern Romania. Besides the fact that it represents a landform unit of transition between a mountain and a plateau or a plain, with diverse natural resources, it also contains the most important salt reserves, which have been exploited and traded since time immemorial. The salt “trade” (barter) used to have a regional level, but currently it is still practiced on local level, around the salt-water sources. It is still surprising that the old salt brine exploitation crafts have been conveyed and preserved. From this viewpoint, the tourist resource, based on salt brine exploitation techniques, can represent a significant source of income. The governmental measures should not affect ethnomanagement, because it is in agreement with the ecologist ethnovision. However, the State must intensify the modern management of freshwater.

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