

The impact of agricultural practices on environmental components in the Transylvanian Plain

¹Adrian Vodiță, ²Irina Raboșapca, ²Andras-Istvan Barta, ²Eduard Schuster

¹ Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Department of Regional Geography and Territorial Planning, 5-7 Clinicilor str., 400006 Cluj-Napoca, Romania;

² Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Bistrița Academic Extension, 3-5 A. Mureșanu str., 420117 Bistrița, Romania. Corresponding author: A. Vodiță, adrian.vodita@gmail.com

Abstract. The landscapes have undergone changes over time due to human intervention. Even today, human activities are responsible for almost all landscapes transformation. This is how the agricultural cultural landscape emerged, as a result of plant cultivation and animal husbandry activities, followed by the forest cultural landscape, closely linked to the agricultural one. This article is tackling the evolution of agricultural landscape in the Transylvanian Plain and the way in which humans have shaped it thru different ages. Another important aspect discussed is the negative impact, which people have on the environment of the Transylvanian Plain in the pursuit of shaping landscapes after their will.

Key Words: impact, landscape, cultural, agricultural, modification, pollution, environment.

Introduction. The agricultural cultural landscape is one of the first types of cultural landscapes and the largest of all cultural landscapes. The agricultural cultural landscape is in a state of rhexistazy, because in order for this type of landscape to be possible, the natural landscape had to suffer alterations. The most concrete impact that the human factor has on the ecosystem has occurred with the domestication of animals and the cultivation of plants. These two processes create a symbiosis between animal and plant species on the one hand and man on the other. These processes have been particularly important for spatial expansion and population growth. Therefore, without agriculture, a human sedentary life would not have been possible, and the human population could not evolve, set up permanent villages and towns, and develop classified societies that include specialized and dedicated segments (MacDonald 2003).

This article is part of a broader study, namely a PhD thesis in support. The aim of this paper is to analyze the changes in the agricultural cultural landscape of the Transylvanian Plain. The objectives are to give a clear picture of the Transylvanian Plain landscape, to make connections between causes and effects that have led to changes in the area's cultural landscape and to follow the evolution of the agriculture landscape over time.

The evolution of agricultural landscape in the Transylvanian Plain. The emergence and spread of agriculture has been a phenomenon broad all over the world. Experts agreed that the emergence of agriculture took place in the Neolithic era, when several hunter and gatherer populations decided to handle the cultivation of land and the domestication of animals, and so with agriculture, human society was shaped as we know it today. The transition of the population from the hunter-gatherer occupation to livestock farmers and landowners has been a very important point in the history of modern man, this transition leading to technological development that has facilitated the shaping of the natural landscape in a positive or negative way. This phenomenon was among the first processes by which the natural landscape was transformed into a cultural landscape (Dunn et al 1991).

Following the archaeological findings in the Transylvanian Plain, researchers believe that the population in this area first dealt with the domestication of the animals, then to the cultivation of plants, especially of cereals. Therefore, at first, the natural landscape was modified more to expand the pastures and less to cultivate the land, the expansion of the necessary surfaces was made by using fire as a mean of deforestation. Widespread fire has led to local climate change and the reduction of forest biodiversity. In the Bronze Age, the significance of the two agricultural practices is balanced. With the emergence of bronze tools and agricultural development, the earliest lands prepared for

cropping appear and the areas with plant cultivation grow, and a more pronounced agricultural landscape can be observed (Manciulea 1944).

The development of iron tools led in the Transylvanian Plain to the occurrence of deforestation with the purpose of obtaining pasture, grasslands and, of course, arable land, causing visible changes in forests and silvo-steppe plains. During this period, with the growth of population and settlements, there is an extension of agriculture dictated by necessity. Agriculture is diversified, new crop species are selected out of wild species and besides animal breeding and plant cultivation the first forms of fish farming appear in The Transylvanian Plain, especially on the present valley of Fizeş, during the Dacian-Roman period (Lockyear 2004). The first forms of fish farming were practiced in natural ponds, the concept of embankment and modern ponds emerging later. These practices have made changes in the structure and diversity of animal and plant species, leading to a more developed landscape from an agricultural point of view. Also during this period is considered that the first agro-terraces that are visible today in the landscape of the Transylvanian Plain, these terraces have appeared due to the plowing along the level curves and the turning of the furrows down for tens, hundreds, or even thousands of years. These agro-terraces appeared on the slopes and on the terraces made by watercourses, protecting crops from floods and providing food stability to local populations (Baciu 2006).

In the Middle Ages, with the increasing number of settlements and their surface and their population, agriculture is becoming more organized, responding to the requirements and the growing needs, the production and export of cereals and animals from the plain to other regions is beginning and agricultural areas and pastures are organized by noble fields. There is an organization of crops, but due to the more aggressive interventions in nature, the first surface erosion processes (ravens, torrents, holes and even landslides) are beginning to manifest due to the introduction of larger areas of land in agriculture (Pop 2015).

With the industrial revolution and the introduction of modern agricultural techniques, agriculture moves to another level. Interventions in the landscape are increasingly aggressive, with modern technology leading to an unprecedented expansion of pastures, grasslands and arable land. If so far in agriculture were used just animal and human labor, starting with this period, were used more and more complex agricultural mechanisms, like the steam engine, the internal combustion engine, and later of the electric motor.

In the last three decades new forms of agriculture have appeared in the Transylvanian Plain, there is a so-called reconversion of farmers, agricultural organizations such as livestock, vineyards, orchards, etc. appearing. Farmers bought new breeds of domestic animals that are not suitable for grazing in open air. This can be also observed through the reduction of grasslands and the increasing of the hayfields (Table 1; Figure 1).

Table 1

The evolution of the agricultural fields in Transylvanian Plain

Year	Agricultural fields		Arable fields		Hayfields		Pastures		Orchards		Vineyards	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
1994	358370		218030	60.84	32977	9.20	98492	27.48	6418	1.79	2453	0.68
2004	356483		217978	61.15	38516	10.80	94964	26.64	4391	1.23	634	0.18
2014	356619		220834	61.92	41027	11.50	89458	25.09	4622	1.30	678	0.19

Source: National Institute of Statistics (<http://statistici.inse.ro:8077/tempo-online/#!/pages/tables/inse-table>).

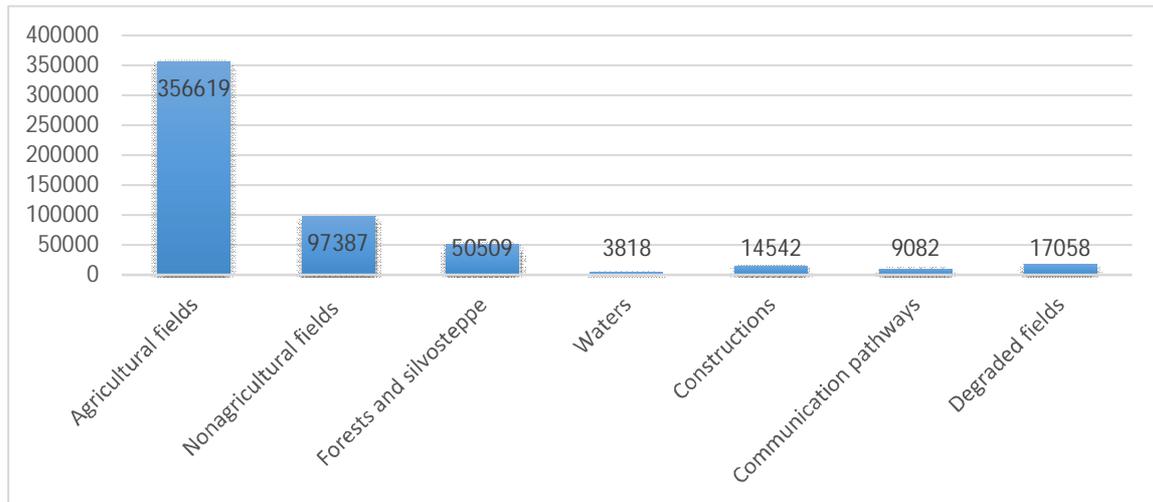


Figure 1. The Land Fund of the Transylvanian Plain in 2016 expressed in hectares according to the National Institute of Statistics (source: <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>).

At present, the cultural landscape of the Transylvanian Plain area is predominantly generated by the rural population, which through specific activities of plant cultivation, animal husbandry, fish farming and beekeeping support the agricultural development as well as the modification of this type of landscape according to their needs and necessities. New crops that replace old technical plants (soybeans, rape, medicinal or aromatic plants) and new unacclimatized fruit trees are emerging, bringing a new color to the landscape (National Institute of Statistics).

As can be seen on the map displayed in the Figure 2, the cultural landscape of the Transylvanian Plain was divided according to the land use, thus observing the cultural landscapes generated by the crops, the fruit trees, the vines, as well as the pastoral and fishery. It can be noticed that the cultural landscape of the Transylvanian Plain is quite a mosaic, predominantly non-irrigated arable lands, followed by secondary pastures, complex crop areas, orchards and vineyards (Pop 2012).

Analyzing the values of human pressure in the territory, it is found that this pressure through arable, live, orchards, pastures, hayfields varies depending on the orientation of the slopes and the suitability to certain cultures, we deduce that we have two types of agricultural landscape in the Transylvanian Plain, namely: an agricultural landscape based on plant culture and fish farming in the southern part, and an agricultural landscape modeled by pomiculture, viticulture, hays and pastures in the North of the Plain.

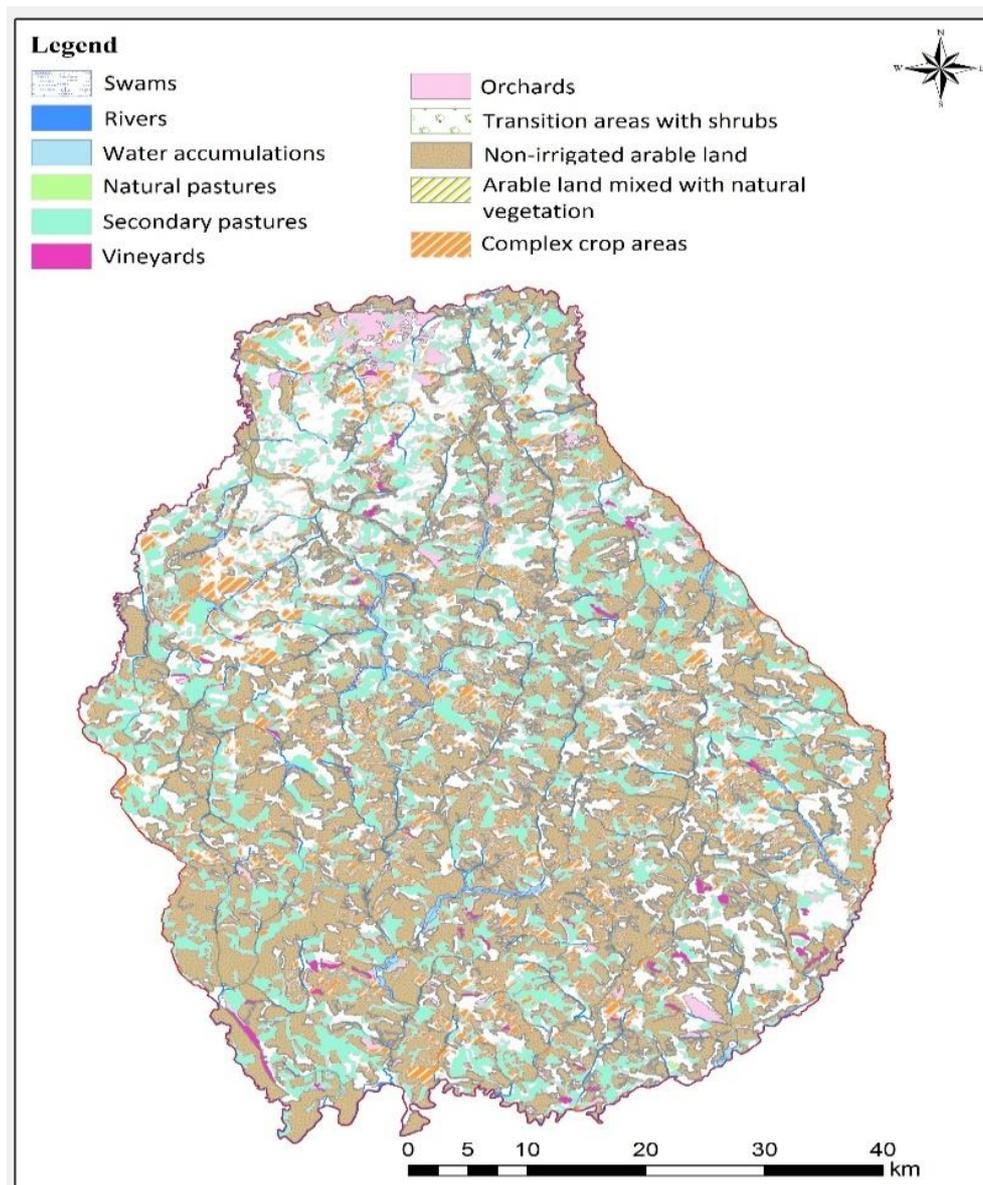


Figure 2. The use of agricultural lands in Transylvanian Plain and the cultural landscape generated by it (drawing by Adrian Vodiță).

The negative impact of agricultural practices. The most aggressive agricultural practices are developing in the aftermath of the Second World War, and in the Communist period. Therefore the Agricultural Production Cooperatives (APC) appear. This period is characterized by mechanized agriculture, traditional farming practices are losing ground to modern machinery, decreasing the time preparation of the land and crop cultivation, leading to a larger production that in many cases was forced. At this time, it is also largely abandoned the plowing along the level curves leading to the unprecedented intensification of the slope processes (Iordachi et al 2014).

Also during this period, a lot of technical plants (sugar beet, tobacco, flax and hemp), modern fruit trees, as well as a large number of forage plants are being introduced into cultivation, thus bringing about important changes in the landscape. By using modern mechanized and chemicalized agriculture, especially the large-scale use of pesticides and herbicides, had been eradicated much of the natural vegetation and had been reduced the bee population, leading to a decline in biodiversity. This drastically reduced the habitat of very useful herbs, reduced the number of flowers and their quality with major implications in beekeeping, and with the decrease of the bee population, there

were problems with the pollination of plants and fruit trees. From the above, we can see that the processes influence each other with cumulative effects in the environment.

Through the embankment process, a big number of fish ponds are being set up in state-owned farms on almost all of the rivers in the Transylvanian Plain. These fish ponds reach a very large size (Taga-164 ha) producing large quantities of fish. Over 50 lakes have been set up, leading to a unique lake landscape. These lakes are mostly used for recreational fishing and not for fish for consumption, new re-populations have been made with fish from different regions of Europe and Asia, so accidentally or intentionally introduced invasive fish species such as the stone moroko (*Pseudorasbora parva*) or the brown bullhead (*Ameiurus nebulosus*), extremely damaging to the aquatic ecosystems (Anastasiu et al 2017). These two species had being fed with the native fish. Another problem of the Transylvanian Plain water ecosystems is the large-scale use of chemical amendments and chemical fertilizers that have changed the chemical composition of water, increased nutrient quantities in water, especially nitrogen and phosphorus, by enhancing the eutrophication of lakes such as Brăteni, Șuatu and Săcălaia (Floca et al 1988).

Mechanized agriculture has imposed changes in the landscape and by arranging the communal roads necessary for access to agricultural equipment. The arrangement of these roads alongside the actual agricultural practices have led to unprecedented intensification of erosion processes and led to brutal changes in the landscape, as seen in Figure 3.



Figure 3. Erosion on a communal road in Șăulia village, Mureș County (photo by Adrian Vodiță).

Inappropriate use of arable land and misapplication of production technologies are sources of risk. This occurs on the ground by inappropriate landscaping along the slopes, the transformation of pastureland and hayfields into arable land, which accelerates the erosion of the soil through these processes, leading to the growth of rivers slides and facilitates a more easily transport for chemical substances used in soil fertilization and crop protection. Many lands have been deforested and farmed with pastures, hayfields, arable lands, causing phenomenons identical to those previously mentioned (Rusu et al 2009).

Another risk factor is the mechanized work of the land. Through the action of mechanized works, the soil is brought to a lower resistance state each year. Crops that require a cultivation technique that lessens the soil layer will produce a less loss and reduce the risk associated with it. Although the yield of mechanized crops is higher, this increase in productivity will not last long, as it leads to accelerated soil erosion (Ciampalini et al 2012).

By using mechanical machinery in agriculture, intensive soil compaction, soil layer destruction and texture B (Bt horizon) formation are observed.

Man-made disturbances through abusive land management result in a profound decrease in water retention capacity in soils. The disturbances occurring in the hydrological regime of the soils and which act as the triggering factor of the very complex mechanisms of soil degradation are mainly the result of the fact that at the eroded surfaces a significant amount of atmospheric precipitations do not infiltrate the soil but drain quickly to surface or evaporate (Rusu et al 2010). The water that remains in the soil tends to infiltrate the soil depths by washing the nutrients. This leads to a gradual reduction of moisture in the upper layers of the soil, causing the vegetation to be impoverished, which in turn causes the deterioration of the water balance (Environmental Protection Agency Bistrita, 2003).

Other forms of degradation resulting from animal breeding are:

- overgrazing;
- the destruction of the soil layer by the animals' treading;
- the destruction of the natural landscape characteristic in pasture areas.

The destruction of the vegetal cover from an ecosystem occurs as a result of overburdening by herbivorous animals that are too much in the area. Due to modern grazing practices, the grazing rotation does not occur, and the phenomenon of overburden that destroys the vegetal cover leads to an increased surface erosion (see Figure 4) (Barrow 1991).

The pressure exerted by the animals on the vegetation cover and soil results from the number of animals per hectare of pasture, the number of animals per grazing area is between 3-8 heads / ha of pasture, this number varying according to the geomorphological and geo-climatic characteristics of region. A certain area of pasture can feed only a certain number of herbivores, depending on the nature of the soil, the climate and the vegetation component, and the speed with which the animals graze and the species they belong to (Environmental Protection Agency Bistrita 2003).

This notion defines the limited capacity of the land. If this limit capacity is exceeded, vegetation and soil degradation occur frequently in this territorial unit.

The economic factors, in particular the growing needs of animal products (milk, meat, eggs, leather), lead to the overburdening of pastures, which led to the overgrazing phenomenon. In this situation, the animals produce a strong degradation, removing the vegetation to an extent that exceeds its regeneration possibilities. This has been observed on some pastures since July.

In addition to grazing, it is a further cause of grassland degradation, the trampling and soil compaction by herds and livestock. Resting on limited surfaces, animals strike the vegetal carpet and the superficial soil layer and cut it with hooves. Thus, the vegetation gradually disappears on certain surfaces that become the site of erosion process. Soils whose vegetation is overgrazed are likely to suffer severe imbalances and degradations.



Figure 4. Overgrazing in Răzoare village, Mureș county (photo by Adrian Vodiță)

Conclusions. From the informations analyzed above we deduce that man has shaped the natural environment of Transylvanian Plain through agriculture according to his needs and according to the degree of development he has reached. The modeling of the natural environment has gradually emerged, in the studied area, and a more aggressive intervention can be observed in the modern period. During this period the great majority of the imbalances appear and intensive processes of degradation occur. We notice that each component of the environment suffers, problems are chained with cumulative effects that are hard to stop or remove, and in this way, is difficult for the Transylvanian Plain landscape to recover.

References

- Anastasiu P., Preda C., Bănăduc D., Cogălniceanu D., 2017 Alien species of EU concern in Romania. *Transylvanian Review of Systematical and Ecological Research* 19(3):93-106.
- Baciu N., 2006 [Transylvanian Plain - geoecological study]. Publishing House University Press Cluj, Cluj-Napoca. [in Romanian]

- Barrow C. J., 1991 Land degradation: development and breakdown of terrestrial environments. Cambridge University Press, 295 pp.
- Ciampalini R., Follain S., Le Bissonais Y., 2012 LandSoil: a model for analysing the impact of erosion on agricultural landscape evolution. *Geomorphology* 175: 25-37.
- Dunn C. P., Sharpe D. M., Guntenspergen G. R., Stearns F., Yang Z., 1991 Methods for analyzing temporal changes in landscape pattern. In: *Quantitative methods in landscape ecology*. Turner M. G., Gardner R. H. (eds), Springer-Verlag, New York, USA, pp. 173-198.
- Environmental Protection Agency Bistrița, 2003 [Report on the state of the environment in Bistrita-Nasaud County]. [in Romanian]
- Floca L. A., Sorocovschi V., Mihaiescu R., Persecă M., Vescan I., Floca D. L., 1988) [Aspecte privind trăsăturile hidrologice și fizico-chimice ale iazurilor din Câmpia Transilvaniei (Valea Fizeșului)]. *Studia Universitatis Babeș-Bolyai, Geographia* 43(2): 43-51. [in Romanian]
- Iordachi C., Bauerkamper A. (eds), 2014 The collectivization of agriculture in communist Eastern Europe: comparison and entanglements. Central European University Press, 568 pp.
- Lockyear K., 2004 The late Iron Age background to Roman Dacia. In: *Roman Dacia: the making of a Provincial Society*. Hanson W. S., Haynes I. P. (eds), *Journal of Roman Archaeology*, Portsmouth, RI, pp. 33-74.
- MacDonald G. M., 2003 *Biogeography: introduction to space, time, and life*. John Wiley, New York, 505 pp.
- Manciulea Ș., 1944 [The Transylvanian Plain]. *Country and Nation Collection*, Bucharest, pp. 21-38. [in Romanian]
- Pop G., 2012 [Transylvanian Basin]. 2nd edition, Publishing House University Press Cluj, Cluj-Napoca. [in Romanian]
- Pop V. V., 2015 Landslides from the Apatiu, Meles Basin (Transylvanian Plain). *Revista de Geomorfologie* 17: 63-68.
- Rusu T., Gus P., Bogdan I., Moraru P. I., Pop A., Cacovean H., Pop L., 2009 Influence of soil tillage systems on soil organic matter dynamics in some soils of Transylvania (Romania). *IOP Conf. Series: Earth and Environmental Science* 6(2009) 242036.
- Rusu T., Weindorf T., Haggard B., Cacovean H., Moraru P. I., Pop A., Pop L., Soptorean M. L., 2010 Soil temperatures, water and humus conservation of the Transylvanian Plain, Romania. *Geophysical Research Abstracts*, Vol. 12, EGU2010-1092-1.
- *** National Institute of Statistics - <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>.

Received: 02 April 2018. Accepted: 29 May 2018. Published online: 30 June 2018.

Authors:

Adrian Vodiță, Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Department of Regional Geography and Territorial Planning, 5-7 Clinicilor str., 400006 Cluj-Napoca, Romania, e-mail: adrian.vodita@gmail.com

Irina Raboșapca, Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Bistrița Academic Extension, 3-5 A. Mureșanu str., 420117 Bistrița, Romania, e-mail: irina.rabosapca@ubbcluj.ro

Andras-Istvan Barta, Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Bistrița Academic Extension, 3-5 A. Mureșanu str., 420117 Bistrița, Romania, e-mail: andras.barta@ubbcluj.ro

Eduard Schuster, Babeș-Bolyai University of Cluj-Napoca, Faculty of Geography, Bistrița Academic Extension, 3-5 A. Mureșanu str., 420117 Bistrița, Romania, e-mail: eduard.schuster@ubbcluj.ro

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Vodiță A., Raboșapca I., Barta A. I., Schuster E., 2018 The impact of agricultural practices on environmental components in the Transylvanian Plain. *Ecoterra* 15(2):52-59.