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NATURAL SYSTEM – HUMAN SYSTEM INTERFUNCTIONALITY SPECIFIC TO RURAL COMMUNITIES. CASE STUDY: AGRO-ECOSYSTEM, ECOLOGICAL VALUES AND BEHAVIOURS

ABSTRACT

The present paper attempts to identify the determinants of the relation between the natural system and the human system in the rural area from Țara Hațegului – Retezat. The natural system and the human system from the rural area represent a coupled system, where people interact with the natural elements; understanding the complexity of interactions within this system is mostly important both for people's welfare and for the sustainability of natural resources.

At the same time, the study approaches the relation between the natural and the human systems from the perspective of ecological values and behaviours manifested in the investigated rural communities, in relation to the on-household activities and to other present anthropic activities that can influence the quality of environmental factors. The study uses the quantitative and qualitative analysis, assisted by SPSS and ATLAS Ti software, the main instruments used being the following: questionnaires applied to rural households and in-depth interviews applied to the farmers from Țara Hațegului rural area.

Key words: natural system, human system, agro-ecosystem, ecological values and behaviours.

JEL Classification: Q12, Q20.

1. INTRODUCTION

The rural area from Țara Hațegului–Retezat, which represented the investigation area of the present study, consists of 11 communes and 3 villages pertaining to the town Hațeg. The identification of the determining elements within the natural system-human system relationship is based on the quantitative analysis of the information gathered through the questionnaire applied to rural households (besides the demographic and social aspects, the questionnaire applied to the rural households in this area also comprised elements linked to their ecological behaviour, with reference to agricultural and on-household activities which could generate negative aspects in relation to the environment) and the qualitative analysis of the in-depth interviews applied to farmers in the investigated area.

The assessment of the interconditionality relations between the two systems had in view two important dimensions, namely: objective dimensions – linked to the farming practice types in the investigated area, which determine different effects at the level of environmental factors and subjective dimensions – linked to the way in which the respondents evaluated the different investigated aspects, with implications upon the environment (the pollution potential of domestic and farming activities).

The main hypotheses of the present study are the following: a) the agricultural patterns present in the area generate a low impact upon the natural factors and b) the local ecological values and behaviours are influenced by the respondents' demo-social characteristics and also by the valorization, by them, of the economic advantages induced by the anthropic factors in the first place.

2. STATE OF KNOWLEDGE

The understanding of the complexity of interactions between the natural and human systems represents a central objective of the process of ensuring the welfare and sustainable development. The coupled natural and human systems represent integrated systems in which people interact with the natural elements (Liu *et al*., 2007). Although many studies approached the man-nature relationships, starting with George Perkins Marsh, who, in 1864 described for the first time the interdependence between the environment and society in his paper *Man and Nature* (Thomas Jr., 1956; Touner II, 1990; Vitousek *et al*., 1997), the complexity of the coupled systems has not been fully understood (Schneider, Londer, 1984; Berkes *et al*., 2003). Rosa (1998) considers that this is due to the traditional separation of ecological sciences from the social sciences. Although some authors approached the coupled systems as adaptive complex systems, most papers were of theoretical rather than of empirical nature.

Within this context, the scientists and other important players developed new integrated knowledge for understanding the complex systems, in order to solve up certain urgent social and environmental problems (Carpenter *et al*., 2009). One of the approaches bringing together detailed knowledge from different fields (social, economic, geophysical and biological) was known under the name of *Study of Coupled Human and Natural Systems* (briefly CHANS). This is based on the long tradition of research works on the interactions between the human and natural systems and it is different from other approaches through the explicit acknowledgement of the fact that these are coupled through mutual interactions, regarded as material flows, energy and information. The integration of the pieces of knowledge from different fields is essential, but at the same time difficult (Baker 2006, Baerwald 2009). Building up a conceptual model commonly agreed upon is crucial for collaborative, interdisciplinary research (Heemsherk *et al*., 2003).

3. MATERIAL AND METHOD

For the study of the "natural system – human system" interfunctionality specific to the rural communities (case study: agro-ecosystem, ecological values and behaviours), we used the quantitative and qualitative analysis of the rural interfunctionality processes and phenomena, assisted by the SPSS and ATLAS Ti informatics programs. The following instruments were used in the present paper:

- Questionnaires applied to rural households in the rural area from Țara Hațegului (communes Bretea Română, General Berthelot, Sântămăria Orlea, Baru, Sălaşu de Sus, Pui, Răchitova, Densuş, Râu de Mori, Sarmizegetusa, Toteşti and the villages pertaining to town), for revealing the farming types practiced at their level, as well as the ecological values and behaviours (a component of the socio-economic study). There were 400 investigated households in total. The questionnaires were subsequently introduced in a database and processed by the SPSS software, a program dedicated to the quantitative analysis;
- In-depth interviews applied to the farmers from the Romanian agricultural area (traditional products: ewe cheese, goat cheese, mixed cheese, potatoes, bee products, tzuica). The qualitative analysis of the in-depth interviews regarding the traditional agriculture in Țara Hațegului, conducted during the field surveys in the period August–October 2009, was made with the help of the ATLAS Ti 5.0 informatics program. From the identified sample, 10 in-depth interviews on traditional agriculture were selected for the qualitative analysis. This program represents a software tool dedicated to the qualitative analysis, being mainly useful when multiple, large documents must be analyzed, as in the case of in-depth interviews applied during the field surveys in Țara Hațegului. The choice of this program was based on the first place on the possibility to work with several documents/interviews simultaneously, within a single project/file, as well as on the multiple codification, visualization and information processing options, and on the possibility of exporting the results to compatible files with the quantitative analysis programs such as SPSS and Excel.

4. RESULTS AND DISCUSSIONS

The natural and human systems in the rural area represent a coupled system, where people interact with the natural elements; understanding the complexity of interactions within this system is extremely important both for the peoples' welfare, and for the sustainability of natural resources.

Within this system, the agro-ecosystem represents an important component, which covers an important share of the total area worldwide, being dominated by the anthropic activity (these landscapes range from intensively mechanized agricultural systems to extensive, subsistence systems).

Agriculture represents an important economic sector, mainly for the developing countries, with a low income per capita, representing an important share of GDP, and providing many jobs for the population. In this context, the analysis of the relation between agriculture and ecosystem represents a natural approach, having in view that agriculture represents an ecosystem where the anthropic activity prevails and that mutual interconditionality relations exist between the two components.

We shall next present the relation between the human system and the natural system in Țara Hațegului-Retezat area, both from an objective and subjective point of view, namely:

- Objective dimensions: types of farming practices and their impact upon the natural elements, other activities on the rural households level with a potential impact upon the environment (including the household endowments: the household annexes, their distance to the water resource, the domestic waste and manure storage, the place for animals slaughtering);
- Subjective dimensions: linked to the modality in which the respondents appreciated the main on-household activities from the pollution point of view as well as the influence of the anthropic constructions (dams, roads, guest-houses) upon the environmental factors.

4.1. Objective dimensions

4.1.1. Agricultural patterns in Țara Hațegului – Retezat

The analysis of the agricultural activities on the rural households revealed the existence of two agricultural patterns in the investigated area, namely: one pattern based on the utilization of both organic fertilizers and chemical inputs (fertilizers, herbicides, pesticides) in the agricultural activities and a traditional, ecological pattern, with a minimum impact upon the natural system elements. As regards the size of land into ownership, the rural households in Țara Hațegului own 4.6 ha on the average, out of which 76.41% are land areas with agricultural destination and 23.59% are land areas with forestry destination.

The structure of agricultural land, by categories of use, is the following: 48.50% arable land, 49.47% pastures and hayfields, 1.83% orchards or solitary fruit-trees, 0.20% land under vineyards. This structure differs across localities, with the relief as main factor of influence. The average agricultural land area, at the level of the whole investigated area, is 3.51 ha, ranging from 2.23 ha in the commune Baru to 5.81 ha in the commune General Berthelot. The hierarchy of the rural localities is the following: General Berthelot 5.81 ha, Sălaşu de Sus 5.35 ha, town Hațeg 4.78 ha, Pui 4.71 ha, Bretea Română 3.88 ha, Râu de Mori 3.70 ha, Densuş 3.51 ha, Sarmizegetusa 3.41 ha, Sântămaria – Orlea 2.59 ha, Răchitova 2.52 ha, Toteşti 2.41 ha, Baru 2.23 ha.

The pastures and hayfields represent the first category of use of the agricultural land by its importance in the investigated area (49.47%), being significantly different from one rural locality to another; thus, the lowest share of the land area under pastures and hayfields in total agricultural land is found in the commune Toteşti (22.56%), while the highest share is noticed in the commune Pui (67.75%).

The arable area represents the second category of use (48.50%) according to its importance in Țara Hațegului. As share in agricultural land area, the arable land ranges from 30.88% in the commune Pui to 75.50% in the commune Sântămăria – Orlea. The average arable land area is 1.71 ha, ranging from 0.75 ha in the commune Baru to 2.94 ha in the commune Sălaşu de Sus (Table 1).

The main crops grown in Țara Hațegului are the following: maize 36.69%, wheat 25.06% and potatoes 20.58%. The cropping structure also includes other crops, yet with a relatively low share: 5.14% of the cultivated area is occupied by vegetables, 4.44% by clover and alfalfa, 4.36% by fodder crops, 1.33% by oats, 1.03% by barley, 0.74% by triticale and 0.63% by two-row barley.

The *structure of hayfields maintenance works* in Țara Hageților is the following: 62.98% of households that operate hayfields perform "hayfield cleaning works", 15.87% "cleaning + organic fertilization works", 5.29% "organic fertilization", 3.37% "chemical fertilization", 3.37% "cleaning + other works", 2.88% "chemical fertilization + cleaning", 2.40% "organic fertilization + chemical fertilization + cleaning", 2. 40% "other methods", 0.96% "organic fertilization + chemical fertilization", 0.48% "cleaning + overseeding".

The main raw materials used in the crop production activity by the rural households from Țara Hațegului are the following:

- *Seeds*: the rural households buy mainly seeds for the maize crop (52.8% of households), potatoes (33.22%) and wheat (31.17%);
- *Chemical fertilizers*: 59.15% of households buy chemical fertilizers; in the rural localities, the households that use chemical fertilizers have a utilized agricultural area larger than than those that do not use not use chemical fertilizers;
- *Organic fertilizers*: these are used from own production on a large scale, so that 60.34% of rural households use organic fertilizers from own households and only 7.07% of households buy them;
- *Pesticides:* 48.73% of households buy pesticides, even though these are used only for certain crops (potatoes, vegetables) not as in the case of chemical or organic fertilizers that can be used in all crops; the share of households buying pesticides is lower in the communes Sarmizegetusa (16.67%), Sântămăria – Orlea 29.62% and Răchitova 30.00%.

Table 1
Characterization of arable areas, by communes and total sample

	Average arable land area	**Share of arable land by communes**	**Share of arable land area in agricultural land area**	**Average number of parcels per hectare of arable land**	**Average area of arable land parcel**
Bretea Română	2.59	5.89	66.72	2.14	0.47
General Berthelot	2.13	2.26	36.61	2.01	0.50
Sântămăria – Orlea	1.95	18.06	75.50	1.82	0.55
Baru	0.75	6.47	33.46	4.08	0.24
Sălaşu de Sus	2.94	11.60	54.93	2.56	0.39
Pui	1.48	15.01	30.88	2.17	0.46
Town Haţeg	2.10	6.99	43.89	1.71	0.58
Densuş	1.68	5.37	48.03	1.87	0.54
Răchitova	1.27	2.12	50.45	2.00	0.50
Râu de Mori	1.72	11.46	46.44	2.36	0.42
Sarmizegetusa	1.67	3.54	48.81	2.06	0.49
Toteşti	1.81	11.24	74.91	1.59	0.63
Total	**1.71**	**100.00**	**48.50**	**2.17**	**0.46**

Source: processing of data collected during the field survey conducted on a representative sample of households in the communes from Ţara Haţegului, in the period June–September 2009.

In the case of this agricultural pattern, the rural households also use chemical inputs (fertilizers, herbicides, pesticides), besides organic fertilizers resulting from livestock production, both in the land preparation stage for the establishment of crops and in the vegetation period. The excessive use of these products can lead to the degradation of the environmental factors, and further on, to disequilibria in the relation between the human system and the natural system.

The second pattern identified at the level of the investigated area is that of the traditional agriculture. Depending on the traditionality level and the ecological sustainability, the investigated traditional products are split into two categories:

A. *traditional products with maximum ecological sustainability* – obtained only within the traditional technological links while complying with the environmental conditions without any chemical aggression (no chemical treatment is applied);

B. *traditional ecological products* – obtained only within the traditional technological links with a relative respect of the environmental conditions by applying certain minimal chemical treatments.

In the first category (traditional products with maximum ecological sustainability) we can find products such as: goat cheese, ewe cheese, potatoes, tzuica, bee honey and forest fruit jam. These products are obtained on the basis of traditional methods, without using chemical substances in any stage of the production process:

– Iovăneasă Pavel, ewe cheese producer. "*...We do not apply chemical fertilizers in maize…* Could you use ecological methods on larger areas? *Yes, it can be done. We are trying to remove chemicals from our food, we accept them only in case of force majeure... We have not given our potatoes nitrogen for years, neither complex fertilizers, nothing, we grow them traditionally, we only put manure on the land, with our sheep, in autumn; we plant the potatoes there. The potatoes take the nitrogen they need from sheep manure. They take enough nitrogen from the sheep manure.* Do you use the sheep manure for potatoes, maize, and wheat? *First in potatoes, then in maize, not in wheat.*"

– Dudău Dinu, goat cheese producer. "...Do you apply organic fertilizers on the hayfields, no chemical fertilizers? *Yes, no chemicals...* Did you use chemical fertilizers last year? *No, only manure...* The small potatoes that you give to the goats are from your own harvest? *Yes. Everything goats eat is from our own harvest, we do not buy anything.* Do you treat the potatoes with anything? *Only with goat manure. We also have two cows. We apply only manure on the field*."

– Sandu Septimiu, potato, maize and tzuica producer. Tzuica: "*...You must take good care of them, the same as with children. If you do not take care, if you do not dig them to get roots, if you do not apply manure, sure they won't grow up, won't develop... We do not put manure at the orchard every year, only at about two years.* Why at every two years? *We apply manure every two years, because it has enough of it. The soil does not assimilate it so quickly. I also make a rotation, as there is not enough manure for all the 800 plum trees...* If you do not apply pesticides, what treatments do you apply? *Well, if we clean them and take care of them, trees won't suffer. Pests do not appear anymore, but normally pesticides should be applied. The leaf rust may appear.* Has it appeared since '89? *It happened to appear.* What did you do? *In fact, we didn't do anything. The yield was lower that year. People won't drink it... They drink beer and whisky instead. People won't drink a clean, ecological tzuica, made in a copper still. Mine has 0.02 impurities."* Potatoes and maize: "...Have you applied chemical fertilizers in maize? *No, only manure. I have it here in the village and I brought only manure.* Have you applied pesticides or herbicides? *Only manual weeding. S*o, you did not apply anything. Is it an ecological crop? *Yes, it is ecological...* What is the area under potatoes? *Around 30–35 ares.* Do you sell the potatoes? *I sell the surplus, some remain here.* What do you treat them with? *Manure and digging.* Do you use any chemical fertilizers on potatoes? *No, I don't..* Do you use pesticides? *No, I don't.* Herbicides? *I don't either. We have only 30-35 ares, we farm them in the family, we dug them, two rounds of manual weeding and ready...* So, there are small land areas with potatoes, and people do not use chemical fertilizers. *That's it. We only put manure on soil. The potatoes are not infested and they taste differently...* Are they white or red potatoes? *Both white and red. The red ones are in more demand, at least in this area of Hunedoara county. We grow both types. It is a well-known fact that we do not use any chemicals in this area.*"

– Avrămescu Miuțu, bee honey producer. "...Did people ask you for ecological products or not ? Are they indifferent? *People became sensitive to quality, they want to buy quality products. Many people would ask me if I put sugar in it. They would ask me: is it 100% natural honey? I tell them that it is. They are interested in this, whether the honey is 100% from bees, whether it is acacia honey, or polyflower honey... We collect much pollen here. There are many willow-trees and hazelnut trees. This guy, who gave me the collector, has been collecting it for a long time. There is also another guy who does this. We thought we might get a better price. This year it was around 3 euro/kg. It is not a polluted zone, it is clean.*"

– Ciolea Ioana, producer of forest fruit jam "...What quantity of raspberry do you collect to make jam? *There's a lot of raspberry round here, but there isn't anybody to collect it. I make jam from 1 bucket or two of raspberries.* What is the capacity of one bucket? *10 kg.* Do you also gather blueberries? *Yes, we do, but not his year, we didn't have time. C*ould you tell me the raspberry jam recipe? *My daughter makes it. You put raspberry and sugar in the same amount and you stir them with the wooden spoon.* Do you put it on oven? *No, we don't.* How long do you stir the mixture? *About 2 hours. What do you make from blueberries*? *Also jam.* How do you make it? *Blueberries are boiled with sugar. You put 1 kilo to 1 kilo, because it tastes good like this. You boil it for an hour or so. You leave it to get cool.*"

In the second category, of traditional ecological products (type B) respectively, we find both vegetable and animal products (potatoes, ewe cheese). These products are obtained through traditional methods and techniques, but some minimal chemical treatments are also applied in the production process:

– Suciu Septimiu, potato producer: "...What can you tell us about potatoes? *In autumn we till the land. Autumn ploughing lasts until November 1, until freezing time. I apply organic fertilizers, around 20 t/ha. In spring, in April, I plough, but not so deep. I sow the potatoes with the potato planter...* Where do you buy the seeds from? *From Hațeg. I use the seed from my own production, but every 3 years I buy elite seeds. I put one bag of seeds on one are, that is 3500 kg/ha. At 10–15 days after sowing I apply chemical fertilizers, nitrogen 500 kg/ha. I apply nitrogen only once... The next stage is digging, after the emergence of aerial stems. This is mechanized. I use Sencor or Aflon as herbicides. Afalon is not manufactured any more, but it was good. The herbicides are also applied mechanically, I put them in the pump on the tractor and apply about 2 kg/ha. The manual weeding comes next, with the family members. We weed about 15 days in one year. I treat the potatoes against the Colorado beetle, twice, and against blight, also twice...* Can we grow crops in the absence of chemical fertilizers? *We can make it without chemicals, only with the hoe, without herbicide, in certain crops. But not in potatoes, because of the Colorado beetle. You must apply treatments, as there is no other way. In potatoes it is quite difficult, as the production is small and you cannot make it only with manure and by hoe.*"

– Olărescu Emil, potato producer. "*...I use manure as fertilizer. I take it to the field towards the end of the winter. I take about 5–6 trailers. A trailer has around 1 ton, so around 5-6 tons of manure in total. I also apply chemical fertilizers, but only after sowing, that is in late March, early April. I put around 6 bags of nitrogen, and I do this only once. When potatoes spring, that is when they are 10 cm tall, at 3 weeks – one month after I sowed them, I apply herbicide, Sencor. I use Calypso against the Colorado beetle. I also apply two treatments against blight, twice a year. 2 weeding rounds, depending on when they emerge, the first before applying the herbicides and the second when they grow bigger, to have them better covered with earth.*"

– Brăila Cornelia, ewe cheese producer. "...Do you own the pasture? *I own 2 ha of hayfields in the mountains. I have a lot of land. In one place we mow the grass, the animals graze in another place. I also take them to the communal pasture. I cannot take them from one place to another without crossing the communal pasture with them.* What else do you feed them on, besides hay? *In the suckling period I give them barley, wheat and oats.* Do you apply any chemicals on wheat or on maize? *No. Only in wheat I sometimes apply herbicides...* Do you make any treatments in animals? *I make treatments because there are many diseases now. The shepherd gathers many sheep in summer, his and others' sheep, and I do not know what diseases they can get.* Do you have a vet? *Yes, we do.*"

This category of traditional products (type B) generates a minimum impact upon the natural system elements in the investigated area, by the rational use of the chemical substances, in parallel with the organic ones, in the situation in which their use is absolutely necessary. Together with the traditional products with maximum ecological sustainability (type A), these make up an agricultural pattern that must be supported and developed; this represents a modality to support the "local heritage" and an important approach in the process of maintenance/ preservation of the cultural and actional identity of the rural area.

4.1.2. Household annexes

The aspects investigated in this section refer to the existence of the household annexes, to their age as well as their distance to the water source.

Out of the total households investigated in Țara Hațegului, 77.5% own stables – for horses or cows, 60.5% storage facilities, 12.3% sheep pens, 39.5% shed, 87.8% poultry coop and 54.3% pigsty. Other household annexes such as glasshouses or mobile plastic greenhouses are also present in this structure, yet with very small shares in total sample.

As regards the share of households that own annexes, per communes, there are important differences in the case of most household annexes categories. By the main annex categories, the situation is the following:

- Stables – for horses or cows: lower shares are found in the communes Toteşti (56.1%), Sântămăria – Orlea (62.3%) and General Berthelot (71.4%), while higher shares are found in the communes Răchitova (100%), Bretea Română and Râu de Mori (93.3% each), and Sarmisegetuza (92.9%);
- Storage facilities: their shares range from minimum 39.1% in the case of the villages pertaining to the town Hațeg (39.3% in the commune Sântămăria – Orlea) to maximum 86.7% in the commune Bretea Română;
- Sheep pen: there are communes where the share of households that own such annexes is zero (Bretea Română and General Berthelot), going up to 25.3% in the case of the commune Pui, or 16.7% in the case of the commune Densuş.

Referring to the household annexes of the type glasshouse / mobile plastic greenhouse, there is a very small number of households that own such annexes: one household in the commune Toteşti (glasshouse) and 7 households with mobile plastic greenhouses, out of which 3 in the villages pertaining to the town Hateg, two in the commune Toteşti and one in the communes Sâtămăria – Orlea and Râu de Mori.

Most household annexes are old-aged in total sample – over 30 years old. An exception is represented by the glasshouses and mobile plastic greenhouses, the average age of which is 3 and 5 years respectively. There are also significant differences by communes in the case of this indicator, for instance: in the case of stables – the average age ranges from minimum 35–36 years in the communes General Berthelot and Răchitova to maximum 51 years in the commune Sălaşu de Sus; in the case of sheep pens – values much under the average of the sample are found in the communes Sântămăria – Orlea, the villages pertaining to the towns Hațeg and Sarmizegetusa – 10, 11 and 15 years old respectively, with higher values in the communes Toteşti, Râu de Mori and Densuş – 40, 41 and 58 years old respectively. Similar situations are also found in the case of household annexes of the poultry coop and pigsty type, whose age ranges from 20 to 43 years, in the first case (communes General Berthelot/Râu de Mori); and from 11 to 51 years, in the second case (communes General Berthelot/Sălaşu de Sus).

The next investigated indicator, the average age of the household annexes by household head/manager's gender reveals the existence of the following tendency: **in most cases, the households run by women own household annexes that are older than those run by men**.

The differences between the average age, by annex category, are in general 3 years. The greatest difference can be noticed in the case of storage facilities, where their average age is 45 years, in the case of the households run by women and 40 years, in the case of households run by men. The only category of annexes that does not follow this trend is represented by greenhouses. If we analyze this indicator in the investigated communes, we can see that there are significant differences between these, namely: communes with very great differences in

favour of the households run by men (Bretea Română, Baru, Densuş); there are also cases where in most annexes, the differences are in favour of the households run by women – Sălaşu de Sus and the villages pertaining to the town Haţeg.

People's age represents another factor influencing the age of annexes owned by the investigated households. Thus, **the households run by persons aged less than 40 years own annexes that are newer than those run by persons in the older age categories**. This phenomenon holds true for most types of household annexes included in the present analysis. The trend is also maintained in the case of the comparison between the households run by persons aged between 41 and 55 years and those run by persons over 55 years old. An exception in this case is represented by the annexes of poultry coop and pigsty type: 43 years *versus* 37 years old – in the first case, 38 years *versus* 37 years respectively – in the second case.

Another important indicator in this section is represented by *the distance to the water source of household annexes* – which can generate negative effects upon the environment, mainly in the case of annexes for animal raising activities.

Out of total investigated households that own stables for cows or horses, the greatest part, i.e. 26.3% have these annexes located at 20–50 meters from the water source. Those placed at 10–20 meters come next, with 25.5%, those at 5–10 meters, with 13.7% and those placed at a distance smaller than 5 meters, with 13.3%. Taken together, these categories represent 78.8% of the investigated households. The remaining shares are divided between the households with stables placed at: 50–100 meters (7. 8%), 100–500 meters (8.2%), 500–1000 meters (3.9%) and over 1000 meters – 1.2% (Table 2).

Table 2

Share of households according to the distance of stables to the water source, by communes and total sample

– % –

Commune/ Distance	< 5 m	5– 10 m	10– 20 m	20– 50 m	50– 100 m	100– 500 m	500– 1000 m	> 1000 m
Bretea Română	7.7	…	7.7	38.5	15.4	7.7	7.7	15.4
General Berthelot	…	20.0	20.0	40.0	…	20.0	…	…
Sântămăria – Orlea	16.7	30.0	13.3	13.3	6.7	10.0	10.0	…
Baru	17.1	17.1	31.4	20.0	…	5.7	5.7	2.9
Sălaşu de Sus	22.2	5.6	22.2	27.8	…	11.1	11.1	…
Pui	6.1	16.3	26.5	18.4	18.4	12.2	2.0	…
Town Haţeg	16.7	16.7	16.7	22.2	…	27.8	…	…
Densuş	22.2	5.6	27.8	33.3	5.6	…	5.6	…
Răchitova	33.3	11.1	33.3	22.2	…	…	…	…
Râu de Mori	6.3	6.3	31.3	37.5	15.6	3.1	…	…
Sarmizegetusa	10.0	…	50.0	40.0	…	…	…	…
Toteşti	11.1	16.7	27.8	38.9	5.6	…	…	…
Total sample	**13.3**	**13.7**	**25.5**	**26.3**	**7.8**	**8.2**	**3.9**	**1.2**

Note: (...) – there are no cases or valid answers for calculation.

Source: processing of data collected during the field survey made on a representative sample of households in the communes from Ţara Haţegului rural area, in the period June–September 2009.

As regards the share of households according to the distance of stables from the water source, by communes, the tendency for their placement at relatively small distances is maintained; however, there are also communes where the share of the communes falling into the first distance categories (under 5 meters, 5–10 meters) is small: Bretea Română, Râu de Mori, Sarmizegetusa. Similar situations are also found in the case of the other types of household annexes.

4.1.3. Domestic waste/manure storage

Most investigated households (75.7%) declared that they store the household waste in bins, dumpsters or bags, which is eventually collected by specialized firms and transported to the landfill of waste. The remaining households store the household garbage either in a garbage pit (on the household or at the locality level) – 6.1%, or use other storage methods/forms – 18.2%.

The differences between the investigated communes, from this point of view, are quite significant: there are communes where the households exclusively use bins, dumpsters or bags as waste storage form – General Berthelot, Sarmizegetusa, the villages pertaining to town Hațeg, Toteşti, Densuş, Baru, Râu de Mori, Sântămăria – Orlea (over 87% of the households); there are also communes where the share of the communes using this method is under 50% – Bretea Română (42.9%), Pui (33.3%) and Răchitova (30.0%). The latter mainly use other forms of household garbage storage (70.0% of the investigated households in the commune Răchitova) or garbage pits at the level of household or locality.

As regards the storage of waste resulting from the animal raising activities at household level, out of total of households falling under this category, 40.8% declared that they store it on earth platforms, 32. 2% under other forms and 16.7% in their own garbage pit in the ground. Only 10.2% of households involved in such activities store their manure on concrete platforms or in their own concrete pits. In this case as well, there are significant differences between the investigated communes, mainly as regards the category “concrete platforms”. Thus, we can find communes where the share of households using this method is quite significant – Sarmizegetusa (57.1%), Sălaşu de Sus (23.1%), Sântămăria – Orlea (12.0%), and also communes where none of the investigated households mentioned that they use this method – Bretea Română, General Berthelot, villages pertaining to the town Hațeg, Densuş, Răchitova or Râu de Mori. In the case of the last three mentioned communes, we could notice the highest share of households using their own concrete pits for manure storage (Table 3).

Having in view the small number of households that use different manure storage forms, meant to ensure a high protection degree, such as the concrete platforms and the concrete pits, the structures by gender, **age or education of the**

household head have small differences by categories, which let us draw the following conclusions: the households run by men opt for these storage forms in a higher share compared to those run by women; from the household head's age point of view, the households more oriented towards these forms are run by persons under the age of 40 years (in the case of concrete pits) and those aged 41–55 years (in the case of concrete platforms); as regards the educational level, those who use concrete pits are persons with no schooling, those who graduated high school and post high school/faculty, and those using concrete platforms graduated other forms of schooling, high school and secondary school.

Table 3

The share of households by manure storage modality, by communes and total sample

– % –

Commune/Manure storage modality	Own pit in the ground	Own concrete pit	Earth platform	Concrete platform	Other situations
Bretea Română	25.0	…	16.7	…	58.3
General Berthelot	25.0	…	25.0	…	50.0
Sântămăria – Orlea	24.0	…	36.0	12.0	28.0
Baru	22.2	2.8	27.8	2.8	44.4
Sălaşu de Sus	7.7	7.7	38.5	23.1	23.1
Pui	12.7	1.8	47.3	3.6	34.5
Oraş Haţeg	…	…	50.0	…	50.0
Densuş	5.3	10.5	42.1	…	42.1
Răchitova	22.2	11.1	33.3	…	33.3
Râu de Mori	20.0	8.6	65.7	…	5.7
Sarmizegetusa	14.3	…	…	57.1	28.6
Toteşti	20.0	5.0	40.0	10.0	25.0
Total sample	16.7	4.1	40.8	6.1	32.2

Note: (...) – there are no cases or valid answers for calculation.

Source: processing of data collected during the field survey on a representative sample of households in the rural area from Ţara Haţegului, in the period June–September 2009.

4.1.4. Animal slaughtering options

Animal slaughtering represents an activity with potential impact upon the environment, mainly under the conditions in which it takes place near water sources.

Out of total investigated households that answered this question, the overwhelming majority, i.e. 98.5%, stated that animals are slaughtered in the household yard; the share of those that appeal to slaughterhouses for this activity is only 0.6%, while 0.9% use other modalities.

The only cases of households that appeal to slaughterhouses to have their animals slaughtered were found in the commune Sălaşu de Sus, and the households that used other modalities to slaughter their animals were found in the communes Sântămăria – Orlea and Pui.

From the demographic and social factors point of view, the few households that appeal to slaughterhouses to have their animals slaughtered are run by men, aged over 55 years, who graduated secondary or vocational school. As regards the distance from the slaughtering place to the nearest water source, most investigated households declared that animal slaughtering takes place at 20–50 meters from the nearest water source – 43.8%, followed by the distance interval 10–20 meters, with 23.8% and 5–10 meters, with 15. 2%.

There are significant differences between the investigated communes with regard to the distance of the slaughtering place to the nearest water source. Thus, there are communes where all the investigated households, or most of them, slaughter their animals at less than 50 meters from the water source – Sarmizegetusa, Sălaşu de Sus, Toteşti, Râu de Mori, Pui; there are also communes where we can find a significant number of households that slaughter animals at a distance over 50 meters from the water source – Bretea Română, Densuş, Sântămăria – Orlea and Baru.

4.2. Subjective dimensions

This section refers to the way in which the respondents evaluated the impact of anthropic activities upon the natural system elements of the investigated area – on-household activities, agricultural activities, tourism and the building up of the water storage dams on the Râul Mare-Retezat river.

The structure of answers, by gender, reveals that the women respondents appreciate to a greater extent, compared to the male respondents, the non-polluting character of the activities developed at household level – on-household activities (82.8%) and crop growing (84.7%). The animal raising activity is not considered to be a polluting activity by 85.4% of the male respondents and by 84% of women respondents (Table 4).

The respondents with a higher educational level stand out as regards the assessment of the activities developed at household level, compared to the other categories: 78.6% consider that the household activities are polluting, compared to the respondents with only primary education (88.2%); similar situations can be also found in the case of answers regarding animal raising and crop growing. However, the distribution of answers reveals different values within the same educational category, which can be explained by the dependence of the educational capital on the socio-economic status of the rural community. In the respondents' opinion, the anthropic factors of the type: dams, guest-houses, leisure houses and roads (newly built or modernized) had a low or very low impact upon he environment: dams – average score 1.88, guest-houses – 1.55, leisure houses – 1.46 and roads – 1.81 (Table 5).

Table 4
Perception of the polluting status of the main rural activities

– % –

	The on-household activities are not polluting		**Animal raising is not polluting**		**Crop growing is not polluting**	
	men	women	men	women	Men	women
Baru	77.4	69.6	87.1	80.0	77.4	84.0
Bretea Română	87.5	83.3	87.5	100.0	87.5	85.7
Densuş	90.0	91.7	90.0	91.7	77.8	100.0
General Berthelot	100.0	100.0	100.0	100.0	100.0	100.0
Pui	68.4	90.6	84.2	90.6	83.8	93.8
Răchitova	66.7	100.0	66.7	75.0	66.7	100.0
Râu de Mori	90.0	77.3	78.9	81.8	85.0	77.3
Sarmisegetusa	66.7	87.5	80.0	87.5	80.0	87.5
Sălaşu de Sus	45.5	71.4	81.8	71.4	63.6	66.7
Sântămăria – Orlea	85.7	75.0	84.6	85.7	89.3	89.3
Toteşti	85.0	90.5	95.0	76.2	85.0	71.4
Villages pertaining to the town Haţeg	88.9	92.9	77.8	85.7	77.8	85.7
Total	**78.9**	**82.8**	**85.4**	**84.0**	**82.4**	**84.7**

Source: processing of data collected during the field survey on a representative sample of households in the communes from Ţara Haţegului, in the period June–September 2009.

Table 5
Influence of anthropic factors: dams, guest-houses, leisure houses, roads upon the environmental factors

– average values –

Do you consider that… contributed to environment pollution?	**Dams**	**Guest-houses**	**Leisure houses**	**Roads**
Bretea Română	1.90	1.33	1.50	1.57
General Berthelot	2.50	2.50	1.60	2.40
Sântămăria – Orlea	2.20	1.81	1.77	2.42
Baru	2.08	1.41	1.11	2.13
Sălaşu de Sus	1.86	1.80	1.57	1.83
Pui	1.78	1.71	1.38	1.62
Oraş Haţeg	1.15	1.56	1.64	1.21
Densuş	1.73	1.11	1.10	1.25
Răchitova	1.50	1.50	1.25	1.63
Râu de Mori	1.92	1.36	1.57	1.44
Sarmizegetusa	1.20	1.00	.	1.50
Toteşti	1.62	1.50	1.53	1.90
Total	1.88	1.55	1.46	1.81

Note: average value, where 1 represents not at all, and 5 very much.
(.) – there are no valid data for processing
Source: processing of data collected during the field survey conducted on a representative sample of households in the communes from Ţara Hategului, in the period June–September 2009.

The spatial distribution of the answers does not reveal significant differences as regards the polluting potential evaluation of the anthropic activities. Moreover, lower average values can be found even at the level of the communes whose territory is equipped with hydro-technical facilities and where a great part of the accommodation units of guest-house type can be found; this can be explained by the valorization by the respondents of the economic advantages induced by these factors (jobs, economic development of the zone) in the first place.

5. CONCLUSIONS

The main elements that intervene in the natural environment – human environment relation in the investigated rural area are represented by the anthropic activities and behaviours.

Agriculture. The two identified agricultural patterns in the area generate different effects at the level of the natural environment component. The first pattern, which combines both traditionality and modernity elements (by the utilization of the chemical inputs such as fertilizers, herbicides and pesticides, besides the organic substances) can lead in time to the degradation of the environmental factors in the situation of the excessive use of these chemical products, and further on, to the emergence of a lack of equilibrium within the human system – natural system relation. However, in this case, the necessary premises exist for lowering the pressure upon the environment – we have in view here that almost half of the investigated households do not use such chemical inputs (due to insufficient financial resources to purchase these products, small land areas cultivated for self-consumption), as well as the increase of the demand for ecological products, which could determine some rural households to shift to the conversion to organic farming. The second identified pattern, i.e. the traditional ecological agriculture, has a very low impact upon the environmental factors: we refer here to the traditional products of B type for the production of which the chemical inputs are rationally applied, in parallel with those of organic origin, only in the situation in which their use is absolutely necessary. Together with the traditional products with maximum ecological sustainability (type A), these contribute to an agricultural pattern that should be supported and developed; this represents a modality to support the local "heritage" and an important approach in the process of maintenance/conservation of the cultural and actional identity of the rural area.

Ecological values and behaviours. The analysis of the investigated rural communities reveals the existence of a moderate ecological behaviour at the level of the rural households, resulting from: the high share of households having their household annexes (stables for horses or cattle) placed at a small distance from the water source, the low share of households using manure storage modalities that provide for a high protection level – concrete platforms and pits; a low awareness level of the potential dangers generated by people's activities (domestic activities,

livestock raising, crop growing) in relation to the environmental factors. Yet, there are also favourable elements which could lead, in time, to the change of the current situation: high share of households using sustainable methods for household garbage storage (bins, dumpsters); high awareness level with regard to the main role that all the local community members must play in the field of environment protection, before other institutions or organizations; as regards the impact of other anthropic activities upon the natural capital elements (dams, guest houses, leisure houses, roads) the respondents from the investigated rural communities generally consider that these have a low or very low impact, fact which could be explained by the valorization by the respondents of the economic advantages induced by these factors (jobs, economic development of the zone) in the first place.

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