DRIVERS AND DYNAMICS OF AGRICULTURAL LAND FRAGMENTATION IN THE WESTERN PART OF THE ROMANIAN PLAIN

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Abstract. Excessive fragmentation of the agricultural land in Romania has been a governance challenge over the last decades, yielding multiple social and economic implications particularly for the development of the rural space. This study analyzes the causes of land fragmentation and the dynamics of land use during the last 30 years in the western part of the Romanian Plain (i.e. the Romanați Plain), an agricultural area where excessive land fragmentation is one of the most visible effects of land governance, which significantly connects with the way agricultural resources are used, the level of crop productions, as well as with land degradation. The agriculture in Romania has experienced strong changes since the fall of the totalitarian regime in 1989, passing through major transformations during the transition and post-transition periods toward market economy, especially in what regards land tenure, land structure and yield productivity. Based on field observations and semi-structured interviews with local authorities and managers of 15 farms of different sizes, we analyzed the main drivers of land fragmentation and their effects on yield production and on the evolution of the land use structure. It is shown that governmental measures regarding property ownership, irrigation system operation, demographic trends, EU Common Agricultural Policy and land and food markets are the main direct and indirect drivers of land fragmentation. Discussion about the implications of these findings for debates on adaptation and agricultural sustainability, and thematic research perspectives complete this article.

1. INTRODUCTION

Land fragmentation is one of the multiple consequences of the structural transformations that followed the fall of the centralized regime in Central and Eastern Europe, particularly of the many reforms during the transition and post-transition periods from a command economy toward market economy. The political and economic transitions have powerful impacts on what happens on land because past structures are reassessed for their utility, reorganized and new networks and patterns of land functionality emerge (IGBP Report No. 53/IHDP Report No. 19, 2005). At times of transition, the dynamics in all spheres (e.g. social, economic, and political) are quite sharp and likely to produce discontinuities of the processes that generate the functionality of different systems. Referring to the land system, it requires sound examination of the relationship between the socioeconomic dimension and land use, land cover and rural communities for understanding the land change patterns and for providing insights on appropriate coping strategies for development that might be taken at local and regional levels (Rindfuss *et al*., 2004; Verburg *et al*., 2015; Meyfroidt *et al*., 2018).

The countries of Central and Eastern Europe have been through a series of land reforms since 1989 with the purpose of privatizing state-owned agricultural land. Depending on each country conditions and historical background, this process took different implementation forms, being related

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to various degrees of land fragmentation (FAO, 2003; Hartvigsen, 2014; Banski, 2017). Hartvigsen (2014) synthesizes the ways land reforms occurred in Europe, highlighting the drawbacks and opportunities for rural development. For instance in Poland, where before the fall of the socialist regime land was private in as much as 75% of the agricultural land (i.e. private ownership as well as in private use by individual farms), less had to be returned to its former owners; the privatization here was mostly done by land sales in auctions and through direct sale to eligible groups, but with a preference for the former owners (Hartvigsen, 2014). In Hungary, it was established a compensation form, which was not limited only to agricultural land but to all assets nationalized from the citizens between 1949 and the beginning of transition in 1990; the compensation rights were given to former land owners; also, another form of ownership rights attribution consisted in the distribution of land to landless members of former collective farms and employees of state farms. Thus, in Hungary the 1.5 million new owners received in total 3 million ha through distribution of physical parcels (Hartvigsen, 2014). In Romania, as we will detail later, the privatization of the state-owned agricultural land was based on the restitution of land ownership rights in the form they were just before communism came into power in 1947. In general, land reforms generated in each country various degrees of land fragmentation. In the context of European Union, Romania is the country with the most numerous agricultural family farms of very small and small size (EUROSTAT, 2015, 2018), fact which is associated with a high degree of land fragmentation.

A distinction has been made in what regards the fragmentation of agricultural land, specifically the fragmentation of ownership and the fragmentation of land use (Hartvigsen, 2014; Ciaian *et al*., 2018; Looga *et al*., 2018). The relationship between the two aspects has implications particularly for the dynamics of the land market and the economic situation of farms, and for the development of agriculture, in general.

Land fragmentation is intrinsically connected to land tenure aspects. It particularly relates to land tenure form, i.e. referring to the particular packages of rights regulating who can benefit from land, but also to land tenure security, which is the overall assurance that those rights will be upheld (Robinson *et al*., 2014; Ciaian *et al*., 2018). In general, land tenure (i.e. all rules, norms, institutions that govern land use and access to land and land resources) is a key driver for land use structure and land use change, and an indication about the way agricultural land is managed in a localized context (Robinson *et al*., 2017; Sikor, 2009). Inadequate governance that undermine land tenure security is often associated with situations such as unsustainable farming practices that generate short-term gains at the cost of social and environmental imbalance or unjust investments (Behnassi and Yaya, 2011; Robinson *et al*., 2014).

Moreover, confused and insecure situations about land tenure, which in many cases overlap impoverished socioeconomic conditions of the rural life, could easily lead to such situations of land grabbing, financial speculations on the land and agro-food markets and investments where profits would be externalized (Popescu, 2018; Popovici *et al*., 2018). This is particularly true when market instruments are not strongly regulated in the interests of the local entrepreneurship and preservation of local land resources (Popescu, 2018).

At the same time, agricultural land fragmentation is in numerous cases associated to land degradation, being related to a complex array of socioeconomic, environmental and policy factors (e.g. land use change, land tenure security and property rights, agricultural subsidies and taxes, etc.) (Benedek, 2003; Robinson *et al*., 2014; Feranec *et al*., 2017). High fragmentation of land is associated with existence of numerous small farms and in many cases with subsistence agriculture. In such cases, unsustainable farming practices, difficult financial situations and lack of professional training cause land degradation over time.

Land fragmentation also contributes to yield variability, amplifying the climatic effects and the impact of the management practices. Identifying the main causes of yield variability and designing strategies to minimize them is essential for reducing the associated risks of low productions, land degradation, little technological uptake and inadequate adaptation measures for long-term sustainable management.

The links between land tenure and agricultural land use structure, and subsequent implications for crop production and farms' economic viability, could be well expressed in case-studies investigating site-specific socioeconomic and political factors, institutions and historical trajectories with implications for land use. Furthermore, in areas with the most dynamic land use changes, land tenure tends to be complicated, often subject to continuously emerging institutional (re)arrangements and, therefore, diverse land uses (Behnassi and Yaya, 2011).

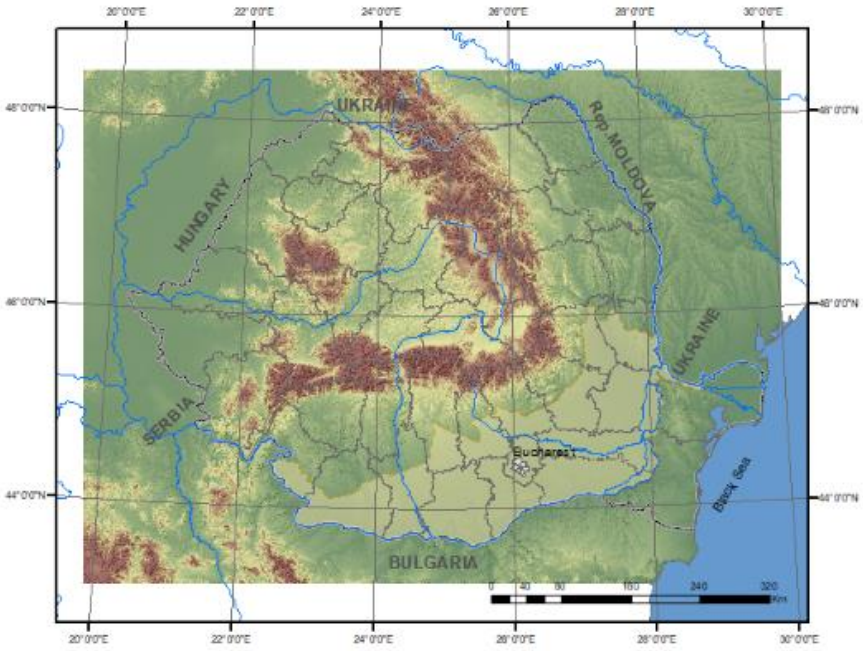
In this context, the aim of this paper is to comprehensively capture the relationships among the drivers of land fragmentation and land use structure and yield productivity in an exemplary area in the western part of the Romanian Plain (Fig. 1). Specifically, we investigated the dynamics and drivers of agricultural land fragmentation and the connections to the structure and yield productivity of farms in the Romanaţi Plain, an agriculturally dominant region in the western part of the Romanian Plain. The analysis was based on field observations along a North-to-South geographic profile and on a survey based on open-questions interviews with 15 farms and local authorities in representative localities of the study-area. The paper proceeds as follows: Section 2 discusses the main physical and socioeconomic characteristics of the study-area and their relevance for the agricultural land use (2.1). It also introduces the field analysis, namely the design of the semi-structured interviews conducted in the study-area with the local authorities and the farmers, and the related data, as well as the field observations (2.2). The following sections summarize the research results, i.e. the main phases of land use dynamics over the last 30 years with emphasis on the radical transformations of the transition periods towards market economy and their effects on land use (3.1), the field observations on land fragmentation (3.2) and the main drivers of land use fragmentation (4.1). The last section concludes the paper, referring to the implications of land measures and need for research for land consolidation (4.2).

2. DATA AND METHODS

2.1. Study-area

The region of the Romanaţi Plain, part of the Oltenia Plain, west of the Romanian Plain, was chosen as an exemplary case-study to show the characteristics of land fragmentation and the connections with land use structure and yield productivity. Located between two major tributaries of Danube, Jiu River in the west and Olt River in the east, the region is bordered in the north by the Getic piedmont hills and in the south by the Danube (Fig. 1).

The natural conditions in this geographical subunit of the Romanian Plain impose the particularities related to agricultural land use and farming practices. The main relief units are: i) the inter-fluvial piedmont plain in the north (i.e. genetically, it forms the southern part of the morfo-structural unit of the Getic Plateau), with altitudes between 180 m and 100 m, covered by loess deposits of 5–15 m thick and, partly, by sand dunes towards the contact with the rivers' formations, and ii) the terraces and adjacent floodplains of the Danube River and its two major tributaries, with altitudes from 75 m to 5 m (Bălteanu, 2006). The Danube floodplain, as well as the Olt floodplain, are largely extended, reaching 10–14 km (i.e. near Dăbuleni locality) and 6–7 km wide, respectively. Likewise, a non-uniform cover of sand dunes extends over floodplain areas, most of the rivers' terraces and partly over the piedmont plain areas in the north (e.g. on the Danube inferior terraces, between Bechet and Dabuleni localities, high (i.e. 15–20 m) and nonconsolidated eolian sand dunes are largely extended) (Geografia Romaniei V, 2005).



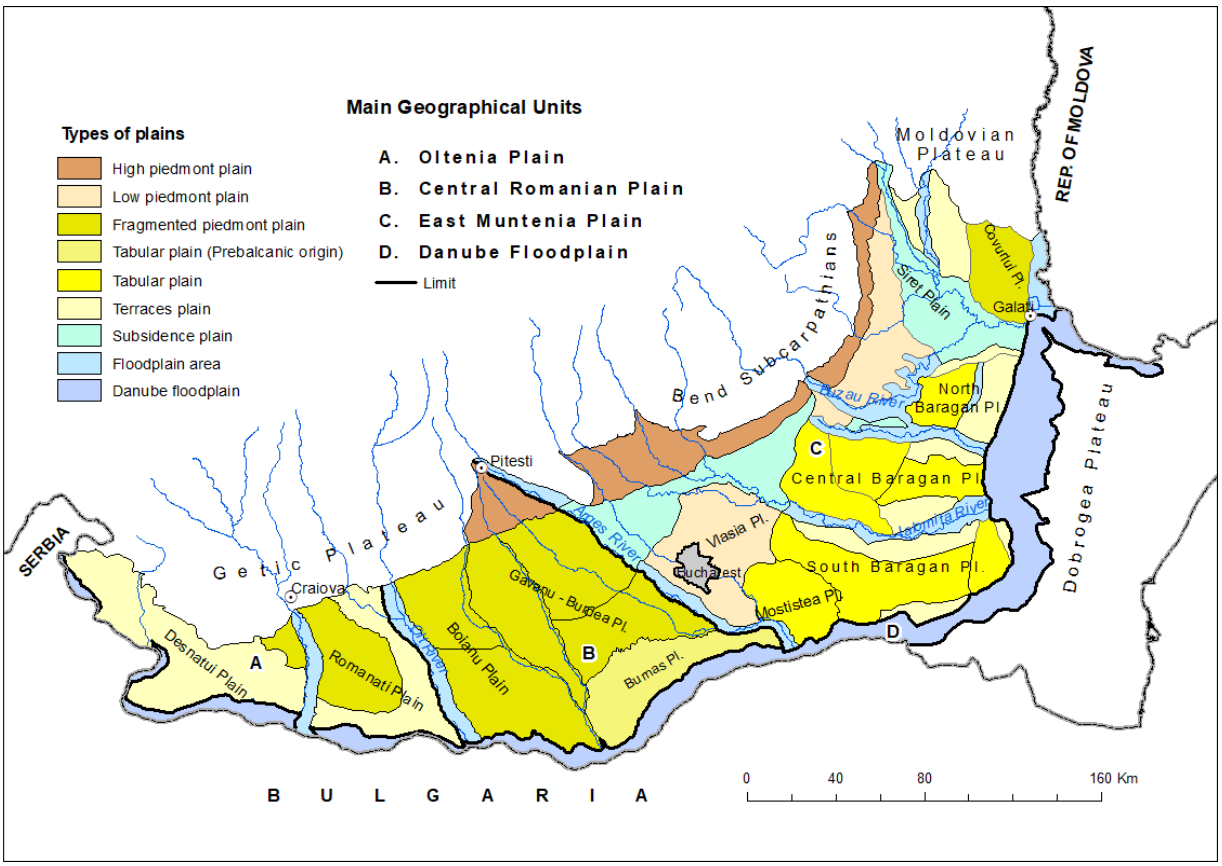


Fig. 1a – The main geographical units of the Romanian Plain.

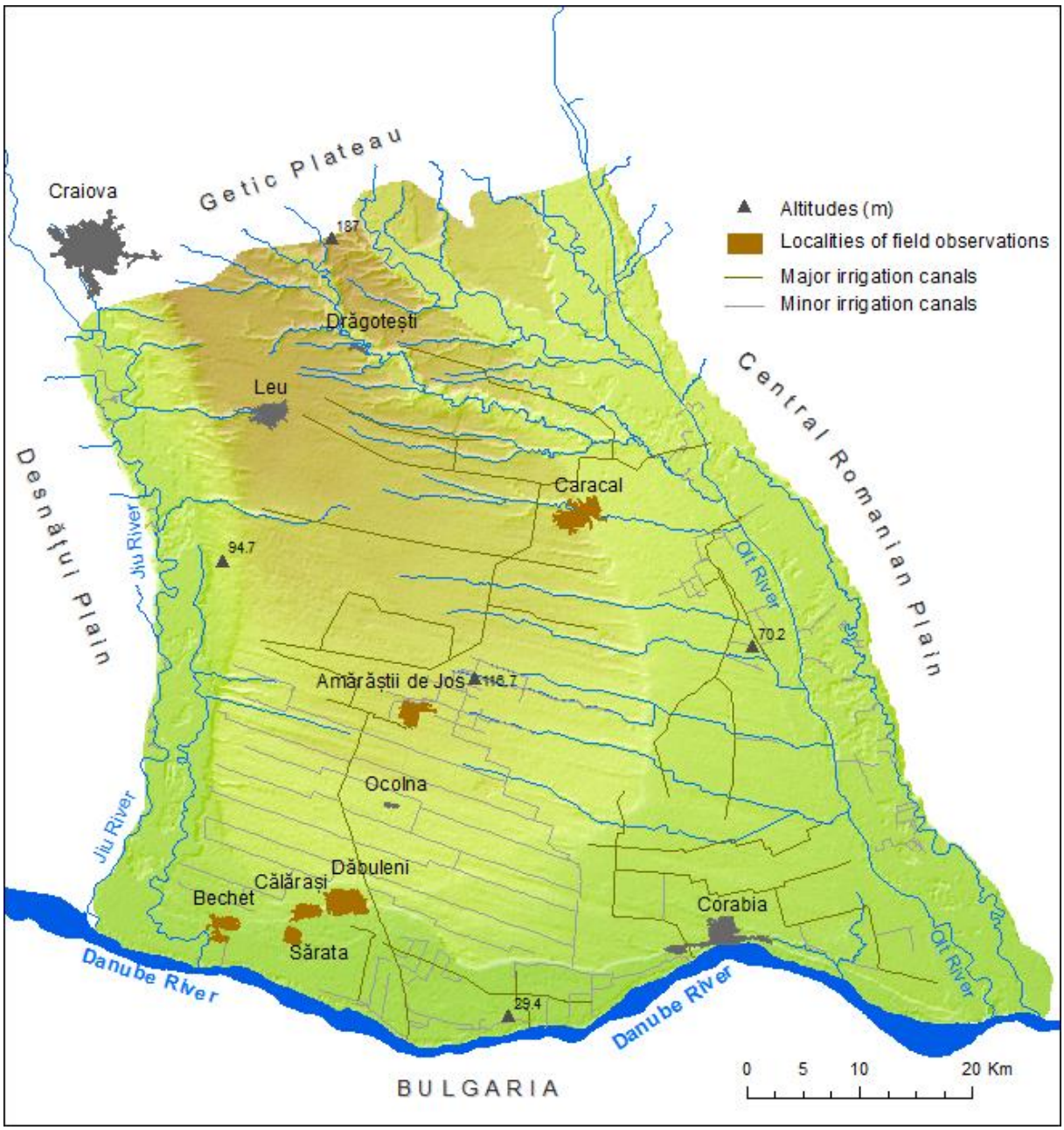


Fig. 1b – Study-area: Romanați Plain, West of the Romanian Plain.

Nutrient rich soils, specifically the Chernozem types with a good water retention capacity are met in the northern part of the region (Canarache, 2006), down to Amaraştii de Jos – Ocolna alignment of localities, being suitable for high crop productions. Conversely, towards the south, sand soils are dominant, while alluvial soils, under different evolutionary development phases, are specific for floodplains areas. These types of soils require substantial supplementary land amendments (e.g. fertilization, irrigation / water drainage) in order to support economically profitable cropping systems.

The region has a temperate-continental climate with Sub-Mediterranean influences, where the mean annual temperatures rise as high as 11^0C, while the precipitations amount to 525–600 mm per year

(Geografia României V, 2005). Likewise, frequent and even more intensive droughts are an evidence of the area, as they are for the entire Romanian Plain, constraining farmers' activities and needing significant actions of both mitigation and adaptation to these conditions (Lupu *et al*., 2018). Fig. 2 suggests that lower yields correspond to drought, although detailed analyses are needed for explaining the climate-driven variability of crop yields and the associated socioeconomic drivers behind yield productions.

Fig. 2 – Crop yields during 1990 – 2017 in the Romanian Plain at county level.

Therefore, the particularities of the relief, given primarily by the thick loess deposits, river terraces and floodplains and the presence of sand dunes, along with the soil and climatic characteristics impose the local conditions for agricultural activities. Moreover, the climatic scenarios show that the seasonality of precipitation will increase and the summer precipitation in south-eastern part of the Danube basin will decrease, while the weather and hydrological extremes (droughts, heat, and floods)

will increase with higher certainty (Mauser and Stolz, 2018). As well, the climatic scenarios project increases in drought intensity and frequency for Central and South-Eastern Europe, thus affecting the agricultural productions as well as the hydrological regime with consequences on the region's water availability (CLAVIER, 2009; IMPACT2C, 2015).

In this case, the adaptation implies both agro-technical measures (e.g. drought resistant cultivars, farming practices based on preserving/increasing soil water retention capacity, efficient application of irrigation in order to optimize crop water productivity, etc.) (Sandu and Mateescu, 2014), and sustainable land use and water resources management at regional scale (e.g. equitable allocation of water among sectors, upstream-downstream beneficial integration of water resources, application of efficient irrigation supply systems according to the environmental conditions and availability of water resources) (Mauser and Stolz, 2018).

2.2. Open-question interviews and field observations

Local information was collected by conducting semi-structured interviews with farmers and local authorities in 4 localities of the study-area during a field trip activity organized dewing September 9 – 12 2018 (Fig. 1). The scope was, on the one hand, to compile site-specific data on crop productions and structure, farming practices and agricultural resources management at farm level, and, on the other, to understand the main processes and characteristics of farms' development and land use dynamics, as well as the socioeconomic factors that influence or directly impact the land use system in the study-area. Table 1 presents the questions which formed the base of the discussions, including topics on farms' land use structure and yields obtained over the last years as well as on the farming practices during the growing season. Aspects concerning the physical and economic constrains that are hindering the activity of the farms were also considered. Further, issues on the effects of different land policies, such as the role of the incentives per hectare of cultivated land or the distribution of irrigation water at no costs (Law no. 133 / 2017) were discussed with the interviewee. Different-sized farms were subject to our analysis, specifically small, medium small, medium and large size farms (Table 1). Additionally, discussions with mayors, representatives of agricultural units in the town halls in Bechet and Dăbuleni towns, Călăraşi, Amărăştii de Jos and Amărăştii de Sus communes were held for capturing as much as possible details on the land use situation in the area.

Table 1

Semi-structured interview topics and questions

Topic	Issues discussed in the interview
Farm characteristics	– Short description of the evolution of the farm – Size, land structure and crop production in 2017 and 2018 – Main farming practices – Types of hybrids used
Challenges for crop production	– Physical constraints (e.g. soil, access to water and climate) – Agricultural infrastructure (i.e. (non)operational irrigation systems, investments in agricultural technology) – Natural hazards (i.e. droughts, floods, hail spells) – Socioeconomic constraints (e.g. land ownership issues, high input production costs, crop prices, labour force in agriculture, social risks in rural areas)
Governance issues	– EU structural measures; national sectoral incentives; National Programme for Irrigation Rehabilitation 2020; existence and function of the Organization for Irrigation Water Users in study-area; – agricultural services (e.g. support for the agro-food products on the market, development of the food markets; land markets; cooperation among profiled/related institutions)

The most common crops in the area are winter wheat, maize, barley and sunflower, while a particular feature in this part of the Romanian Plain is the cultivation of water melon, being a well-known product on both local and external food markets. Farms have a rather heterogeneous structure, especially in the case of small farms, while the most visible feature in the agricultural landscape is the excessive land fragmentation (Table 2).

Table 2

Characteristics of the analyzed farms

Category	Size	Crop structure	Examples of crop productions (2018)*
Small	> 5 ha and < 20 ha	heterogeneous	3.5 t/ha (corn); 2.5 t/ha (wheat); 2.0 t/ha (barley)
Medium small	> 20 ha and <100 ha	heterogeneous	2.0 t/ha (sunflower)
Medium	> 100 ha and <300 ha	4–5 main crops	5.75 t/ha (corn); 5 t/ha (wheat); 2.0 t/ha (sunflower)
Very large	> 1000 ha	3-4 main crops	3 t/ha (sunflower)

* higher yields were obtained in 2017 as compared to 2018 which was considered an agricultural year affected by drought; ** very small (< 5 ha), medium large (>300 ha and <500 ha) and large (>500 ha and < 1000 ha) size farms will make the subject of further investigations concerning land fragmentation in the Romanian Plain area

In addition to the information derived from our field interviews on the land use system in the study-area, we have scoped out a series of publications in the domain of rural and agricultural development strategies, land and water resource quality and use, land use management, etc. in order to document on the study objective and provide consistency to our results regarding the drivers and dynamics of land fragmentation in the Romanați Plain, west of the Romanian Plain.

3. RESULTS

We distinguished the dominant phases in the evolution of land use based on both interviews derived-information and literature documentation, we synthesized the data collected about land fragmentation and, subsequently, summarized the drivers of land use change and fragmentation.

3.1. Phases of land use changes during the last 30 years

In Romania, the current land use structure is a result of the disruptive dynamics of land use processes that have occurred particularly over the last 30 years during the transition and post-transition periods toward market economy. These processes relate to a series of interconnected drivers of land use change, such as the socioeconomic factors, land governance, agricultural infrastructure, land markets, etc. Their effects consist in highly spatially diverse situations, e.g. fragmented lands alternating with large parcels belonging to commercial-oriented agricultural holdings, various farming practices, considerable destruction of the irrigation systems which are crucial for drought combat, little social returns for the local community from the locally well performing agricultural activities, etc. Three distinct intervals could be distinguished in the evolution of land tenure, land structures and type of farms in Romania since early 90s. They are described synthetically in Fig. 3.

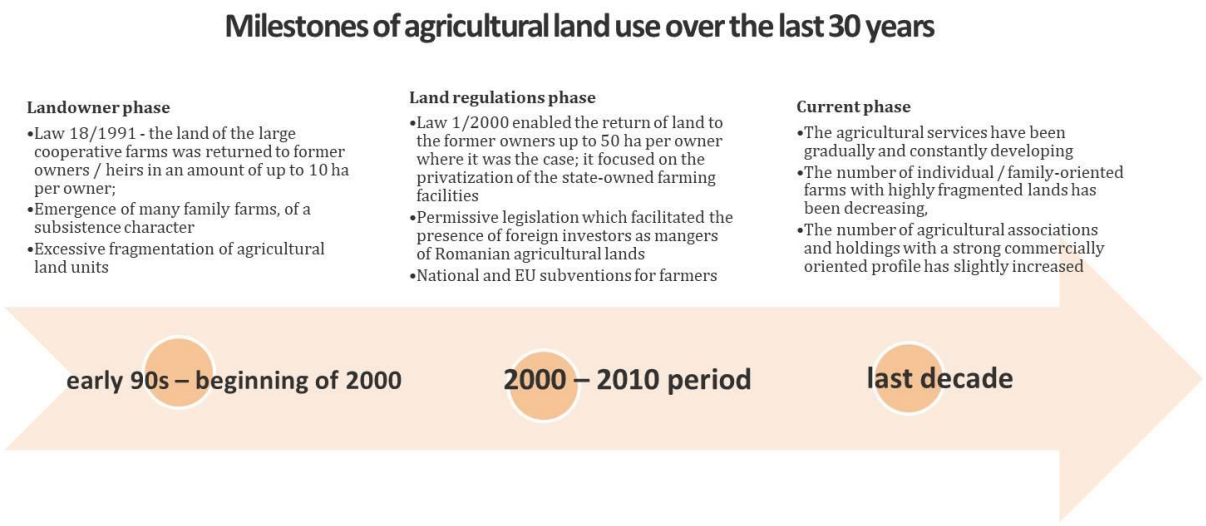


Fig. 3 – Land use dynamics during the last three decades in the Romanian Plain.

Specifically, ***in the first 10 years*** (1990 – 1999 period) since the fall of the totalitarian regime, the excessive fragmentation of cropland, emergence of numerous individual (family) farms of subsistence agriculture, poor agricultural infrastructure and services (degraded irrigation systems, inappropriate farming practices, lack of investments in the agricultural infrastructure etc.) contributed to obvious changes in the agricultural landscape, as well as to significant impact on agricultural productivity and reduction of crop production. The land law (i.e. Law 18/1991) had a major effect on the land structures at that time. It stipulated that the land which formed the large cooperative farms during the centralized regime to be returned to the former owners and/or their heirs in an amount of up to 10 hectares. The effect was an excessive fragmentation of the agricultural land. At the same time, the socioeconomic consequences of land restitution in this phase manifested intensely. The rural space experienced a demographic increase through the return of the new land owners to their homelands simultaneously with the emerging of numerous family farms, many of which of subsistence character. Moreover, the recipients of the agricultural land were new, of a rather advanced age and unexperienced to aspects related to modern farming practices, to the functioning of land and food markets in a free market economy, and, thus, the management of their land was challenging (Benedek, 2003). The agricultural infrastructure had become technically worn-out, obsolete and degraded, the most common example being the substantial destruction of the irrigation system (Bălteanu and Popovici, 2010). Also, the low incomes, the poor capital of land exploitation of the new owners, the absence of the financial instruments to encourage and help the local entrepreneurs in agriculture (e.g. credits), etc. led to a weak position of local investors on the land market making it vulnerable in front of foreign investors (Popescu, 2018). The way the land rights were restituted during this phase contributed a great deal to a design of land tenure system which was not sustainable (e.g. in many cases it was difficult to return the parcels on the same location because during the communism the borders among the individual land properties were erased or because of the changes in the structure of the agricultural landscape or of the rural localities; ambiguous reconstruction of the owners' land rights; lack of economic and natural evaluation of land before restitution, this being only based on physical measurements, etc.) (Popescu, 2018).

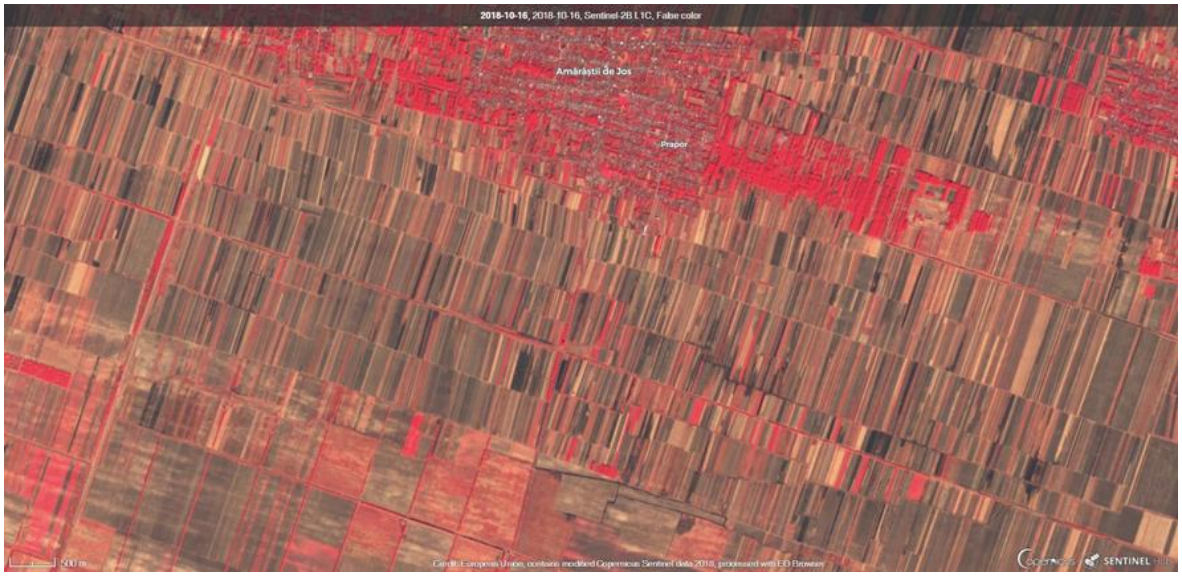
The second interval corresponds with the ***2000–2010 period*** which was marked by important regulations regarding land property and land market. First, it was the revision of the previous land law which increased the return of the land to the former owners up to 50 ha, where it was the case, and the privatization of the agricultural land and farming facilities belonging to the state-owned agricultural

enterprises (i.e. Law 1 /2000). Also, the land market was quite flexible and thus attractive for investors and many agricultural lands could be sold and leased on long terms. It was the period when foreign investors acquired large amounts of lands, particularly in the Danube floodplain areas, starting their agricultural businesses here, to the disadvantage of local (potential) investors who had weaker capacities for investments. This aspect relates to the first two laws issued in 2005 regarding the reform of the property and justice systems, i.e. Law no. 247/2005, and Law no. 312/2005 that gave foreign citizens the possibility to acquire land. This was the beginning for foreign investors to hold under lease agricultural land in Romania and develop businesses here. However, the largest surfaces of agricultural land were acquired by foreign investors after Romania`s integration in EU. The second important milestone of this interval was Romania's integration in European Union in 2007 when the legislative norms and access to EU structural funds created opportunities for modernization and development of the agricultural sector, aspect that marked a period of improvement of the quality of the farming practices as a consequence of the farmers' possibility to loan a credit from the banks to start / improve their agricultural businesses. At the same time, the legislation was designed to facilitate and improve farmers' association structures with the purpose of increasing the potentials for sustainable and profitable agricultural productions. It could be said that during this period the dynamics concerning the use of the agricultural land in our study-area, as it was also the case of the Romanian agricultural in general, were very much influenced by the incentive-based policy instruments (national and European Union through Common Agricultural Policy) which farmers could access. These instruments have aimed to primarily help farmers to increase their work productivity (i.e. primarily through modernization of farms' infrastructure and farming practices) and contribute to rural development (e.g. investments in rural infrastructure, incentives for new farms of young local entrepreneurs, etc.), including the safeguard of the agroecosystems' goods and services, particularly in terms of productivity increase and land resources' protection (Bold, 2018).

Over ***the last decade***, the development of the agricultural services has been gradually and constantly on an upward trend (e.g. ship of the agricultural products, mainly by terrestrial routs, but, recently also by water through fluvial or Black Sea ports, the acquisition of containers and the possibility to store larger amounts of agricultural products, the emergence of consultant companies to support farmers to develop investment projects, etc.). The number of individual / family-oriented farms with highly fragmented lands has been starting to decrease, while the agricultural associations and holdings which are commercially oriented increased. During our interviews, the farmers' opinions concerning the process of land or farm association and/or land leasing, exchange and transaction have been mixed. They confided that although it is commonly agreed on the advantages of managing large, spatially continuous fields instead of very small or small farms composed of fragmented parcels, this process is not always straightforward due to financial benefits and opportunities people (i.e. owners) expect in doing so. In many cases it is the quality of land or the offers made that they invoke as major constraints for land association process. However, the situation is spatially different, as, still, in many parts land fragmentation remains high, impeding the performance of profitable agricultural productions, and the agricultural resources are unexploited and/or impacted by drought and desertification / land degradation, water stress, confusion about property rights. It is in this context that the many national or EU funds have been supporting, to a large extend, the 'big cropping system' where the investments favored the modernization and investments in irrigation system and the acquisition of, for instance, GPS guided machineries that could serve large cultivated areas. In certain cases, such investments outclass the potential of medium-sized farms to use the new infrastructure to its full capacity due to insufficient land capital. Therefore, investments, particularly in the modernization of farm through infrastructure, need to be designed according to the physical particularities and capital and well as to the future farms' potential to extend.

3.2. Field observation on land fragmentation in the study-area

One of the striking and at the same time visible feature in the analyzed area was the high fragmentation of the cropland (Fig. 4). For example, there are numerous cases where one very small farm, under 5 ha, has its cropland spread discontinuously in ~ 8 to 10 plots, or a small farm of 14 ha was divided into 14 parcels. Fig. 5 synthesizes the information collected in this respect from the individual farms as well as from the agricultural units of the local administrations. It represents the ratio of land fragmentation per farm, considering the number of plots and the size of the farm. It reflects the highest degree of fragmentation in the case of small farms.



a)

b)

Fig. 4 – COPERNICUS Sentinel-2B L 1C, Oct. 2018, false color (843); Land fragmentation in the Romanaţi Plain (Amărăștii de Jos (a) and Dăbuleni (b)) (*Source: COPERNICUS Sentinel Hub*).

There are *several causes that lead to a high degree of land fragmentation* in the study area:

- First, the land that during communism time belonged to the cooperative structure was restituted to the former owners, leading to the division of large agricultural land into in small parcels.
- Second, a large share of the people that obtained their land back at that time were already elderly, and the land was handed on to their heirs, this being a subject to further division.
- The third issue that contributed to land fragmentation was that, in many cases, the owners had not received their lands on the same location as it had been before restitution. The initial agriculture or forest function of the land was converted into another function, e.g. construction, and therefore the plots were discontinuously spread.
- Fourth, the confusion about property rights and the conflicts that prolonged the clarification of the size and location of the plots (in many cases they were solved in law courts) induced changes in the structure of the land, further increasing the land fragmentation.
- Fifth, the degradation of the irrigation system was, undoubtedly, one of the biggest cause of the transformations in land use structure. Usually, the farmers chose to split the land into multiple (small) plots allocated to different crops in order to be able to cultivate it in the absence of the necessary infrastructure suitable for larger cropping fields.
- Sixth, the EU subventions per hectare that farmers can access ensure the economic maintenance of their farms and offer possibilities for development. Apart from the opportunity for investments, the EU support gives farmers a sense of stability which restrain them from exchanging the plots with neighbor farmers, particularly in the case of small-sized farms, in order to merge the plots and reduce land fragmentation.
- Last, but not least, the natural conditions impose a series of constrains with regard to the compactness of the land structure. For instance, the dunes with sand soils cover extensive areas on the Danube terraces (e.g. the large area around Dăbuleni, see Fig. 5), constraining land management to particular uses and farming practices. During the operation of the irrigation systems such lands were large vineyards, while nowadays these areas are fallow lands, the owners preferring not to cultivate them due to increased input costs and low yields. As well, increasing drought periods are a serious limitation for a performing agriculture in the Romanian Plain, requiring different farming options and land uses to limit its effects.

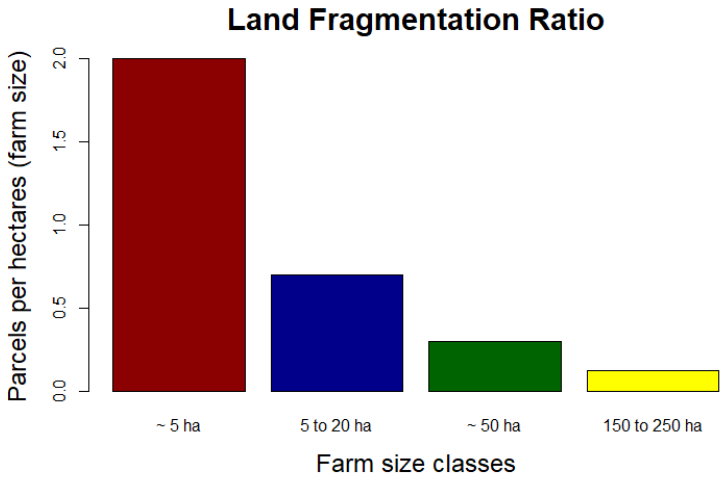


Fig. 5 – Land fragmentation ratio for the farms in the Romanați Plain area, west of the Romanian Plain.

Photo 1. Crop plots in the South of the Oltenia Plain (Sarata),
September 9th 2018. Photo: Lupu, L.

Photo 2. Amarastii de Jos, September 11th 2018; a narrow barley strip (8.7m × 1140m)
of a plot on a small size farm. Photo: Lupu, L.

Photo 3. Two farming practices (treated and not treated land for weeds) applied on a winter wheat plot; Amarastii de Jos, September 11th 2018, Photo: Lupu, L.

4. DISCUSSION AND CONCLUSIONS

4.1. Drivers of land use dynamics in the Romanian Plain, with implication for land fragmentation

The changes in land use in the study-area, and, in general, in the entire Romanian Plain are a clear expression of the planning measures concerning the management of agricultural land over time, on the one hand, and of the human use of the region's natural capital, particularly the agroecosystems goods and services, on the other.

As mentioned before, the agriculture in the Romanian Plain was profoundly affected by the disruptive changes of the transition and post-transition periods, particularly in terms land use, land property structure, sectoral economic development and workforce, institutional (re)arrangements, resources management, land and agri-food markets and socioeconomic profile of the rural areas. Correlated with the projected impacts of climate change scenarios, these aspects are of high relevance for the agricultural production which depends on the environmental conditions as well as on the farming practices and resource management strategies. In this context, the drivers of change, which are briefly described below, represent the key factors that interdependently generated the current functionality and structure of the agricultural land in the Romanian Plain, including our study-area.

1. Land ownership

One of the key drivers shaping the present agricultural land use has obviously been the change of land ownership. The collapse of the centralised ruling political system in 1989 and the transition toward capitalism led to transformations of agricultural land use structure through land restitution and privatization so the ratio between land users and land owners has drastically changed. For instance, before 1989 the state had over 90% of agricultural land in use and only a small share of it belonged to owners, particularly the in the mountain and hilly areas; in 2007 the number of individual agricultural exploitations was 3.9 million, covering 65% of the agricultural area, while the rest of the 35% of the area was cultivated by agricultural enterprises with juridical status (INS, 2010). In 2016 the number of individual exploitations decreased to 3.4 million, being with 5.7% smaller than in 2013, while the number of agricultural enterprises with juridical status also decreased with 6.4% as compared to 2013 (INS, 2017). However, the INS 2017 communication note states that the average size of cropland per agricultural exploitation is slowly increasing in both categories, individual exploitation (from 2.02 ha in 2013 to 2.04 ha in 2016) and agricultural enterprise with juridical status (214 ha as compared to 207 ha). Ownership changes associated with other governance settings (e.g. legal and institutional arrangements with regard to farm associations and agricultural services, land market, etc.) has largely impacted land use, particularly through fragmentation and cropping patterns.

2. Irrigation infrastructure

Romania benefits from a large experience in irrigation. During 70s–80s, an extensive irrigation system was installed to serve approximately 3 million hectares. It was built especially in the south of Romania, the Danube being the main source of water abstraction for irrigation). These large infrastructures turned inoperative and/or were destroyed following the period of land restitution and privatization when the owners lacked the necessary capacity, financial and/or managerial, to maintain, secure and use the irrigation systems, while the interested state companies had also had difficult times concerning restructure, reorganization or closure. Despite the acute need of irrigation application in the Romanian Plain, the coverage of the irrigated areas is below 10% of the total area equipped with supply systems (Fig. 6), the reasons being multiple, mainly due to the advanced degree of deterioration

of the old infrastructures, drop of the irrigation water demand particularly in highly fragmented farmlands, water and pumping energy costs, and frequent reorganizations of the administration of the water users. Regionally, the situation is slightly different as in the south-eastern part of the Romanian Plain the irrigated area is about 20% of the total area equipped for irrigation, while in its south-western part, it drops to an insignificant value. This situation reflects the territorial disparities of the cropland management. Some of the large agricultural holdings of strong commercial profile are found in the eastern part of the Romanian Plain where they have good conditions for intensive agriculture using modern infrastructures, including irrigation at large scale and farming practices for higher yields and profits. Contrary, the agriculture in the western part is still related to the existence of small farm properties and land fragmentation which constrain the growth of agriculture and development of rural areas (Dumitraşcu, 2006).

Nevertheless, the use of irrigation throughout the Romanian Plain is a prerequisite for drought mitigation and productive agriculture. In the recent past (2009 – 2016) about 600 000 hectares total the land that could be irrigated (National Agency for Land Reclamation in Romania – AFIR, 2017), while the situation is improving with the support of increased subsidies and investments in this sector. In this respect, the National Programme for the Rehabilitation of the Primary Irrigation Infrastructure of the Ministry of Agriculture and Rural Development (MADR, 2016) stipulates that 2 006 941 hectares are going to be ready for irrigation by 2020.

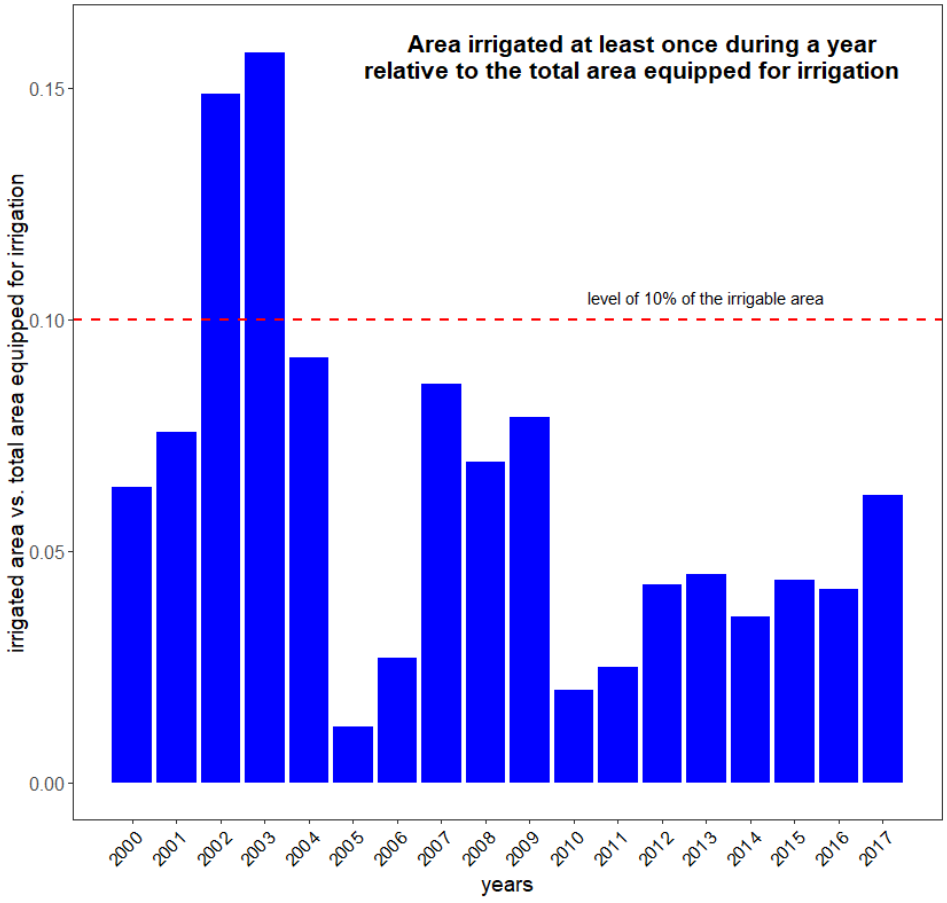


Fig. 6 – Irrigated areas in the Romanian Plain over 2000–2017 period.

Photo 4. Non-operational secondary irrigation canal in the Romanaţi Plain;
Photo taken by Lupu, L., September 9th, 2018.

Photo 5. Operational primary irrigation canal (Magistral) in the Romanaţi Plain;
the farmers with nearby croplands are most likely to use the water from it during the irrigation periods;
Photo taken by Lupu, L., September 9th, 2018.

3. Demographic trends

Rural areas are subject to increasing depopulation and ageing processes. These demographic trends are also coupled with relatively poor social and physical infrastructure and a relatively low connectivity to the urban centers which is the case for numerous rural localities. One of the most noticeable phenomena which has a strong impact on rural demography and its activities is the migration outside Romania. This process has changed the structure of the rural population. For instance, in the Oltenia Plain, the population aged 65 and above accounts for more than 110 000 persons (i.e. 22% of total population, higher than the national average which is 16 %) (INS, 2019).

Also, the population occupied in agriculture holds a large share (i.e. 73% of the employed population works in agriculture in the rural area in the Oltenia Plain) denoting not only a high concentration of a single economic sector, but also a lack of connecting services to it.

Such demographic trends and labor force aspects are important divers in agricultural land use management / land use change. Many agricultural farms in the flat areas of Romania represent a family or extended family business, which are run usually by farmers who are over 55 years old, being

generally small-sized farms. The possibility to leave the home place and the diverse and attractive opportunities for off-farm jobs create issues of farms' succession. This means that many of these farms lack successors who can take over the business once the farmer is no longer able to work it. It takes hard work and time to be able to make profit of these small plots of land and many young people feel that they can achieve better quality of lives by moving to urban areas or abroad. Therefore, depopulation, ageing and declining interest of the youth in agricultural activities are one of the challenges faced particularly by small sized farms.

4. Land markets

The newly enforced regulations on land privatisation, ownership titles and rights opened opportunities to transact the land. As well, real estate and construction companies created a strong competition for the agricultural land found in the vicinity of cities. The regulations on land markets were more flexible on the onset of the privatisation process and have become gradually more restricted. The average price of 1 ha of land is nowadays around 6000 euros, varying considerably across regions and depending on the land quality (www.agrointel.ro), raising from less than 2000 euros in 2010 (EC, 2016). Apart from the easy lease or sell of (good quality) land during the 2000s which favoured numerous foreign investors to make profits, the land market led to changes in the use of agricultural land. However, this aspect is very much related to the local quality of the land and the price, as well as to the economic interests of the owner or farm manager.

5. European Union Common Agricultural Policy

Generally the EU CAP, through subventions for farms and rural development, has been oriented so far toward the support and stimulation of production. However, in Romania the activities should had been prioritized according to the necessities of the farms. The recent reform of EU policy on agriculture articulates the necessity of adopting agricultural practices oriented toward green economy by supporting the economic growth while preventing environmental risks (EC, 2010). It is acknowledged that sustainable agricultural measures can support water management through sustainable farming practices. More efficient water saving irrigation techniques will have to be developed and applied along with sustainable regulatory actions envisioning water use, with special attention to water demand to prevent or effectively respond to water scarcity challenges (EC, 2010).

Nevertheless, the EU subsidies in agriculture along with the possibility of bank loans have greatly helped farmers to improve their farming practices and make them more efficient through modern and highly performant machineries, use of new cultivars and fertilizers as well as through services such as consultancy. The financial support in agriculture through EU and national funding have helped farmers maintain their agricultural business constant, and in many cases expand them, fact that clearly influenced land use in agricultural areas.

6. Agri-food markets

The agri-food markets are usually dominated by big companies which dictate crops' selling price. However, the agriculture in Romania is still dominated by individual agricultural exploitations or relatively small exploitations. These types of exploitations are known to be less productive than the exploitations in the EU countries. In this respect, the relations between the local producers and the agri-food consumption markets need to be reinforced in the sense of increasing, through efficient new regulations, the implication of the local producers on the market fluxes (Popescu, 2013). Therefore, farms would better respond to the domestic demand for agricultural products, being able to use their land accordingly.

7. Physical / natural drivers: climate, soil types and forest belts

Increased frequency and intensity of droughts; diversity of soils, including extended areas of sand dunes as in the Romanaţi Plain (e.g. Dabuleni – Ocolna area); forest (belts) degradation / destruction represent important drivers that decisively influence land use and crop production. As well, land fragmentation dynamics over the last 30 years has generated different structures of land uses according to the degree of fragmentation. Such aspects require integrative solutions for the management of farms, including both climate change adaptation measures and economic viability and grow of farms. In this respect, there have already been initiated studies concerning Danube basin on water use efficiency, crop potential and sustainability in agriculture (Probst *et al*., 2018).

4.2. Conclusions and further research

Agricultural land fragmentation is an important issue in terms of both, land governance and land use system research. The paper explained how the excessive land fragmentation in the western part of the Romanian Plain connects with the existence of numerous individual, family-based farms (i.e. an effect of the return of landownership rights to former owners and/or their heirs), along with other factors such as socioeconomic background and tendencies, agricultural infrastructure maintenance and agrarian policies. In this context, the prevailing issues reside in finding optimal solutions to concurrently use the agricultural potential of the area while maintaining the agroecosystem functions, respond to the farmers' needs, and increase wellbeing of the rural communities.

In Romania, land tenure issues are associated to the return of land property rights to former landowners which took place in relatively successive episodes over the last three decades, being rather distinct and little coherent from a strategic point of view and/or insufficiently grounded in studies meant to enable sustainable land use structures and evolutions (Popescu, 2018). From this point of view, the consequences of land regulations in the first decade of the transition period led to an excessive fragmentation of the agricultural land and emergence of numerous small, family-oriented farms (the average farm size reached 1.9 hectares). Also, the process of land restitution triggered a reinvigoration of the rural space through the return of a large share of the newly landowners to their home places.

The next decade was marked by legislatives norms that ensured the privatization of the state-owned farming facilities. At the same time the socioeconomic conditions in the rural space were marked by advanced ageing of people working the lands, stronger depopulation, and insufficient and/or poor agricultural infrastructure of farms.

Further, the national and EU supporting funds for agriculture were established when Romania joined the EU community in 2007, with the purpose of growing agricultural productivity, modernization / development of agricultural infrastructure and rural development. The support schemes were set out within the framework of National Development Programmes for Agriculture 2007–2013 and 2014–2020, respectively (MADR, 2014, 2016). They included, for example, support for the development of new farms managed by young farmers, rehabilitation of the principal irrigation system infrastructure, subventions per cultivated hectare, modernization of farms, training programs and development of agricultural services, etc. In this context, aspects related to land fragmentation evolved contextually, with a general tendency to convert from strong fragmentation associated to individual, small and very small family-oriented farms to larger fields attributed to agricultural associations and holdings having a commercially-oriented profile. However, this situation is spatially diverse throughout the Romanian Plain since in many areas, as it is the case of our study-area, the fragmentation still high and the lands are prone to drought and desertification, water stress or are insufficiently exploited compared to their productive potential.

Setting out and extending the agricultural associations instead of managing small farms seems beneficial and a promising development prospect considering the socioeconomic tendencies in the rural areas. However, this process is not always straightforward due to the expectations, financial and/or societal, that farmers/land owners assume. In many cases it is the price of land offers and the quality of the agricultural land that farmers invoke as major constraints in the association process.

As investigated in our study, the very high degree of land fragmentation is the case of the very small (< 5 ha) and small farms (> 5 ha and < 20 ha) in the Romanaţi Plain, being subject to lower yields, heterogeneous land use structure and less profitable agricultural activities. Land fragmentation appears to be a significant determinant of farm productivity in such cases due to farming management difficulties, in particular because of the problems induced by resource efficiency use and labor efficiency, even if other variables, such as fertile soils, use of quality seeds and fertilization are controlled for. At a larger governance level, land fragmentation is important and needs to be taken into account when designing land management strategies as the scale of agricultural producers is, in many cases, different, e.g. in the western part of the Romanian Plain (e.g. Romanaţi Plain) small farms are perceived differently compared with the eastern part of the region (e.g. Bărăgan Plain).

Worth mentioning that drought increasing frequencies, inoperative and/or not affordable irrigations systems, various ecological constraints, e.g. the presence of sand soils over large areas, amplify the difficulties of farming management in agricultural areas characterized by high land fragmentation. They further contribute to low performing agriculture, requiring governance alternatives oriented toward stronger measures of adaptation and integrated resource use efficiency policies.

Agricultural land fragmentation connects with different research issues found at the interference of social sciences, landscape and resource management. Detailed investigations could offer scientifically grounded evidence on the agroecosystems' potentials in particular areas and could improve the current policies, especially in the domains relating to global environmental change. In this respect, *the Earth Observation datasets*, such as COPERNICUS satellite data, are truthful monitoring instruments that could be used to develop and quantify spatial metrics, necessary for timely and pragmatic agricultural land decisions. The new generation of COPERNICUS products cover multiple domains, including land use / cover systems, have higher resolutions and can serve *integrative modelling and simulation techniques* to evaluate hot spots and agroecosystems' vulnerability to various stresses, e.g. water stresses, improper farming practices, inefficient land use structures, spatial discontinuities based on clearly defined land cover classes, etc. The present analysis on land fragmentation will be further extended by using COPERNICUS remote sensing data series and other ancillary data in order to capture the full spectrum of aspects related to the dynamics and structure of land uses and crop systems in representative areas of the Romanian Plain.

As well, *case study comparisons offer substantial information in what regards better management solutions*. Land fragmentation is reflected differently in different parts of the Romanian Plain. The variety of ecological conditions and environmental alterations / changes along with different dynamics of the socioeconomic factors (different market forces, particularly in what regards land acquisition and crop prices, the legacy of the local people considering the land and their perspectives toward sustainable land use, demographic trends in the rural space and the local workforce capital, the access to technological innovations, etc.) define particular land structures and different measures for land use. Each case-study highlights the ways in which land tenure form, knowledge and value systems (traditional and local knowledge), lifestyles and socioeconomic settings relate to land use options, while comparative analyses reveal the spatial and temporal impacts of decision making processes (IGBP Report 53 / IHDP Report 19, 2005). Therefore, cross-regional studies, based on systematic approaches concerning land fragmentation, determine under what conditions land governance provides better options for agricultural and societal development, the outcomes of such analyses contributing to eventual corrections of the negative feedbacks of land use policies. At the same time, the complex

relationships between land use structure and human activities, including the decision making processes, are not amenable to simplistic replication which means that their predictability will never emerge from individual case studies (IGBP Report 53 / IHDP Report 19, 2005). In this sense, it is the regional comparisons, chosen on the basis of documented conceptual models that form the necessary tools for reaching integrated outcomes.

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REGIONAL METEOCLIMATIC HAZARDS ASSOCIATED TO CLIMATIC CHANGE IN THE REPUBLIC OF MOLDOVA

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Key-words: climate change**,** extreme phenomena, meteorological risks, Republic of Moldova.

Risques météorologiques régionaux associés au changement climatique en République de Moldova. Le rythme accéléré du changement climatique est associé avec la manifestation des phénomènes extrêmes, devenus plus intensives et fréquents pendant ces dernières années. Malheureusement, nous connaissons que jusqu'à présent, il n'existe pas une conception unanime acceptée à l'égard des caractéristiques des facteurs du risque, il n'existe pas une base d'information scientifique qui permettra à organiser le fonctionnement des systèmes territorials. La mise en œuvre au niveau national des Conventions des Nations Unies concernant la lutte contre la désertification et le changement climatique ainsi que l'accord d'association de la République de Moldavie avec l'Union européenne conditionne la nécessité de la recherche proposée par une série de directives sur la gestion des risques naturels. Le sommet des années les plus chaudes sur le territoire de la République de Moldavie confirme que les dernières années ont été les plus chaudes de la série des observations instrumentales depuis plus d'un siècle. L'évolution des anomalies pluviométriques indique qu'elles alternent de sèches à humides, conditionnées par l'occurrence de sécheresses et d'inondations. Les sécheresses des années 2007 et 2012 ont causé des dommages matériels d'un montant de plus de deux milliards de lei moldaves (MDL). Les excès pluviométriques (2008, 2010) ont provoqué aussi des dommages matériels substantiels. Nous pensons que les résultats obtenus sur l'estimation spatio-temporelle des risques météo-climatiques, des tendances du changement climatique et sur l'impact de ces changements sur les différents domaines pourraient contribuer à leur atténuation au niveau national.

1. INTRODUCTION

The accelerated pace of climate change is associated with the manifestation of extreme phenomena (Apostol, 2000; Bălteanu *et al.*, 2005; Nedealcov 2014), which have become more intense and more frequent in recent years. To our knowledge, there is no scientific information base at regional level that could allow an optimal organization and functioning of the territorial systems (districts). The implementation of the provisions on the Association Agreement of the Republic of Moldova with the European Union – through a series of directives on the management of natural risks, conditions the necessity of the proposed research. In identifying weather-climatic hazards, we have taken into account the unified risk definition developed by the UN Development Program (UNDP) experts that refers to the probability of the negative consequences and predicted losses resulting from the interaction of the natural, anthropogenic, hazardous phenomena and the vulnerability conditions. In this context, we mention that the vulnerability is the conditions determined by the natural, social, economic and ecological factors or processes, which intensifies the exposure of one or another community to the influence of the danger (Reducing Disaster Risk, global report, 2005). Hence, the notion of risk can not be treated isolated by the return time (or period) of an extreme event, their common and logical source, being the probabilities of producing extreme events. The notion of risk can not be treated without a spatial delimitation of vulnerable areas to their manifestation (Bălteanu *et al.*, 2003; Bogdan, 2005; Bogdan *et al.*, 1999; Nedealcov *et al.*, 2018). In the context in which the risk

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means in the quantity or magnitude with which a concrete phenomenon is manifested or may be manifested, namely climate, on a certain temporal and spatial scale (Bogdan *et al.*, 1999; Nedealcov *et al.*, 2018), the knowledge of the spatio-temporal manifestation of climatic risks is extremely important, since this largely depends on the possibilities of mitigating their consequences in different fields of human activity.

Climatic projections for nearest future years, especially in the countries with heightened aridity, reveal a significant increase in temperature even for the next years (Dascălu *et al.*; Bojariu *et al.*, 2015, Climate Change 2018; Chantal *et al.*, 2017). Adaptation to the effects of climate change must be an important element of national policy, because even if greenhouse gas emissions would fall over a near-term horizon, this does not imply the mitigation of the global warming phenomenon. Moreover, long-term climatic changes connected with the changes in precipitation models, precipitations variations and temperatures are most probable to cause an increase of droughts and floods frequency.

In the absence of an effective strategy for adaptation to the effects of climate change, there is a possibility that the Republic of Moldova will face the future adoption of measures to adapt to the effects of climate change with higher implementation costs and without the corresponding effectiveness from economical and social point of view. It is therefore necessary that, in the case of estimated effects with a high degree of certainty, the measures are to be implemented in the shortest possible time.

Analysis of observational data for long periods of time has revealed that global warming is an ongoing phenomenon, which is also accepted by the international scientific community. Simulations using global climatic models have shown the main factors that determine this phenomenon, both natural (variations in solar radiation and volcanic activity) and anthropogenic (changes in atmospheric composition due to human activities). The cumulative effect of the two categories of factors may explain the observed changes in global mean temperature over the past 150 years. The increase in greenhouse gas concentrations in the atmosphere, especially carbon dioxide, was the main cause of heating by 0.13°C in the last 50 years of the 20th century, which is about 2 times the value of the last 100 years, as shown in AR5 of the IPCC [8,15].

Between 1880 and 2012, since there are multiple sets of independent data, the average global air temperature has increased by about 0.85°C (with variations of 0.65 to 1.06), on average by 0.06°C per decade. The overall increase between the average of the 1850–1900's period and the period of 2003–2012 is 0.78°C (0.72–0.85°C) based on the existing only dataset.

Europe's climate recorded a warming of around 1°C in the last century, higher than the global average. All of the 21st century (2001–2013) is among the top 15 warmest, globally, since 1880, according to the 2013 National Oceanic and Atmospheric Administration (NOAA) report. 2013 is the fourth-largest top of the warmest years of the last 133, being the 37th consecutive year with a medium temperature higher than the one of the 20th century. The years 2010, 2005 and 1998 occupy, correspondingly, the top three places in the hottest years since 1880.

Air temperature has increased above the global average and the one recorded in Europe in our country in the last century. Thus, during the period of 1901–2000, the average annual average temperature increase was 0.6°C, in Romania it was below the global average by 0.3°C, and in the Republic of Moldova it consisted 0.9°C, i.e. above the global average by 0.3°C. Another comparative analysis of the regional data with the national ones confirms the accelerated pace for the territory of the Republic of Moldova: during the 1901–2006 period, the mean annual global temperature increase was equal to 0.74°C, while in Romania it was only 0.5°C [8, 14], and in Republic of Moldova – 1.06°C (Fig. 2).

In this context, we consider that knowing the regional particularities of manifestations of the current climate, also taking into account the specifics of the manifestation of weather-climatic hazards caused by the accelerated pace of climate change is extremely important.

Therefore, the objectives proposed in this paper consist of:

1. Identification of weather-climatic hazards according to the international database of information (CRED) and national one (Department of Exceptional Situations);

2. The selection of the climatic indices and their calculation in order to estimate the intensity and duration of the drought manifestation as the most hazardous phenomena for the national economy.

3. Spatial estimation with forecast elements (with a certain return period) for the types of hazards necessary in adjusting the national normative acts in constructions to the European Union Directives.

2. DATA AND STUDY REGION

The Republic of Moldova is located in the south-east of Europe, near the geographical center of this continent, bordering with Romania to the West and Ukraine to the North, East and South. It spreads between 45º28'01" and 48º29'31" N latitude (336.7 km latitude difference in a straight line) and between 26º40' and 30º6' E east longitude (approximately 150 km). The country covers an area of 33,843 km², and the relief of the Republic of Moldova is fragmented, represented by a succession of plateaus and relatively low plains. As a whole, it is inclined from the northwest to the southeast (wikipedia.org). The highest regions are those in the northwest and central plateaus (300–400 m), in the south the altitudes are lower (100–200 m). The average altitude is 147 m, the maximum one is 429.5 m, in Balăneşti Hill, and the minimum one – about 2 m, in the lower Dniester River (Fig. 1).

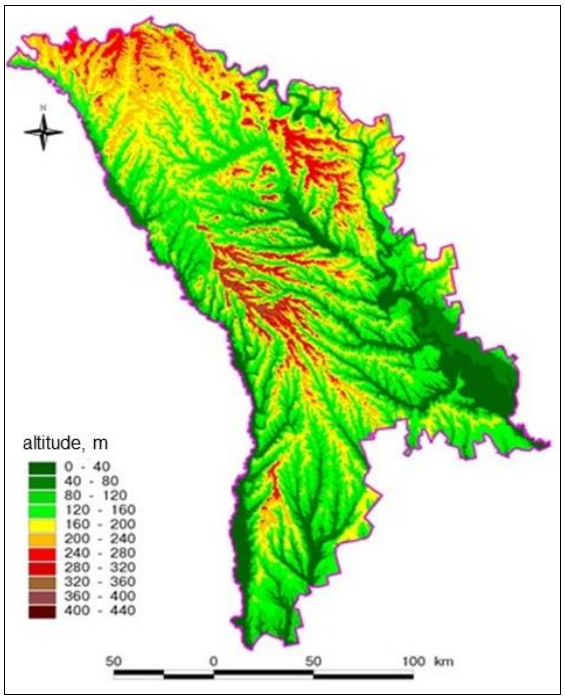

Fig. 1 – Physical map of the Republic of Moldova.

The Republic of Moldova is placed in the temperate-continental climate zone, influenced by the proximity to the Black Sea and the interference of hot-humid air in the Mediterranean area, with insufficient humidity, which determines a high frequency of droughts, which in the last period are intensive and potentially destructive. At the same time, in summer the rains are most often short and abundant, sometimes causing local flooding, leading to substantial material damage (wikipedia.org).

In case of highlighting the national climate change, the trend has been calculated for the time periods 1887–2017. In order to unify the international and national databases, the hazards were identified according to the same criterion (material damage, death toll). The time period of 1961–2015 was selected, a period in which there is a faster rate of climate change and a higher frequency of weather-climatic hazards. The database has served as a pillar for the proposed space-time estimates.

The temporal analysis was performed using the STATGRAPHICS CENTURION XVI software, and the digital maps were developed based on the Radial Basic method of the SURFER software.

3. METHODOLOGY

Monitoring drought and wet periods can be carried out using standardized precipitation index (SPI) and standardized precipitation and evapotranspiration Index (SPEI). SPI was proposed by McKee *et al.*, 1993; SPEI was developed by Serrano, Begueria and Moreno in 2010. Both indices are proposed by WMO which offers data and its calculation for free (Nedealcov *et al.*, 2018).

We mention that the "starting point" in the characterization of the drought serves a certain month in calculating different time scales. For example, for the month of July, the warmest month of the year, the value of the SPI for the 3-month period – will be the calculation of the values of the previous consecutive months, i.e. June, May, April, at the 6-month scale – calculate the previous consecutive months, i.e. June, May, April, March, February, January.

The Standardized Precipitation Index (SPI) is based on the probability of precipitation, and only monthly precipitation for a period of at least 30 years is required for the calculation. Precipitation is normalized using a probability distribution, so that the SPI values are in fact seen as the standard deviations from the median. SPI can be calculated for different time scales. Positive SPI values characterize wet periods, and negative ones – dry periods. SPI Distribution is normal for the whole period, the average is zero and standard deviation – the unit. The drawback of this index is that it only uses atmospheric precipitation, without taking into account the thermal regime and evapotranspiration.

The SPEI index is calculated on the basis of data characterizing the amount of atmospheric precipitation, the thermal regime and the latitude of the site, which also allows potential evapotranspiration to be taken into account. The SPEI is based on the original SPI index calculation procedure and uses the same available time scales. The SPEI calculation is based on the monthly difference between precipitation and potential evapotranspiration, which is a simple water balance methodology and can also be calculated at different time scales. Therefore, in the calculation of the SPEI index, a complete set of serial data characterizing the atmospheric, thermal and potential evapotranspiration is used. In this context, special software has been created to automatically calculate SPEI for a wide range of time scales. The software is available free of charge on the web by the Spanish National Research Council (Nedealcov *et al.*, 2018).

We assessed the climate risk related to precipitation excess (Nedealcov, 2017) using the Fournier Index (IF). This index takes into account the correlation between the amount of rainfall in the month with most precipitations and the annual rainfall and has been used to explain the exposure to terrain erosion processes in the specific wet years.

In regional aspect (Nedealcov, 2017), it is considered that the territory of the Republic of Moldova is in the “very low” erosivity class, registering values below 20. At the same time, this value does not reflect the degree of real erosivity in the years when precipitation intensity is significant.

The Fournier Index (IF) calculation formula is:

$$IF = Pmax.*Pmax/P, \quad (1)$$

where, Pmax.– quantity of precipitations for the month with the highest amount of rainfall, P – annual precipitations sum.

The identification of the degree of pluvial aggression was performed according to the classes included in Table 1, which reflects the degree of climate erosivity of the land.

Table 1

Classes of pluvial aggression determined by Fournier index

Erosivity class	IF
Very low	0–20
Low	20–40
Moderate	40–60
Severe	60–80
Very severe	80–100
Extremely severe	>100

The spatio-temporal estimation of dry/wet periods during the warm season of the year through the above mentioned climatic indexes highlights the magnitude of the vulnerable areas exposed to the weather-related climatic factors during the warm period.

In order to adjust some normative acts in constructions to the directives of the European Union we computed the return periods using the Gumbel distribution for maximum values (Gumbel distribution).

Gumbel distribution for maximums is defined by the probability density function:

$$f(x) = (1/\sigma)*exp(-z-exp(-z)) \quad (2)$$

and cumulative distribution function

$$F(x) = exp(-exp(-z)) \quad (3)$$

where $z = (x-\mu)/\sigma$, μ, şi σ – location and scale (distribution parameters), $f(x) = dF(x)/dx$.

Distribution parameters can be expressed by medium x_{med} and standard deviation σ_1 of the sample:

$\mu = x_{med} - \gamma\ \sigma$, where $\gamma \approx 0{,}5772$ –Euler-Mascheroni constant, $\sigma = (\sqrt{6}/Pi)* \sigma_1$
consequently,

$$\mu = x_{med} - 0{,}45\ \sigma_1 \text{ şi } \sigma = 0{,}7797\ \sigma_1 \quad (4)$$

Quantile function *x(p)* specifies, for a given probability for a probability given in the probability distribution of a random variable, the value at which the probability of the random variable is less than or equal to the given probability. Quantile is the inverse of the cumulative distribution function F (x). Gumbel's maximum distribution is:

$$x(p) = \mu - \sigma ln(-ln(p)) \quad (5)$$

consequently,

$$x(p) = x_{med} - \{0{,}45 + 0{,}7797*ln[ln(1/p)]\}* \sigma_1 \quad (6)$$

Reference value of soil frost depth would be exceed in an year with a probability *p* equal to:

$$x(1-p) = x_{med} - \{0{,}45 + 0{,}7797*ln[ln(1/1-p)]\}*\sigma_1 \quad (7)$$

Reference value of soil frost depth would be exceed in an year with a probability *p* equal to 0,02 (mean recurrence interval IMR=50 years) is equal to:

$$x(0{,}98) = x_{med} + 2.5923*\sigma_1 \quad (8)$$

Exceedance probabilities for the other intervals (period of road construction safety) are shown in Table 2.

Table 2

Exceedance probabilities for recurrence intervals of soil frost depth

Mean recurrence interval, years (IMR)	Exceedance probabilities for a year, p
50	0,02
75	0,01333
100	0,01

We used the Geographical Information Systems (GIS) to process spatio-temporal data and to visualize our results at national scale.

4. RESULTS AND DISCUSSION

The tendency of air temperature's increase (with increase rate of 0.0129°C / year observed in the series of instrumental observations, 1887–2017) in the country allows us to conclude that regional climate change is characterized by a rather accelerated rhythm (Fig. 2).

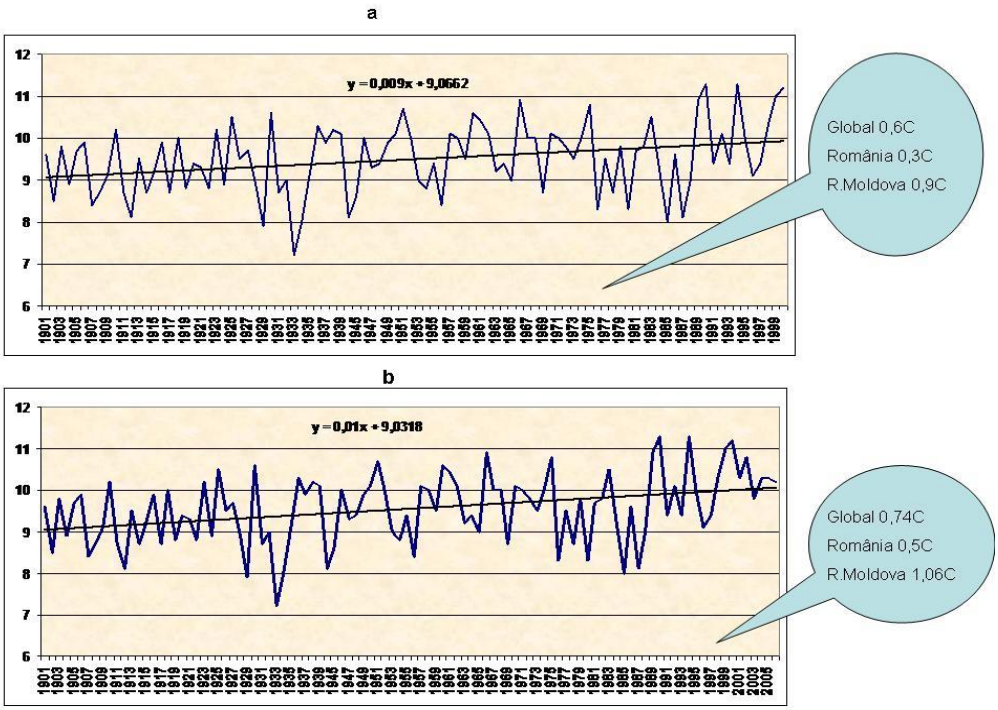

Fig. 2 – Trends in air temperature change in regional and national aspect.

2007 is among the warmest years, and remains the warmest in the last 130 years, after which the years 2015, 2017 and 2016 are set with significant thermal values. So, for the last three years, we have recorded some of the highest values. At the same time, there is an increase in the intensity and frequency of extreme weather events, which in most cases become hazardous phenomena due to the extent of the damage caused.

The database based on the criteria that reflect the material damages and the losses and the death toll using the international data provided by CRED and the national data offered by the Exceptional Situations department was elaborated for the contemporary period 1960–2015 (Fig. 3).

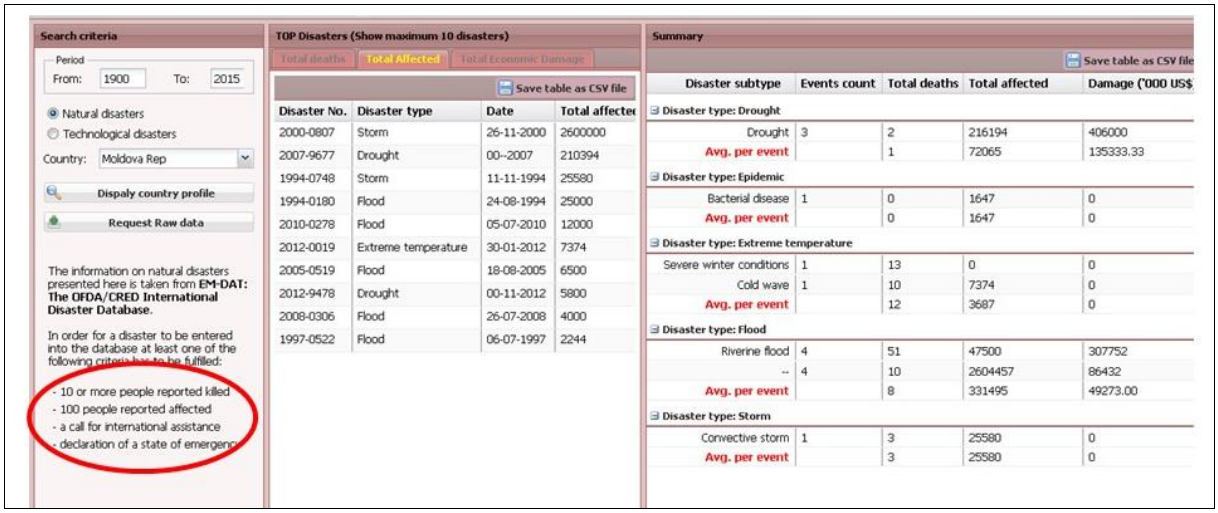

Fig. 3 – Creating of the information database based on the various identification criteria.

Figure 4 is illustrating the weighted estimate of climatic risk that had determined material losses and death toll in the Republic of Moldova, according to CRED data (1960–2015) and the data of the Department of Emergency Situations of Moldova (1960–2015).

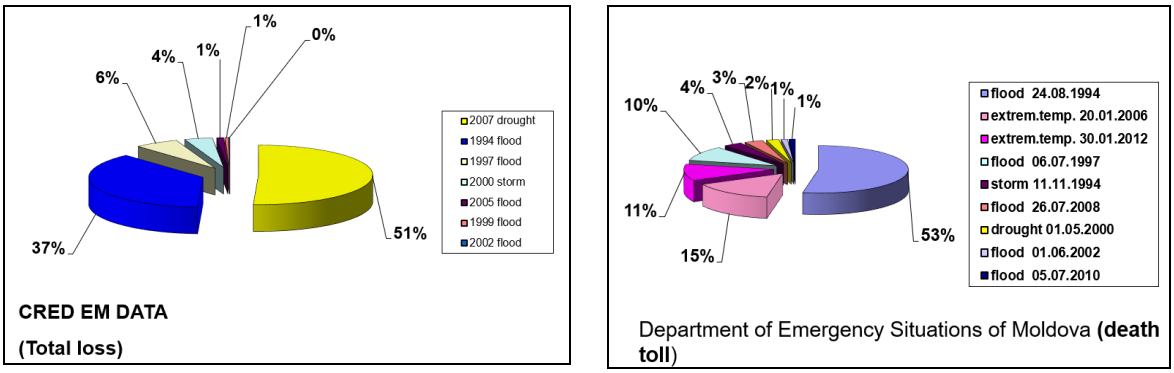

Fig. 4 – The share of climate hazards in the total loss (right) and death toll (left) reported at national scale over the 1960–2015 period in the Republic of Moldova.

The drought of 2007 led to the most significant damage, accounting for about 52% of the losses, while the floods of August 1994 caused at national level about 54% of the total deaths recorded during the period 1960–2015 (Fig. 4).

4.1. Drought and dryness hazards

Thus we obtain not only the intensity of the drought (moderate -1,0 <SPI <-1,49, severe -1,5 <SPI <-1,99 and when SPI <-2,0 drought is extreme), but also of its duration. According to the data presented in Figure 5, in the north of the country, as a duration and intensity we can see the phenomenon of drought that persisted in 1983, 1984, 1985, increasing its degree of severity from -1,0 ie moderate drought for the time scale one month to the extreme drought rating for the 12-month time interval. Over 10 years, the moderate drought phenomenon persists for four years (1993, 1994, 1995, 1996), and in the years 2011, 2012, the drought appeared to be severe.

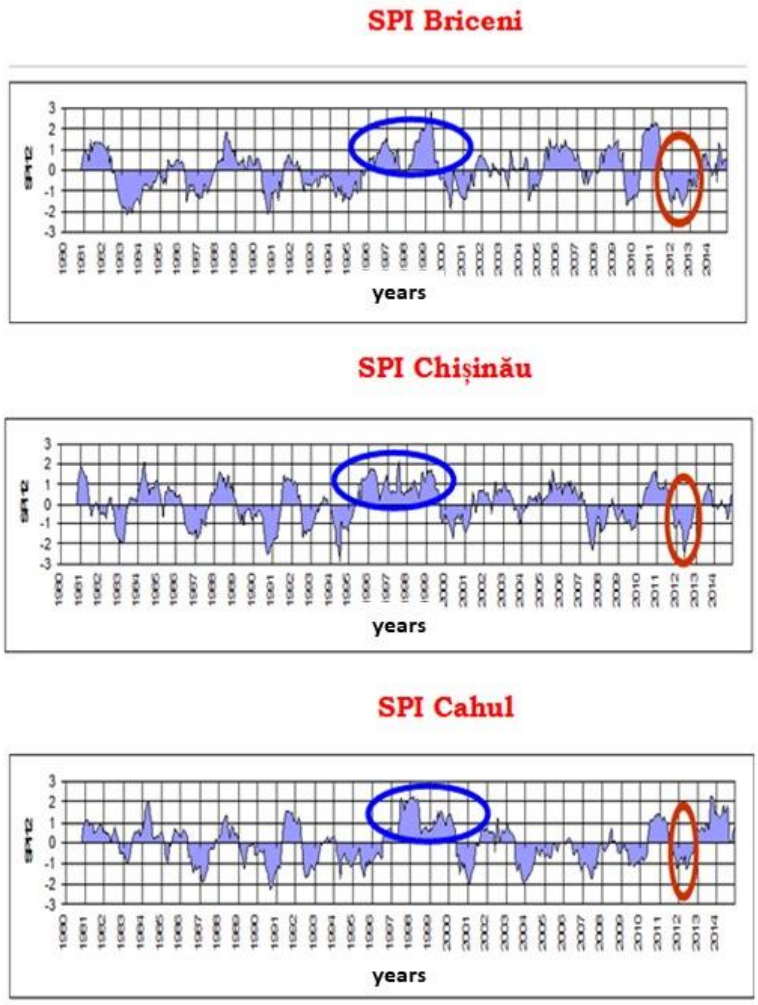

Fig. 5 – Variability of dry and wet periods by SPI at different weather stations in Moldova (1980–2015): a. Briceni, b. Chişinău, c. Cahul.

For the central part of the country the temporal aspect differs from that in the northern part of the country. Significant values of SPI for the one month period (July) are attested in the years 1991, 1993, 1983, 1987, 2007, 2009. For the time scale of the SPI 12 months the drought qualified as severe and extreme was registered in 1991, 2009, 2012 with prolongation and in subsequent years.

In the country's southern part (Fig. 5), SPI is above the limits of the extremes for one month, which is a feature of the drought, and also it is a phenomenon that has prevailed in this region, especially in recent years. With an increase in the time span of up to 12 months, the frequency of extreme droughts has increased in recent years.

The Standardized Precipitation and Evapotranspiration Index (SPEI) takes into account the multi-annual values for the pluviometric, thermal regime and geographical latitude, thus being able to know the potential evapotranspiration (ETP). The same time scales are used as SPI, so these results come to complement each other.

Graphs showing the dynamics of dry periods in the northern part of the country (Fig. 6), show that the dry years previously highlighted by SPI are preserved, but that the intensity and duration of this phenomenon as widening scale up to 12 months is much more concrete. The same regularity is maintained for the central and southern parts, and droughts event continuity from 3–6 months from 6

to12 months, or recording this phenomenon several years in a row, allow making probabilistic assessments for the years in the nearest future.

Current research shows that the last three years (2015, 2016, 2017) have been recorded as some of the warmest of the series of instrumental observations (Table 3).

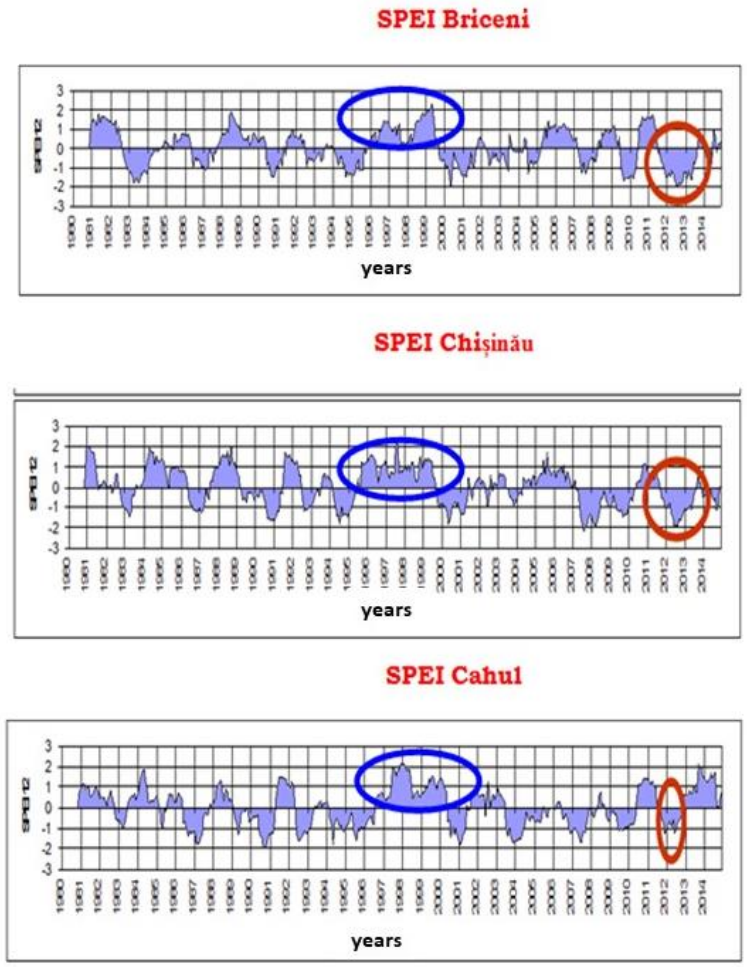

Fig. 6 – Variability of dry and wet periods by SPEI at different weather stations in Moldova (1980–2015): a. Briceni, b. Chişinău, c. Cahul.

Table 3

Top of the coolest and warmest years recorded during the period of 1887–2017

1887–2010 (Nedealcov, 2014)				1887–2017			
very cold		very warm		very cold		very warm	
1933	7,2	**2007**	12,1	1933	7,2	**2007**	**12,1**
1929	7,9	**2009**	11,4	1929	7,9	**2015**	**12,0**
1934	8,0	1990	11,3	1934	8,0	**2016**	**12,0**
1985	8,0	1994	11,3	1985	8,0	**2017**	**12,0**
1912	8,1	**2008**	11,3	1912	8,1	**2009**	**11,4**
1940	8,1	**2000**	11,2	1940	8,1	1990	11,3
1987	8,1	1999	11,0	1987	8,1	1994	11,3
1888	8,3	1966	10,9	1888	8,3	**2008**	**11,3**
1976	8,3	1989	10,9	1976	8,3	**2000**	**11,2**
1980	8,3	**2002**	10,8	1980	8,3	**2012**	**11,2**

If, according to (Nedealcov *et al.*, 2013), during the last two decades the years of the very hot years had a repeatability in 2 years, with the inclusion of the last 7 years, we find that 8 years of the top ten very warm (from the 1887–2017), belong to the period 2000–2017 (2007, 2015, 2016, 2017, 2009, 2008, 2000, 2012). We note the significant share of the last three years in estimating the climate warming trend at regional level. Thus, only with the inclusion of the last year 2017, the trend values increase by 0.00060C, i.e. from 0.01230C / year (1887–2016) to 0.01290C / year (1887–2017), for the whole series of instrumental observations.

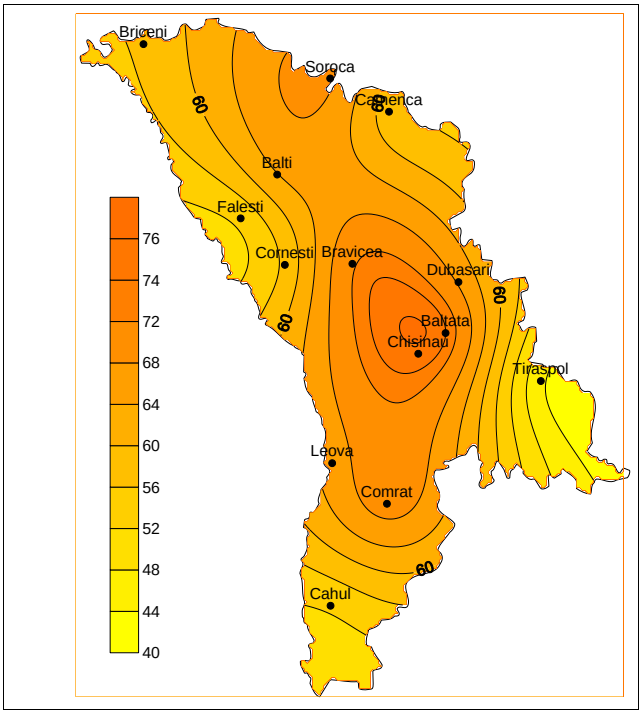

Fig. 7 – Total number of dry days in Moldova (2015).

Those revealed once again demonstrate that climate change persists with a pronounced warming trend. During the above-mentioned years, during the hot season of the year, the days where the daily temperature exceeded 25°C and the relative humidity of the air was below 30% were predominantly considered meteorologically as dry days.

Spatial distribution of the total number of dry days (Fig. 7) on the territory of the Republic of Moldova may reach during certain concrete years (2015) to up to 76 days, sometimes not respecting the principle of the zonality.

4.2. Wetness and pluvial erosion hazards

A specific feature of the regional climate during the warm period of the year is the alternating frequency of dry and rainy periods, and the latter may also be accompanied by material damage, deaths and floods. At the basis of the estimation of rainy periods a standard role is played by standardized indices (SPI and SPEI), used in the identification of periods of drought (Figs. 5, 6). The significant wet period was the consecutive years 1997–1999. So long duration of the falling precipitation with a high intensity can cause the accumulation of large amounts of water that flows on the slopes, in the form of run-off, favouring the production processes of runoff and torrential, that can trigger the

process geo-morphological erosion. The analysis of the time series over more than a century (1891–2016) shows that the Fournier Index (IF) on the territory of the Republic of Moldova (Fig. 8), in certain specific years, has significant value leaps. According to the temporal analysis in the Figure 5 we note that in 1952 the pluvial aggression constituted 86.6 units, which is included in the very severe erosivity class, followed by the erosivity class in 1985 and therefore the severe pluvial aggression (67,7).

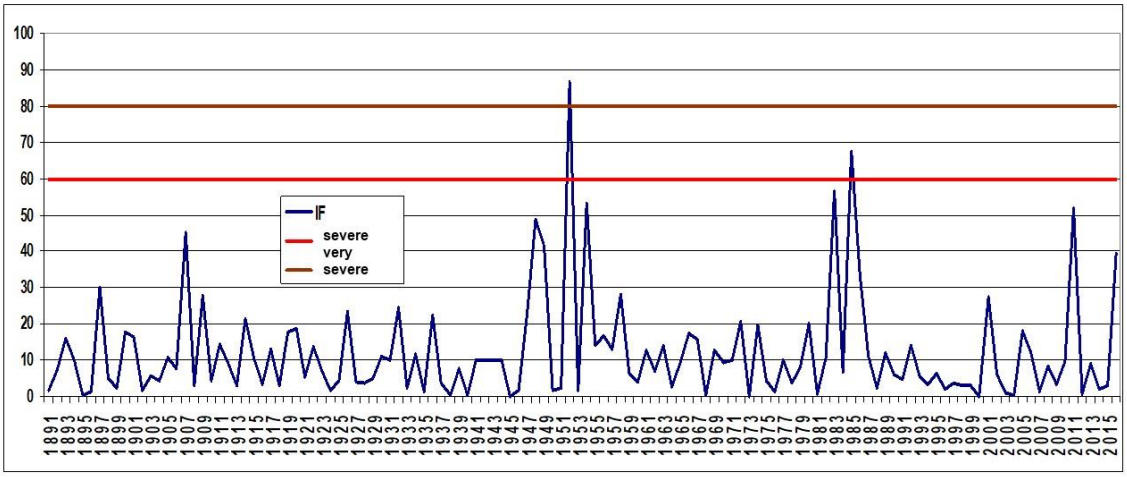

Fig. 8 – Dynamics of the Fournier Index and the estimated pluvial aggressiveness risk at Chişinău weather station over 1891–2016 period.

Cartographic patterns were developed to reveal the multiyear Fournier Index distribution (Fig. 9a), but also for the concrete years apart (Fig. 9b).

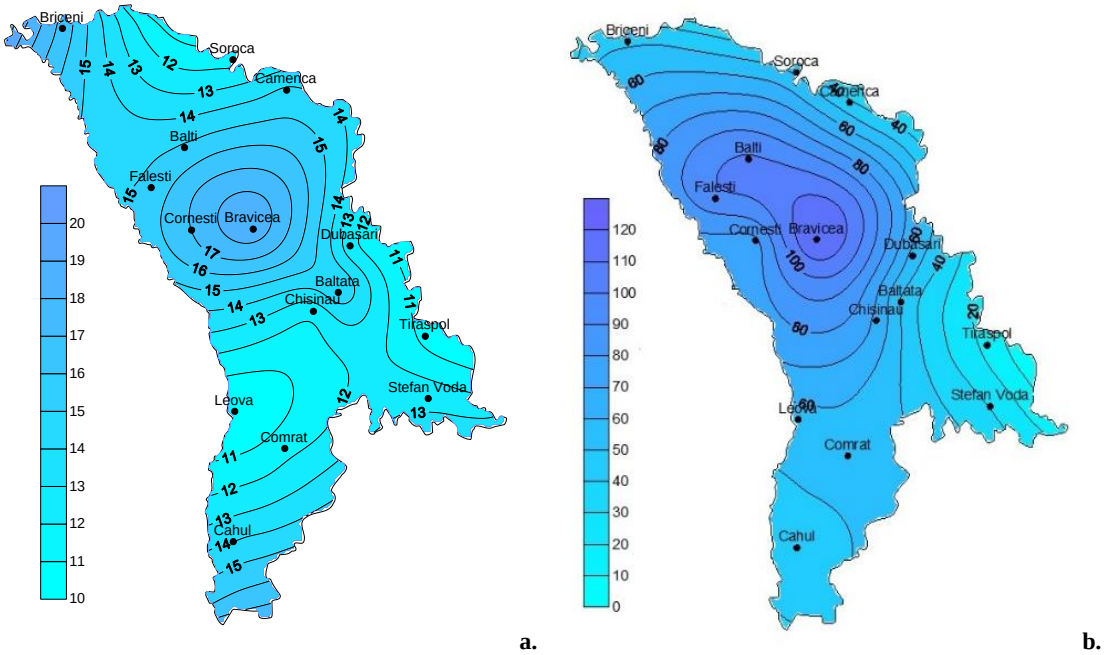

Fig. 9 – The spatial distribution of multi-annual pluvial aggressiveness
(a. 1981–2016) and in specific wet years (b. 1985) in the Republic of Moldova.

Digital map reflecting the multiannual distribution (Fig. 9a) of this index indicates that in multi-annual aspect, according to the IF values distributed in space, the pluvial aggressiveness is very low throughout the Republic of Moldova. If the Fournier Index in multi-year terms is estimated to be below 20 units, in some concrete years IF on extended areas sums severe, very severe and even extremely severe pluvial aggression (Fig. 9b). It should be mentioned that in the case where the pluvial aggressiveness is essential in the fragmented territories, as was the case in 1985, the situation may become even more complicated due to the more pronounced inclination of the slopes in the region

Therefore, the knowledge of the temporal aspect of the manifestation of the pluvial aggressiveness, as well as the highlighting of vulnerable areas, could contribute to the adequate estimations regarding the role of climate erosion in triggering unfavorable geomorphological processes. So there is no doubt that the effect of pluviometric extremes (although they have a rare record in time) in some concrete years can be disastrous.

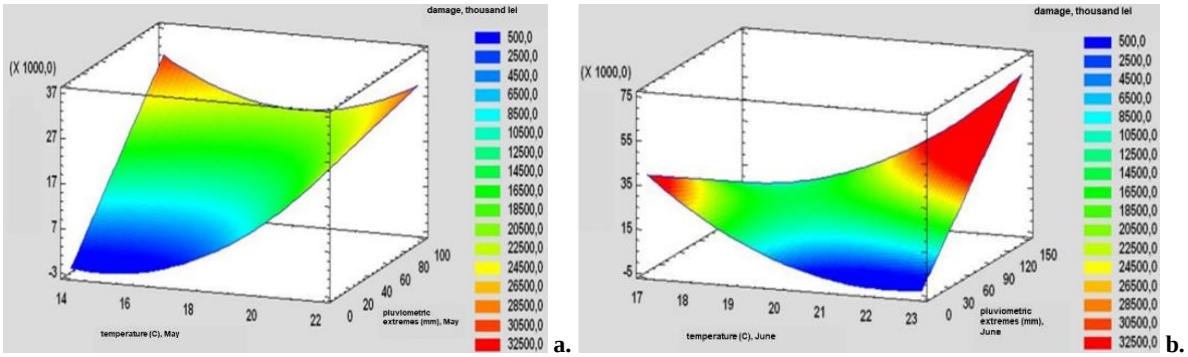

Fig. 10 – The material damage (a. May; b. June) caused by the pluviometric excesses (2000–2014) on the territory of the Republic of Moldova.

Analysis of data on material damage resulting from torrential rain in May (Fig.10a) and June (Fig. 10b) notes that in the years 2000–2014 they varied within the limits of 500–32500 thousand lei. Taking into account the frequent alternations of dry and wet periods, we conclude that the trend of recording material damage will remain in the future.

4.3. Hoar frost and glazed frost risks

From the multitude of climatic risks with manifestations during the cold period of the year, the territory of the Republic of Moldova significantly increased the magnitude of hoar frost and glazed frost manifestation, with the recording of the most essential material damage. In the north there is an increase of days with hoar frost with 0.0269 days / year, and in the central and southern part, due to the peculiarity of the synoptic conditions in the cold period, largely determined by the current climate changes, there is a decrease of -0.0081 days / year in the central part and more pronounced this trend (with - 0.1288 days / year) in the south of the country.

The frequency of hoar frost on the territory of the Republic of Moldova, due to the frequent alternations of the cold and hot periods, has a reversed distribution in regional aspect, compared to the number of days with glazed frost. In the north of the country, in the last years there is a decreasing trend of -0.0093 days / year and an increase of 0.0902 days / year in the central part and 0.0143 days / year in the south of the country (Nedealcov *et al.*, 2018).

At the same time, we note that in the first decade of the 21st century (2000–2010), everywhere was recorded a number of hoar frost days below the trend line, a period of time during which less

synoptic conditions of training were certified, after 2010, in the central and the southern part, frequent short-term fluctuations of cold and warm periods contribute to the more frequent occurrence of this unfavorable phenomenon over time.

Within the framework of the proposed researches, the cartographic models of the day and daylight manifestation were obtained in 10 years depending on the physical and geographical factors: geographical latitude and longitude, absolute and relative altitude, slope orientation and slope. The elaboration of the regression models revealed the significant weight of the geographical latitude, the absolute altitude and the orientation of the slopes in the redistribution of the studied climatic elements (Fig. 11). It was found that in colder periods, the number of days with glazed frost may vary geographically from 5 to 12,8 days in the north to 20,8 to 27,1 days in the central and south from the annual average corresponding 9,9 days (north), 10,7 days (center) and 13,9 days (south).

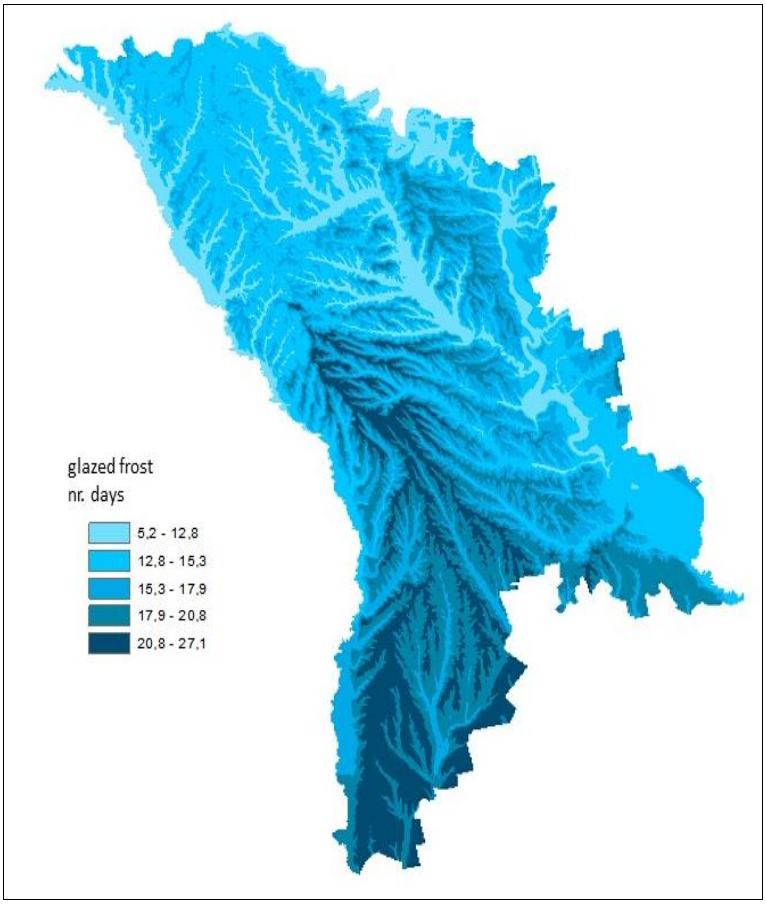

Fig. 11 – Spatial distribution of the number of days with glazed frost in Moldova with a return period of 10 years.

The estimation of the hoar frost days that can occur once in the coldest winters in 10 years reveals the fact that most days are recorded in the north, northeast and at the altitudes in the central and southern part (Fig. 12). Thus, the valleys of large and small rivers in the south and south-east of the country register for 6,5–10,9 days, and in altitude forms they reach values of 19,4–29,0 days. The multiannual values of the chill days on the territory of the Republic of Moldova show a decrease from

north to south, namely: from 13,8 days in the north to 8,2 days in the center and 7,9 days in the south. Mapping models highlight the redistribution of this phenomenon in space, and the likelihood of occurrence once in 10 years indicates the possible values that this unfavorable phenomenon can sum up. An important role in the construction of the roads and the edifices is the knowledge of the maximum depth of the frozen soil. We mention that the maximum annual values are obtained from the extreme values observed during five days or decades between November and April.

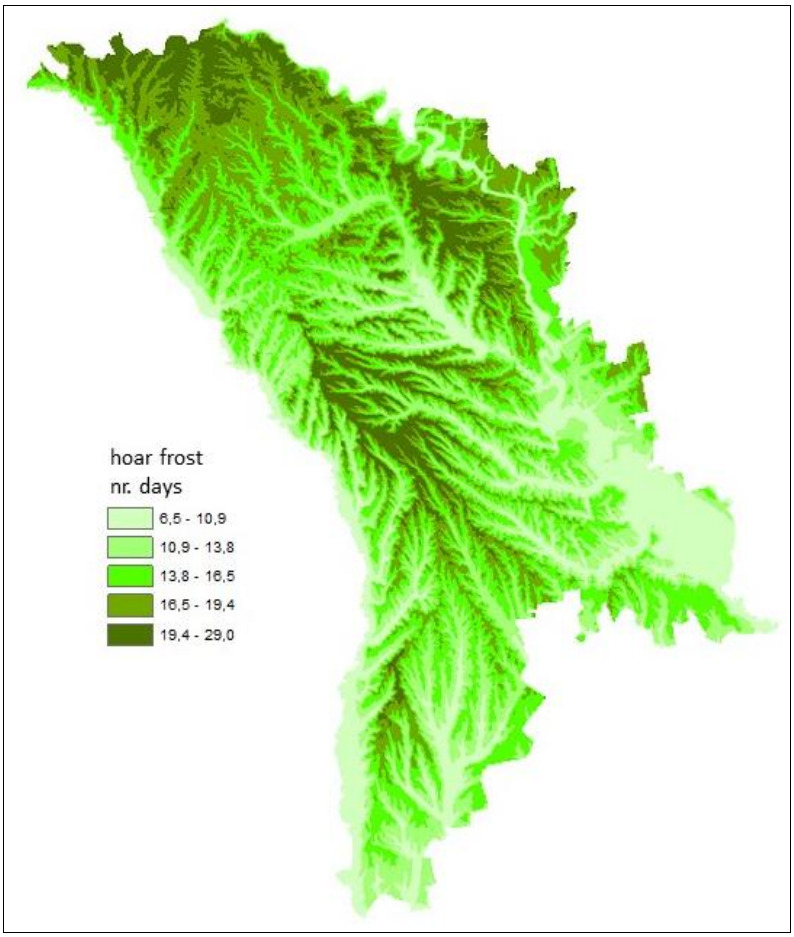

Fig. 12 – Spatial distribution of the number of days with hoar frost in Moldova with a return period of 10 years.

4.4. Soil frost risk

Thus according to Fig. 13 and Fig. 14, depth of frost soil return period once in 50 years may be 90–100 cm in the north of the country, Edinet, Donduseni, Riscani, Ocnita, Glodeni, Soroca and in the east of the country, coinciding with the East Rezina, Dubasari, Grigoriopol. The smallest values that characterize the soil frost depth with the recovery period in 50 years are characteristic of the areas in the south of the Cahul district (under 60 cm). On a large part of the central and northern districts (Falesti, Floresti, Soldanesti, Balti, Hincesti, Ialoveni, etc.), the isothermal zero degrees in the soil will reach the depth of 80–90 cm. The almost null difference between the interpolated data and the observed data confirms the quality of the obtained digital maps.

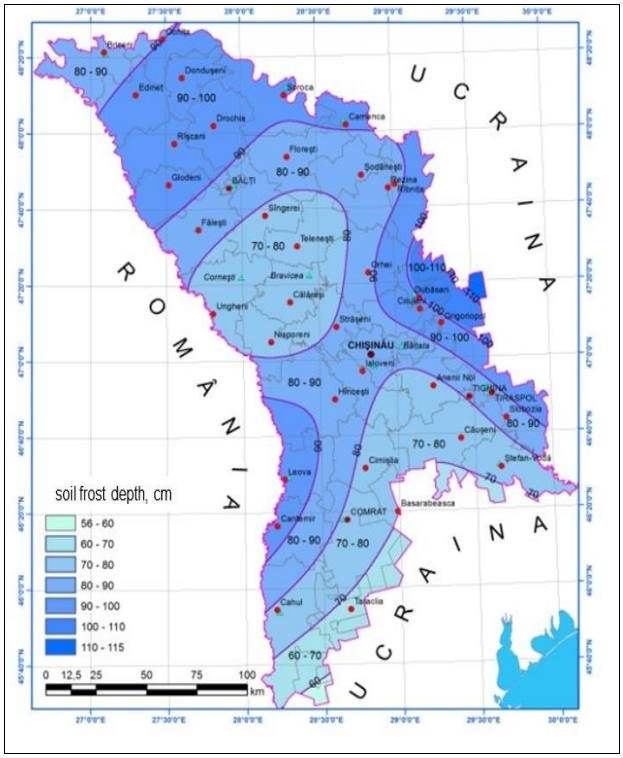

Fig. 13 – Soil frost depth with a return period of 50 years in Moldova (Nedealcov *et al.*, 2018).

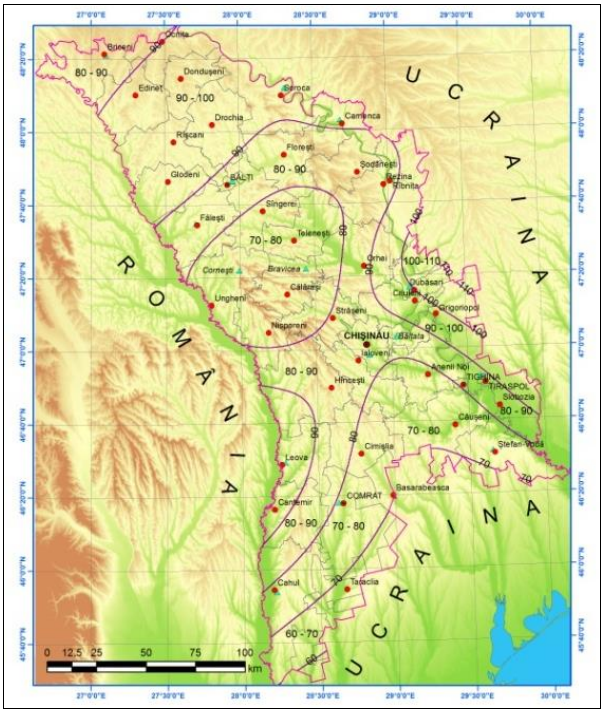

Fig. 14 – Zoning of the return period (IMR = 50 years) of values that characterize the depth of frozen soil (Nedealcov *et al.*, 2018).

5. CONCLUSIONS

Therefore, the great climatic variability conditioned by the climatic changes observed in the last decades leads to the increase of the magnitude and frequency of the climatic risks. These in the most frequent cases take on the appearance on hazardous phenomena being accompanied by substantial material losses and even by human victims. Therefore, the identification of the weather-climatic hazards based on an imposing volume of data stored both internationally and nationally, allowed to highlight the vulnerable areas, and their return periods. The data obtained is extremely necessary when taking measures to adapt to the new climatic conditions, but also to mitigate the impact of hazards by carrying out operational measures, knowing the particularities in time and space of demonstrations. Some of the results already obtained are based on the adjustment of normative acts in constructions to the European Union Directives on natural risks management. Map of spatial distribution of the number of days with glazed frost in Moldova with a return period of 10 years and map of spatial distribution of the number of days with hoar frost in Moldova with a return period of 10 years are used for decision-making process by the local public authorities when mitigating climatic risks. Map of soil frost depth with a return period of 50 years in Moldova and map of zoning of the return period (IMR = 50 years) of values that characterize the depth of frozen soil are already implemented within the Ministry of Agriculture, Construction Development and Environment.

In conclusion we state that the spatial estimations are based on the use of complex and current information, stored on the basis of contemporary research technologies (Geographic Information Systems), which are meant to ensure updating and operative reference of the climatic climatic factors to the real geographical coordinates . Temporal estimates highlight the re-emergence of some weather-climatic factors on the territory of the Republic of Moldova. We believe that the scientific results presented in this paper will be in the future able to provide state bodies and various economic agents with up-to-date climate information in order to mitigate the unfavorable influence of weather-climatic factors on various practical activities.

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EXPLORING SOME TOPICS FOR A POTENTIAL RESEARCH IN THE FIELD OF CHILDREN'S GEOGRAPHIES IN ROMANIA

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Key-words: Children's Geographies, research topics, Romania.

Abstract. Worldwide, Children's Geographies have developed continuously, increasing its research topics with the expantion of Cultural Geography. In Romania, the children have not so far been sufficiently explored geographically, despite the fact that the Romanian society passes through a difficult period of change which affects the whole population, children included. This paper aims to explore some topics for a potential research in Romania, in the new field of Children's Geographies (e.g. children in different environements, the relationships between children and the natural or anthropic environments and landscapes; different categories of spaces for children and childhood). The topics of the research have emerged from references to the international literature on Children's Geographies. Most of the issues debated in this paper are accompanied by some suggestions/ideas related to Children's Geography adaptated to the country's background, but so far negleted by Romanian Geography.

1. INTRODUCTION

It is recognized worldwide that the child is always located somewhere (Rasmussen, 2004, Gagen, 2004, Clark, 2013), and, without adopting the deterministic approach, the importance of space, place (Tilley, 1994, Holloway, Valentine, 2000, Massey, 2004) and scale (Swyngedouw, 1997, Howitt, 2002, Thomson, 2005, Jonas, 2006, Ansell, 2009) is revealed by many studies focused on the educational, cultural, ethic and economic issues involved by looking for and rising a child in different parts of the world (e.g. England, 1996, Gittens, 2004, Abebe, 2007, Nilsen, 2008, Corsaro, 2011, Kovács, 2014, Souralová, 2014). Undoubtedly, this literature is the answer to James's (1990) question: "Is there a "place" for children in geography?". He suggested then that it was the time to consider how "the other third or quarter – the children – live" (p. 278), making a reference to Tivers's research question (1978) about "How the other half – the woman – lives?" (p. 302).

Now, with a delay of almost three decades, we ask the Romanian academic scholars the same question: "Is there a "place" for children in Romanian Geography?" We try to "build" an answer, based on the contemporary development of Romanian Geography. During the past decades, Romanian Human Geography has developmed in many directions, some of its sub-fields following the well known pathways (e.g. rural and urban geographies, population geography, economic geography) and others, taking new paths or identifying new research topics in traditional topics (e.g. social geography, cultural geography). However, Children's Geographies, as sub-field of Cultural Geography, represent a totally new research direction. Giving that the research potential subject is represented by the 3,047,938 children (meaning 14.06% out of the total resident population in 2017) registered in Romania, and the natural, socio-economic and cultural backgrounds vary a lot in this country (influencing chidlren's lives and places in many ways), undoubtedly, the answer to the above-mentioned question is «Yes, it is a "place" for children in Romanian cultural geography».

The aim of this paper is to explore some topics with a research potential in the field of Romanian children's geographies. Firstly, for investigating and adapting these issues to the Romanian background, the author presents the worldwide trends in this sub-field of Cultural Geography. Secondly, based on the international approaches, the author intends to offer several directions for

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future Romanian children's geographies. Thus, the last part of the paper cummulates some indicative approaches in terms of child's temporal and territorial limits, distinctive categories of children, categories of spaces for children and childhood, etc.

2. CHILDREN'S GEOGRAPHIES – A SUB-FIELD OF CULTURAL GEOGRAPHY

People and land the world over are characterised by inumerable cultural differences (Jordan-Bychkov *et al.*, 2006) and an entire sub-field of Human Geography. E.g. Cultural Geography is devoted to the study of these differences. It focusses on the way in which different peoples and processes come together in particular places, how they interact and how those places change meanings for people (Crang, 1998). Cultural Geography aims to explain cultural change in different geographical settings, from the political to the economic ones (e.g. production and consumption of landscapes), from sexuality, gender to race and nationality (Mitchel, 2000).

In time, Cultural Geography studies have emerged as an alternative to environmental determinism (Ratzel, 1882, 1891, Semple, 1911, Huntington, 1911, 1913), a concept which held a central if not dominant position within Geography only during the early part of the twentieth century, though some of its traces date back to Greek and Arabic civilizations. As an alternative to the idea that the natural environment, at scales ranging from the individual to societies, shapes the human development across various domains (Johnston, 2017), Cultural Geography focuses on cultural landscapes (Sauer, 1925). The traditional Cultural Geography (Fig. 1) was not called "traditional" until 'it' became the focus or subject of scholarly critique (Schein, 2004). Since the 1980s, Cultural Geographers started engaging with many significant ways in which they recast Cultural Geography, through feminist, behavioral and gender geographies (New Cultural geography). Through this new broad range of pathways, Culture finished being conceived simply as a way of shaping the natural landscape, but it has evolved, making differences in everybody's life and everyday places (e.g. ethnicity, disability, cultural and religious practices).

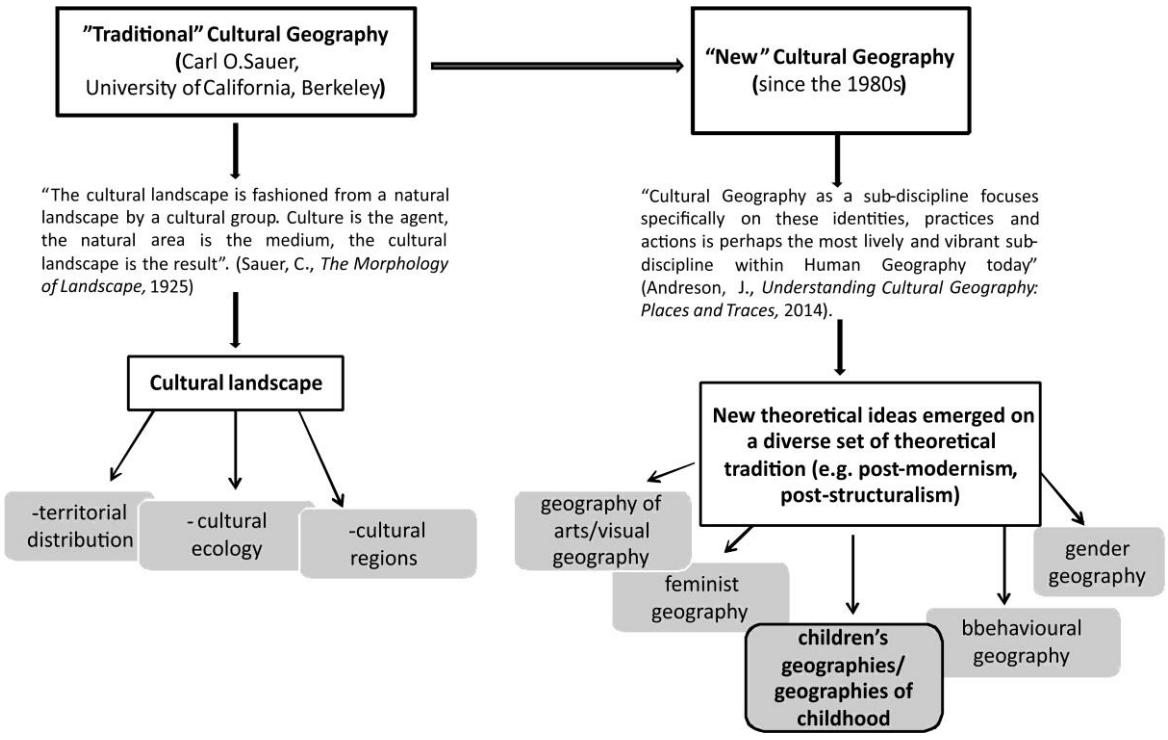

Fig. 1 – Cultural Geography – the dynamic of concepts and scientific interests.

Despite the fact that the child is organized as both a spatial and temporal variable, it has not been a major focus of research in Geography (Holloway, 1998), but gradually, the interest for child's geographies started increasing, two sub-fields of Cultural Geography being developed: Children's Geographies and Geographies of Childhood (Fig. 2). The worldwide geographical literature focussed on children, childhood and their territorial approach shows the blurred distinction between Children's Geographies and the Geographies of Childhood, despite the fact that the two sub-fields of Cultural Geography remain affiliated by research subject: children and their childhood.

The Geographies of Childhood focuses on the multiple ways in which society thinks about the idea of childhood and how this society acts on children's lives and influences them in diverse places and times. Childhood is a socially constructed phenomenon (James and Prout, 1997, James *et al.*, 1998, Holloway and Valentine, 2000). In a traditional way, childhood is approached by emphasizing the various stages of children development (Oakley, 1994), and in the way of the new social investigation, it is studied from two perspectives: (1) as social construction which varies with place and time (Prout and James, 1990), and (2) in which the child is studied as active social actor, as beings with its own rights rather than as pre-adult becoming (Uprichard, 2008, Morrow, 2011) and having a social agency.

As a sub-field of Cultural Geography, Children's Geographies deal with the study of places and spaces of children's lives, with children's experiences of playing, living and learning (Holloway and Valentine, 2000), participating in different "micro-" and "macro-"political engagements (Skelton, 2013, Kallio and Häkli, 2013), involving themselves in community development and environmental care (Hart, 1997).

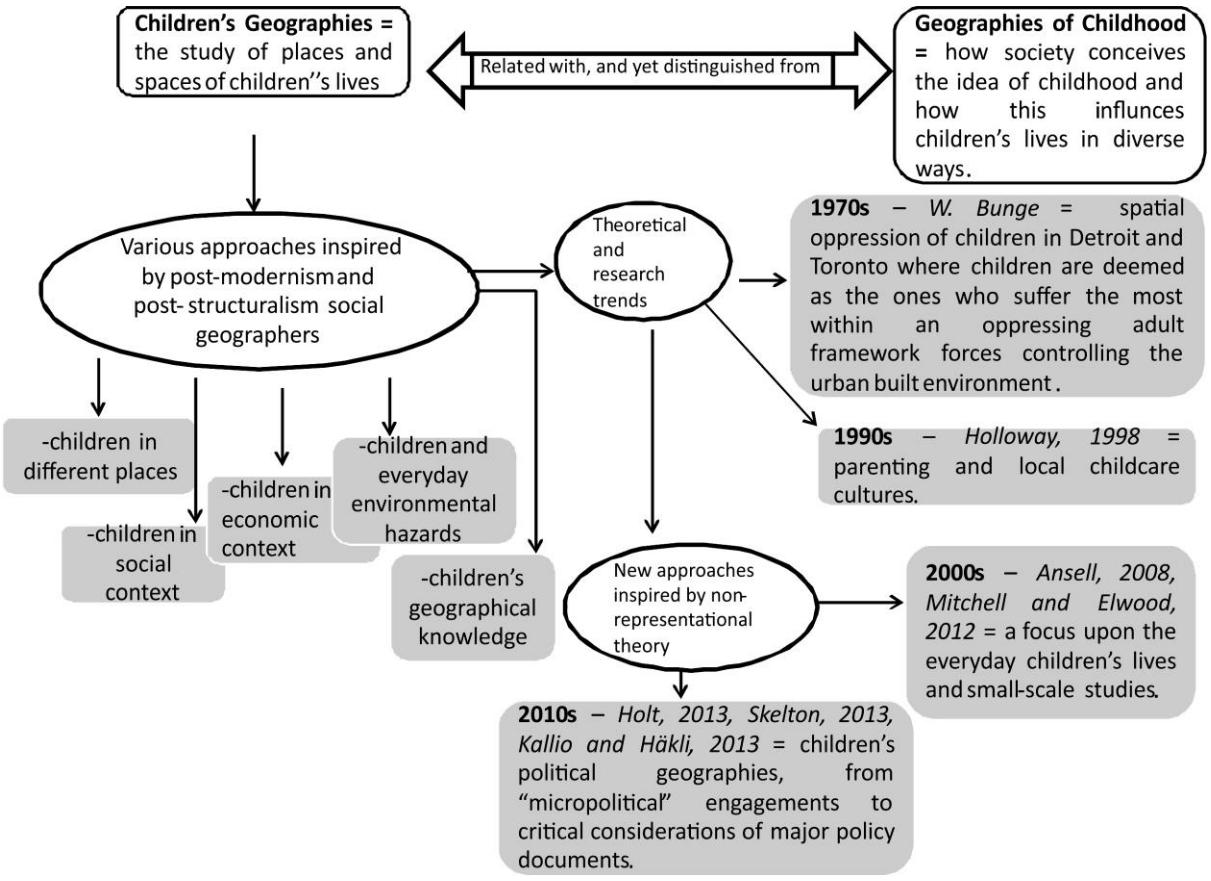

Fig. 2 – Children's Geographies – different research topics approached in the international literature.

Children's Geographies represent a research field which involves the study on and with children, they having unique characteristics and representing a distinct and significant demographic category (James, 1990). In the early 1970s, Bungé (1973) identified the need to include children in geographical studies. In his researches, Bungé considered children as one of the largest minority, he focusing his scientific interest on the environmental forces which influenced children's lives. The need for Cultural Geography to engage more with Children's Geographies was highlighted especially in the early 1990s (James, 1990, Ward, 1990, Winchester, 1991, Philo, 1992) and since then, Children's Geographies are "broadly sympathetic to cultural geographic themes" (Gagen, 2004, p. 406). Discussing the paper published by Ward (1990), Philo (1992) argued on the theoretical affinities with Cultural Geography and identified also some themes that resonate with Cultural Geography (e.g. the ways in which space and place are entangled in the lives of all manner of 'other' human groupings, children included).

3. EXPLORING POTENTIAL TOPICS EMBEDDED BY ROMANIAN CHILDREN'S GEOGRAPHIES

Children's Geographies, as sub-field of Cultural Geography, represent a totally new research direction in Romania. The discussion about topics for potential research embedded by Children's Geographies is structured following the main research trends emerged from the worldwide literature on Children's Geographies.

The child, as scientific concern for researchers activating in Children's Geographies, but also as person, presents some ***temporal limits***. In publications focused on this topic, two types of temporal limits are identified: biological (defined by chronological age) and historical (the child has been perceived firstly, as a passive research "object" and, after that, as an active research "subject" (James, 1998 quoted by Holloway and Valentine, 2000). In the international literature, the authors who debated on childhood and child (e.g. Ariès 1962, Jenks, 1996 quoted by Holloway and Valentine, 2000) wondered when the notions of childhood and child were "invented". Ariès (1960, 1982), studying medieval arts, concluded that in the Middle Ages children were regarded as little adults, an interpretation criticized by Gittens (2004) and Corsaro (2011), and only during the Enlightenment did the concepts of childhood and child started to be more frequent. The changes in the perceptions of child and childhood were more numerous starting from the 1970s and the 1980s (James, 2009), with the launching of the International Year of the Child in 1979, since "the new notion about children and childhood focused on the collective actions of children with adults and with each other" (Norozi and Moen, 2016, p. 77). The temporal limits of childhood vary from time to time in the very same society or in different societies (Norozi and Moen, 2016). Thus, the Romanian researchers in the field of Children's Geographies could approach the issue of temporal limits at different periods and spaces: e.g. in distinct rural or urban settlements/households/homes/families, during certain historical periods such as the inter-war period, or before and after 1989. The school/high school enrollment, the first unaccompanied journey (what/where was that journey?), the first own decisions concerning her/his own everyday or general existence are only few hallmarks which could delimit the childhood from adolescence. For example, it would be challenging to study the interactions between the Romanian children with private and public local places, they depending not only on culture, time, but also on circumstances (Norozi and Moen, 2016).

Jenks (1996) operates with two distinctive ***categories of children***: Dionysian ("the little devil", p. 62) and Apollonian ("the little angel", p. 64). These were differentiated by "the same spatial ideology" (Holloway and Valentine, 2000) according to which children's place is at home, while other places (e.g. public places such as the street) exposed them to risk. The Romanian categories of "Dionysian" and "Apollonian" children are approached such as they result from ones of the greatest works of Romanian literature. E.g. Nică boy, the hero from *Childhood Memories* (*Amintiri din*

copilărie) by Ion Creangă, may be labeled as a Dionysian child, who lived, played and studied in a 19th century Romanian village; the same type of child is Panait Istrati's boy-character, who spent his childhood in a Romanian sub-urban space at the end of the 19th-century (Brăila); the girls-characters from the novel *At the Medeleni* (*La Medeleni)* by Ionel Teodoreanu represent both types of children (according to her father, Olguța is an "angelic devil" and Monica is the embodiment of the Apollonian child), they studied in an urban school, played and spent their childhood in both urban and rural environments, also interacting with outlying geographical spaces (e.g. France); during the '30s of the 20th century, the interactions between child and rural labour, school and the other family members were mirrored in the Moromete family, in which Niculae is the main character; at the same period, the child Mircea Eliade lived, spent his childhood in an intellectual family and studied in a prestigious Capital City high school. This short analysis may be continued by some detailed studies of children and childhood described by other Romanian literature authors (e.g., I.L. Caragiale, Lucian Blaga, Barbu Ştefănescu Delavrancea, Titiana Nica Ţene). These two categories of children could constitute an interesting topic for a potential research, especially related to the issue of "social agency".

Worldwide, a very actual and great potential for research in Children's Geographies is the ***issue of "agency"***. We would mention that, for an individual, having an "agency" means having the capacity to act independently and to make his own free choices; reversely, "structure" in social science, represents those factors (e.g. social classes, ethnicity) which limit, or have a determinant influence on the agency. The geographical research with children and youth as having "social agency", is considered a progress for international Children's Geographies and the Geography of Childhood. Authors, such as Oswald (2013), studied the important changes registered in recent decades in children's everyday lives, as a consequence of new internet, mobile technologies and other forms of globalization, all these in the perspective of children's agency. Other authors (e.g. Carr, 2011), Schänzel and Smith (2014), Schänzel and Carr (2015) and Seymour (2015) looked into the issue of agency in movement, travel and leisure activities beyond one's home. May the issue of child's "agency" constitute a topic for geographical research in Romania? A possible answer may result from the great diversity of geographical and socio-economic backgrounds in which children's every-day life is unfolding. For example, the issue of agency is important and interesting to be studied in the case of children living in many Romanian rural areas, where boys and girls have important roles in household and family activities and productivity: the involvement is their own choice in some cases, but in many others it is the "structure" – the family, the economic and social factors – that enforces this reality, impacting children's agency in terms of school and play choices.

Arguing about the children and youth with or without agency, the Romanian geographers would find a fruitful research topic in ***debating on the scale*** of studies of children and childhood and also on the importance and relevance of choosing a micro- or a macro-scale of analysis. In all the domains of activity, the scale of analysis supposes a geographical approach for "ordering the world" (Herod and Wright, 2002, p. 5 quoted by Ansell, 2009), despite the fact that the concept of scale in Human Geography has been profoundly transformed over the last decades and yet there is no consensus today on what is meant by the term, or how it should be operationalized (Marston *et al.*, 2005). Worldwide, many studies on empirical and theoretical research on the scale were published (e.g. Bird, 1956, Holly, 1978, Howitt, 1993 and 2002, Herod and Wright, 2002, Marston *et al.*, 2005, Ansell, 2009) leading to some ideas which may be useful for some potential Romanian studies on Children's Geographies and the Geography of Childhood: the metaphor of Russian Matryoshka dolls (Herod and Wright, 2002, who explain that the dolls and scales fit together in one and only one way; a geographic study on child or childhood is understood very differently when examined at rural or urban community, regional, national or global scales (Jennings *et al.*, 2006); approaches to scale in terms of three facets: size, level and relation (Howitt, 2002). Nowadays, thinking about scale in terms of hierarchical arrangement, or

as being dominated by "dualistic association of local and global" (Ansell, 2009, p. 10) suffers a change: scale is viewed as bounding the space, Marston *et al.* (2005) proposing to eliminate the scale as a concept in Human Geography. Studying the relevance of a territorial level or another, highlighting the types and the intensity of relations established between children and between children and their living, studying and playing places may be some fruitful and sorted research topic in Romanian children's geographies.

The issue related to ***categories of spaces for children and childhood*** (the so-called "every-day spaces" by Holloway and Valentine (2000) or the "particular spaces" by Gagen (2004), identified and approach in the international geographical literature, are: the home, the school, the playground, the city and the countryside, street. The deep-going study of each of them could constitute a research topic for Romanian human geographers and even for those interested in Physical Geography, the multidisciplinary research being more appropriate (e.g. the diverse effects of landslides, summer or winter extreme climatic phenomena, floods, etc. on the every-day spaces of children), e.g. the educational system is central to the geographies of children and young people and to the organization of much family life, also playing a central role in shaping social identities (Collins and Coleman, 2008). The schools and kindergartens, as main institutions of education, are the places where Romanian children spend a considerable time in their day-to-day lives (e.g. 4–10 hours/day). Their geographical location could constitute a topic for a potential research: children's safety inside the schools and kindergartens located in some vulnerable areas (e.g. bio-physical and socio-economic vulnerability resulted from natural and human events), the opportunity for pupils to interact with local natural and cultural/historical situations (e.g. types of outdoor activities aiming to increase children's geographical knowledge are offered by schools and kindergartens located in different relief steps), the material and technical endowment depends largely upon the schools' and kindergartens' geographical location (generally, isolated rural and urban educational units are disadvantaged in terms of endowment and the educational process is suffering). The territorial differences between the places where children play (in terms of typology, security, equipments, etc.) may constitute another topic for potential research in the field of children's geographies in Romanian.

4. CONCLUSIONS

Children's Geographies could constitute a very fruitful filled of research for Romanian geographers through numerous and diverse topics, such as: the very complex issues related to children and the diverse contexts in which they live, learn, play, travel, etc.; cultural and economic ways/models of parenting in different territorial backgrounds; children's consumption (of food, information, cultural products, etc.) in different types of communities; natural hazards in relation with chidlren's geographical knowledge and their relationships/interactions with natural or anthropic environments and landscapes; children in different environments (e.g. cities and villages, home, schools, playgrounds), differences between children and their distinct features (e.g. children living in rural and urban settlements, those living in houses with courtyard, or in blocks of flats), etc.

The topics related to Children's Geographies which could be valorized by the Romanian researchers through a detailed research in studies, papers and books. Some of the topics present a high potential for theoretical approaches, such as the territorial scale in studies of children and childhood, while others would be valorized by applicative studies (e.g. different categories of spaces for children and childhood). The natural, socio-economic, cultural, historical changes could represent powerful driving-forces in shaping children's lives, but also opportunities for developing multidisciplinary research, which seem to be more appropriate for study and offer some useful and adapted solutions to detected issues.

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EVALUATING THE QUALITY OF LIFE IN URBAN AREA BY USING THE DELPHI METHOD. A CASE STUDY OF M'SILA CITY/ALGERIA

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Key-words: M'Sila; quality of life; Delphi Method; Hierarchical Analysis Process; GIS; Multi-Criterion Analysis for Decision-Making.

Abstract. Studies and research on the quality of urban life are witnessing a renewed interest not only of the research community, but also through policies and attention in urban management and planning for the search of how to make cities more competitive and maintain the development and promotion of the population well-being. In this manuscript, we discuss how to assess the quality of urban life by integrating the Delphi method with one of the multi-criteria analysis techniques in decision-making, the process of hierarchical analysis is sequential (AHP). The city of M'Sila, Algeria, was selected as a case-study, where we proposed a set of criteria for assessing the quality of life in the city, engaging its actors using the Delphi method and selecting six factors (public services, education, environment, culture, recreation, health, security, and protection). The first stage, in the second phase, I use a sequential method of the AHP pyramid analysis, the third stage came to translate the results obtained in a GIS environment, to derive the quality of the life map. One of the most important results follows: (7%) of the study-area achieves: high-quality of life with space (3.77 km²), (9%) average quality of life with an area (4.70 km²) and (14%) moderate quality of life with an area (6.98 km²) and (19%) low quality of life with space (9.75 km²) and (51%). It achieved the least quality of life with an area (26.02 km²). Map results can be used to identify areas that need to be upgraded or to choose the best areas for accommodation.

1. INTRODUCTION

For many years, researchers in all sciences have argued that the quality of any entity has a subjective dimension that is perceptual, as well as an objective reality. An essential element of this assertion is the notion that the environment can be defined as having a natural and socio-cultural dimension (Marans, 2005).

In the light of population increase, rural exodus and the uncontrolled expansion of cities due to the events of the "Black Decade" that took place in Algeria from 1990 to 2000 (the Algerians passed through a decade of instability and terrorism) made all inhabitants of isolated and insecure areas flee to urban areas close to them to provide security. This applies to all Algerian cities, and the city of M'sila was a place of displacement of the inhabitants of the neighboring areas. This fact led to a rapid and indiscriminate expansion of the city, which caused a decline in the quality of life Current, cities in the competition to provide the best quality of life for their inhabitants. In order to understand the quality of urban life in a city, we need to measure the conditions in this place by using sets of indicators, but the quality of life indicators began to emerge through the evolution of the social indicators in the 1960s (Kladivo & Halás, 2012), but they have roots in the economic means of measurement during The 18th, 19th and early 20th century rings (Mostafa, 2012). These innovative indicators are divided into quantity and quality, there are two basic ways of researching the quality of life: a personal and objective approach and a subjective (or internal) attitude focus on the feelings, perceptions, opinions and mental situations of individuals or groups Studied. An objective (or external) approach attempts to conduct research on the quality of life based on a wide range of measurable or observed indicators in the individual and environmental dimensions (Kladivo & Halás, 2012).

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The residential area is one of the main components of quality of life. Furthermore, we need to monitor changes in this area in these circumstances over time in order to assess or determine whether or not these circumstances have changed. If they change, we need to determine whether they have improved or deteriorated, and this effort may include assessing the impact of various public or private interventions that seek to improve conditions. To better understand the meaning of the studies that focus on the quality of urban life that enables us to better understand this meaning and how it can be measured (Marans, 2003). The quality of the place or location at different levels of the range (the area, the city as a whole, the neighborhood, the dwelling) is certainly a subjective phenomenon and everyone in this situation may differ in their views on the subject.

The main objective of the study is to evaluate the quality of life in M'sila city and to identify the areas where they are necessary to raise the standard of living for the welfare of all inhabitants of the city.

2. MATERIALS AND METHODS

2.1. Study-Area

The city of M'sila is one of the inner Algerian cities located within the following geographical coordinates: Between two viewing circles: '35.48°, '35.67° north of the equator. Between linear length: '4.57°, '4.48° east of Greenwich line the north-south link is the seat of the state. The city is characterized by economic diversification. Municipality of M'sila. Estimated Area B: (232) km^2 operated by (214,661) inhabitants, with a population density of (925) inhabitants according to the municipal Bureau of Statistics 2014, an estimated area of study field Urban center of the City B (50.01) km^2 (Fig. 1).

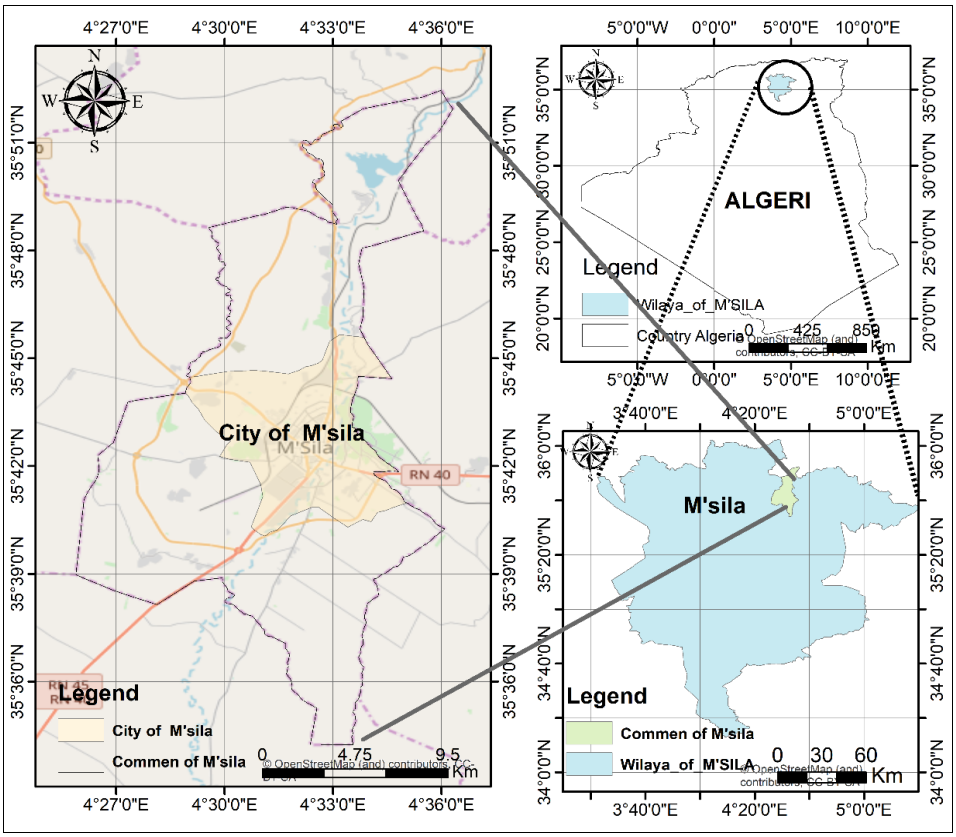

Fig. 1 – Location of the Study-Area City of M'Sila.

2.2. Data Collection

2.2.1. Factors for Evaluating the Quality of Life in the City

As mentioned previously, criteria were determined using the Delphi method to evaluate the quality of life by applying a multi-criterion analysis to decision-making through the analytical hierarchy process. After collecting the geographical data, layers of the main factors and sub-factors were set in the open source programme Q GIS.

2.2.1.1. Security and Civil Protection

In this factor, information was collected by field survey and the identification of all police stations and fire departments and the creation of a layer for the latter in the QGIS programme. Police stations and fire departments were chosen based the opinions of experts and field surveys in determining the range of service: (less than 2,000 m); (2,000 m to 3,000 m); (more than 3,000 m) (Fig. 2).

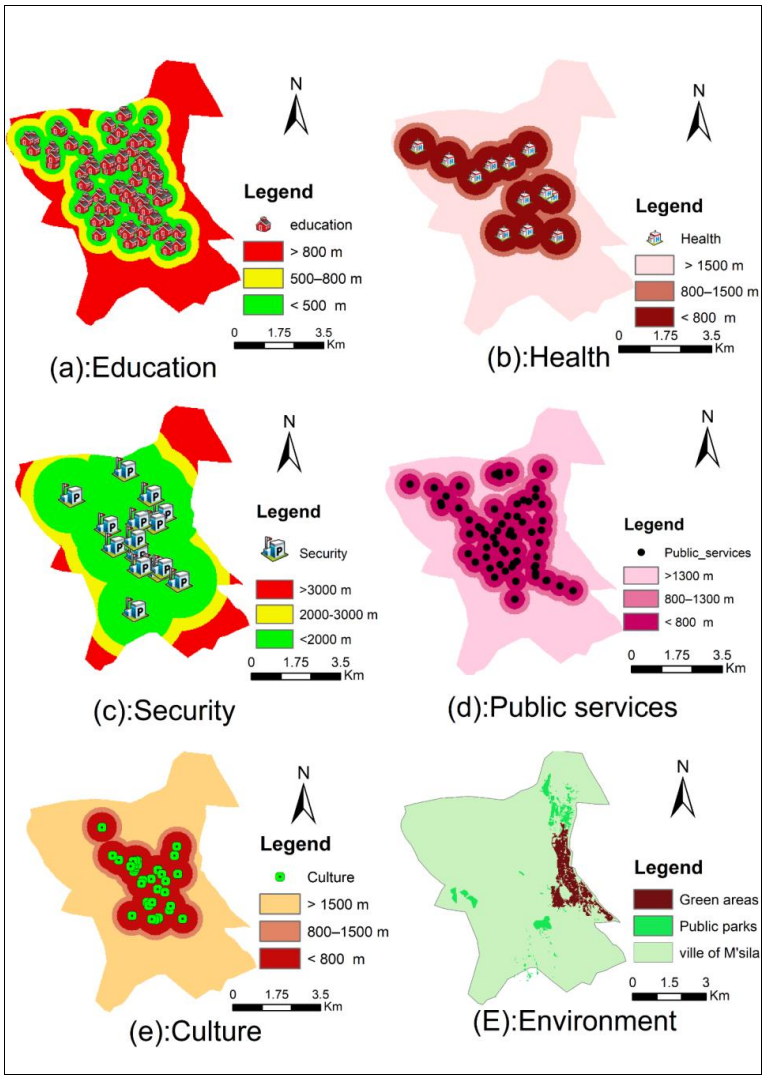

Fig. 2 – Factors studied in the analysis of the Quality of Life in the City of M'Sila.

2.2.1.2. Education

For this factor, we collected all the descriptive data from the Directorate of Education in M'sila and all the spatial data from the blueprints of the planning and reconstruction of M'sila with field survey to update all the collected data. For the range of service, the experts determined: (less than 500 m); (500 m to 800 m); (more than 800 m) (Fig. 2).

2.2.1.3. Culture and Entertainment

For this factor, we relied on all entertainment centers, including public parks, sports centers, football stadiums, swimming pools, theatre houses, cinemas, youth centers, culture houses and all the centers related to social aspects. The ranges of service were based on expert opinions, but the data were collected from the Directorate of Youth and Sports and the Directorate of Culture of M'sila. The range of service were determined as (less than 800 m); (800 m to 1,500 m); (more than 1,500 m) (Fig. 2).

2.2.1.4. Health

For this factor, information was collected on the basis of the blueprints of the planning and reconstruction of M'sila with field surveys to update all the collected data. A layer was then established for all health centers and hospitals. The ranges of service were determined by the experts' opinions as follows: (less than 800 m); (800 m to 1,500 m); (more than 1,500 m) (Fig. 2).

2.2.1.5. Public Services

For this factor we relied on all necessary public services distributed alongside the city, including post-offices, municipal branches, telephone service offices, water supply service, religious facilities, and urban transport service. Data were collected from the blueprints of the planning and reconstruction of M'sila in 2012 with field surveys to update the data. The range of services was determined by the experts as (less than 800 m); (800 m to 1,300 m); (more than 1300 m) (Fig. 2).

2.2.1.6. Environment

For this factor, the forest, agricultural fields, water basins, residential areas, green zones, arid zones, and diverse areas were determined and classified (Fig. 2).

2.3. Methods

Assessing the quality of urban life is a complex process, so a number of possible alternatives must be taken, as well as multifaceted and often conflicting evaluation criteria, such as economic, environmental, social, etc.; here, the Delphi method can be used to define evaluation criteria as a means of structuring the process of collective communication to deal with the complex problem of extracting and studying the influential criteria to find the preferred sites for the quality of life, by calculating the degree of importance of the percentage of significance value (Seyyed *et al.*, 2016) s,. This method has the ability to overcome the deficiencies in common methods such as brainstorming (that may influence collective thinking on the final results) by providing an opportunity for experts to respond anonymously (Kim *et al.*, 2013).

After the Delphi method, we use multi-criteria decision-making methods, which rely primarily on accurate measurement concepts and rigorous evaluation, to assist decision-makers by presenting suitable candidates to assess the quality of life in the city, including the analytical hierarchy process (AHP) (Aalianvari *et al.*, 2012). This style is developed by a world of mathematics Thomas (Wind & Saaty, 1980). "It is a quantitative method of evaluating and arranging alternatives relative to the goal" (Cheah *et al.*, 2018). Thomas has defined an integrated framework that combines subjective objective criteria, based on comparisons based on a relative scale (Wind & Saaty, 1980). This method could provide a methodology for determining weights and evaluating the different criteria used to assess the quality of life. Using AHP, the decision-making process can be divided in several hierarchical levels

so that a decision can be made based on the knowledge and experience of the experts involved through the binary comparison in each level (Yilmaz Kaya & Dağdeviren, 2016) (Fig. 3).

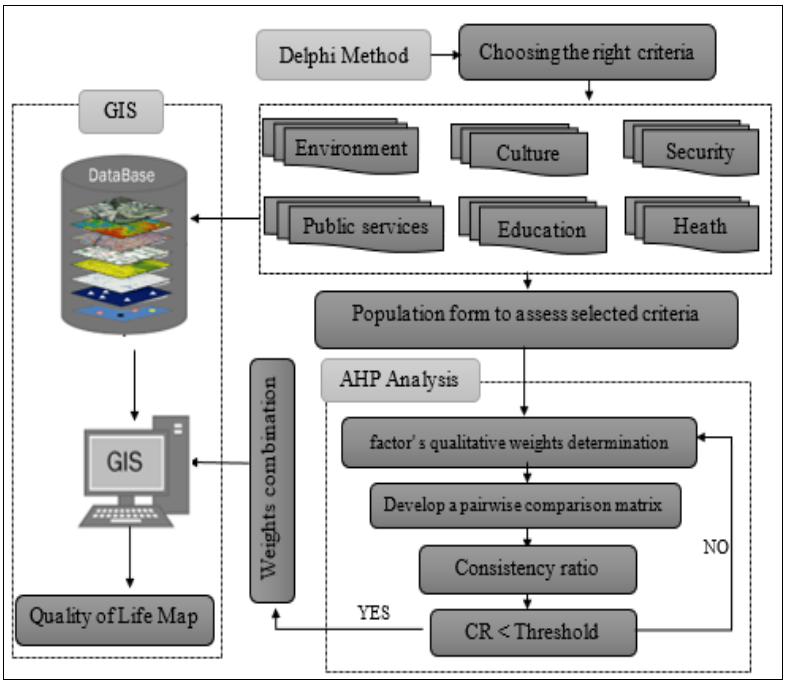

Fig. 3 – The analysis procedure followed for this research.

2.4. Delphi method

Is a systematic and interactive prediction method that relies on a Committee of Experts (Dalkey & Olaf, 1963), as an organized communication technique (Sackman, 1974), for interactive decision-making based on the term "collective intelligence of Experts" (Rowe & George, 2001), and experts to respond to questionnaires on the subject in two or more stages (Turoff & Scher, 2002).

In our research, four stages have been worked out with a group of (30) experts from different disciplines (environment, urbanism, economics, sociology) in various leadership positions and close to the decision-making authority, and after each of the previous phases, we send an anonymous summary containing the Outlook Feed of Experts from the previous stage and the reasons on which their judgments were based, and therefore experts are encouraged to review their previous responses in the light of replies from other members of the Committee of Experts (Linstone *et al.*, 1975). During this process, the range of responses is shrinking and the views of the Expert Group will converge towards the right answer. Finally, a process was discontinued following the fourth and final phase, after which the questionnaire results were determined (Qureshi *et al.*, 2014).

Six different and varied criteria were established, depending on the majority opinion: (health, public services, education, environment, culture and recreation, security and protection), and each of these main criteria has a set of sub-criteria, after the Delphi process the local people were involved in a random sample. In the evaluation of these standards through a closed Questionnaire to assess the quality of life in the city, where they were directed (385) Questionnaires retrieved (370) Questionnaire and loss (15) Questionnaire or White return, among the questions of the questionnaire what service is necessary for you among the proposed criteria? What is the appropriate distance between the house and the services among the suggested distances? Do these variables contribute to your welfare and that of the residents of the city, as you think? Is the distance related to the quality of service?

The degree of preference between the various main and sub-criteria was examined according to the opinion of the population using the scale Thomas watchmaker (Table 1), for the comparison of variables and the majority opinion of the population was taken in comparison AHP. Then go to the AHP serial pyramid analysis process to determine the weights of the main criteria and Sub-criteria.

2.5. Hierarchical Analysis Process (AHP)

AHP relies on the following factors:

2.5.1. Analysis

Decompose a complex problem in a hierarchical hierarchy of interrelated decision elements. A hierarchical structure is created for the thread and sequence of all decision elements in the top-level hierarchy (Pawattana & Tripathi, 2008). The global target is placed at the top of the pyramid structure. The lower level of the hierarchy consists of more detailed elements, which are associated with the criteria at the next top-level (Saaty, 1990).

2.5.2. Prioritization

After the hierarchy is created, the relative importance of all resolution elements is captured and detected through binary comparisons, which are used to create a ratio matrix. Binary comparisons are determined between the main criteria and sub-criteria within the same hierarchical level (Fagbohun & Aladejana, 2016). The digital scale was used as suggested by Saaty (Ouma & Tateishi, 2014), ranging from 1 to 9 (Table 1) in the pair comparison matrices (Saaty, 2008).

Table 1

Gradation scale for quantitative comparison of alternatives
Source: (Abediniangerabi *et al.*, 2014, p. 62)

VALUE	PREFERENCE LEVEL NUMERIC
1	EQUAL PREFERENCE
3	MODERATE PREFERENCE
5	STRONG PREFERENCE
7	VERY STRONG PREFERENCE
9	ABSOLUTE PREFERENCE
2, 4 , 6 , 8	INTER MEDIATE VALUES BETWEEN THEM

The judgment matrices were extracted (Eq. 1).

$$M = \begin{bmatrix} 1 & a1n & \cdots & a1n \\ 1/a12 & 1 & \cdots & a2n \\ \vdots & \vdots & \ddots & \vdots \\ 1/a1n & 1/a2n & \cdots & 1 \end{bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots Eq\ (01)$$

In this matrix, aij = 1/aji. Thus, when i = j, it can be concluded that aij = 1. The normalization of the decision matrix was performed in such a way that each value was divided by the sum of values existing in each column and ultimately by calculating the row values average (Kamali *et al.*, 2017), the weights were obtained. To ensure consistency within the pairwise comparison matrix, a consistency index (CI) was defined according to **(Eq. 2)**.

$$CI = \frac{\lambda \max - n}{n-1} \ldots\ldots\ldots\ldots\ldots\ldots \boldsymbol{Eq.(02)}$$

where: λmax refers to the largest eigenvalue of the decision matrix, and n is the number of criteria. Accordingly, the final consistency ratio (CR) was obtained by (Eq. 3) to measure the degree of CI (Table 2)**.**

Table 2

Random indices from (Saaty, 1977)

n	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

$$CR = \frac{CI}{RI} \ldots\ldots\ldots\ldots\ldots\ldots \boldsymbol{Eq.(03)}$$

In this equation, RI is a random consistency index. Its value related to the dimension of the matrix developed by Saaty (Saaty, 1982). If it exceeds CR 0.1, The Evaluation should be repeated to improve Consistency.

Then, we extracted the measures. The consistency Ratio (CR = 0.05) was less than (0.1) of the values of Saaty (Shokati & Feizizadeh, 2019) at the first hierarchical level of AHP, which meant that measure distribution between the factors was acceptable and showed good consistency (Abediniangerabi *et al.*, 2014).

2.6. Geographic Information Systems

The integration of MCDM methods (such as AHP) with the Geographic Information System (GIS) has enabled a strong decision support system (DSS) to be used for spatial planning purposes (Kazemi *et al.*, 2016). GIS is the process of mapping and integrating computer-based information with the ability of data layers management to make appropriate decisions by combining geographical information layers (Kazemi *et al.*, 2016). Accordingly, several studies have been conducted that emphasize the adoption of Delphi, AHP, or a combination of these methods ,with GIS for the analysis and modelling of spatial suitability (Mousavi *et al.*, 2015).

3. RESULTS AND DISCUSSION

This research adopted the multi-criteria analysis approach using sequential hierarchical analysis to assess the city's quality of life with the participation of the population in several stages. In the sequential hierarchical analysis process, the couple's comparison matrices were implemented for each of the major factors and sub-factors through a questionnaire that included local people and experts.

The questionnaire scores for each of these elements are applied in the degree of importance to Saaty in matrices to be translated into weights. Marital comparisons are made between the main criteria and then the marital comparison is made between the sub-criteria of the same level (Al-shabeeb, 2016), then the weights are extracted (Table 3).

Table 3

Compare AHP among Key Criteria

	Security	Education	Culture	Heath	Public	Environment	Weights	Rank
Security	1	2	2	1/2	1	1/2	0.151	3
Education	1/2	1	1	1/2	3	1/2	0.135	4
Culture	1/2	1	1	1/5	1	1/3	0.084	6
Heath	2	2	5	1	2	1	0.273	1
Public	1	1/3	1	1/2	1	1/3	0.095	5
Environment	2	2	3	2	3	1	0.261	2
	λmax=6.2949 CI= 0.0590 RCI= 1.24 CR = 5 %							

The consistency index value of CR = 0.05 was less than 0.1 of the values (Shokati & Feizizadeh, 2019). Saaty at the first hierarchical level of the AHP process, which means that the weight distribution among the factors is acceptable and shows good consistency in judgment (Abediniangerabi *et al.*, 2014).

Table 4

Results of AHP among Key Criteria and among Sub-Criteria

Key criteria	Sub-Criteria	Weight	Rank	Final weight	Rank
Security	<2,000 m	0.574	4	0.151	3
	2,000–3,000 m	0.361	8		
	>3,000 m	0.065	18		
Education	<500 m	0.717	1	0.135	4
	500–800 m	0.217	13		
	>800 m	0.066	17		
Culture	<800 m	0.537	5	0.084	6
	800–1,500 m	0.364	7		
	>1,500 m	0.099	14		
Heath	<800 m	0.588	3	0.273	1
	800–1,500 m	0.323	10		
	>1,500 m	0.089	15		
Public services	<800 m	0.649	2	0.095	5
	800–1,300 m	0.279	11		
	>1,300 m	0.072	16		
Environment	Green areas	0.413	6	0.261	2
	Public parks	0.260	12		
	Water bodies	0.327	9		

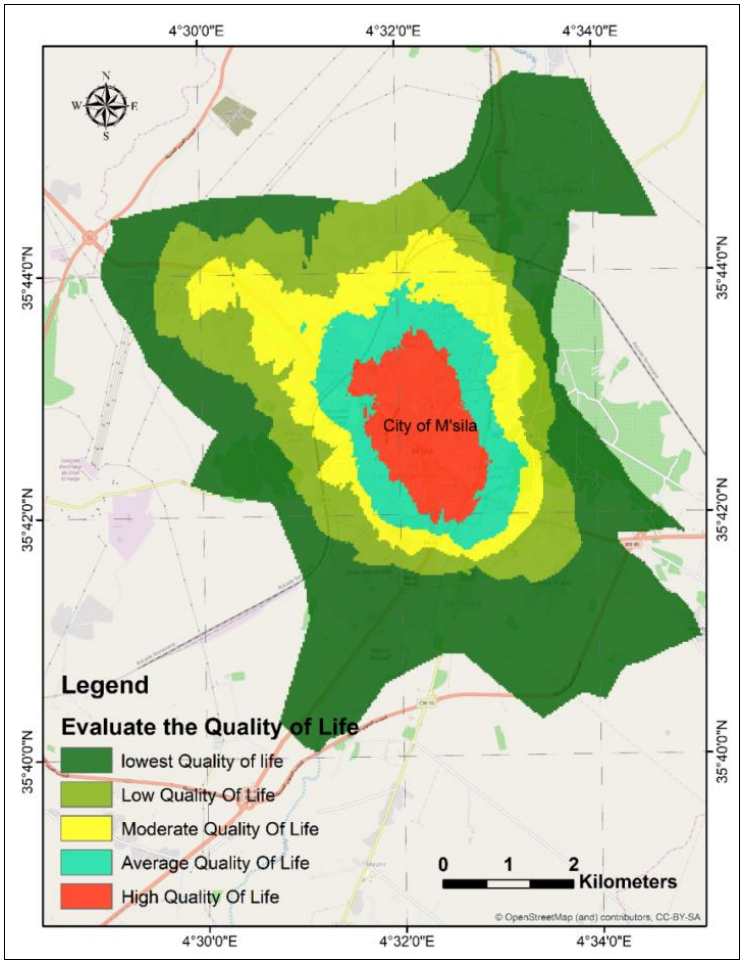

Fig. 4 – Quality of Life Map in The City of M'sila.

Based on the previous hierarchical analysis of the quality of life criteria in the city, the role of Geographic Information Systems comes in the form of a model that summarizes all the stages of work in "QGIS". We collect all pre-defined standard maps in the GIS programme via the Raster calculator tools with each standard multiplied by the weight generated by the AHP process, to produce the map of the quality of life in the city (Fig. 4).

Percentages of AHP for Quality of Life in M'sila. From the percentages, we notice that (7%) of the study-area achieves a High Quality of Life with an area of (3.77 km²) and (9%) an Average Quality of Life with an area of (4.70 km²) and (14%), Moderate Quality of Life with an area of (6.98 km²) and (19%) achieved Low Quality of Life with an area of (9.75 km²) and (51%) the Lowest Quality of Life with an area of (26.02 km²) (Table 5).

By reading the quality of life map, one notes that the areas that have achieved a high quality of life according to AHP are the center of the city and the surrounding areas. That is, there is a distinction between the neighbourhoods of the city and the lack of fair distribution of services and facilities.

Table 5

Percentage of AHP Standard of Quality of Life in M'sila City

	Classes	Area Sq. km.	%
1	High Quality of Life	3.77	7%
2	Average Quality of Life	4.70	9%
3	Moderate Quality of Life	6.98	14%
4	Low Quality of Life	9.75	19%
5	Lowest Quality of life	26.02	51%

4. CONCLUSIONS

In this paper, a method of evaluating the quality of life in cities was proposed by combining the Delphi approach with AHP and GIS techniques. M'sila was chosen as a case-study for this research. A Delphi-based Questionnaire was conducted for a group of experts to come up with a set of criteria, which evaluate the quality of life in cities. These criteria were then measured by conducting a questionnaire with the inhabitants of the study-areas to test factors, which achieve the quality of life in cities. AHP was used to extract measures for the quality of life criteria evaluation. The consistency ratio (0.05) of (<0.1), was therefore acceptable. After creating a geographical database of the predetermined criteria, the measures derived from the AHP process were used in a GIS environment by creating a model, including all spatial analysis processes in the software by using all the measurements to extract the Quality of Life Map with three categories: high, acceptable, and low. The results from the map of the area of the study were: (7%) of the study area achieved a high quality of life with an area of (3.77 km²) and (9%) achieved an Average Quality of Life with an area of (4.70 km²) and (14%) achieved a Moderate Quality of Life with an area of (6.98 km²) and (19%) a Low Quality of Life with an area of (9.75 km²) and (51%) achieved the Lowest Quality of Life with an area of (26.02 km²). The participation of the inhabitants and the integration of the Delphi method with a multi-criterion analysis through the hierarchical analysis in the GIS environment are effective methods which give accurate results relying on the scientific basis of the culture of the community and its ambitions, in evaluating the Quality of Life criteria (EQLC) and identifying areas which require life improvement for the development of cities. This method proved to be effective in evaluating the Quality of Life according to factors determined by the experts and in defining the areas of high Quality of Life and the areas requiring improvement. Still, these factors are local and exposed to change according to each area. The results of the map can be used to identify the areas, which require improvement, to select the best areas for housing, or to determine the value of the real estate, and help decision-makers to establish a balanced development of the city by using this map.

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FISHING AND ITS IMPACT ON THE LOCAL COMMUNITIES OF THE DANUBE DELTA BIOSPHERE RESERVE

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Key-words: fishing, impact, local communities, Danube Delta.

Abstract. Declaring the Danube Delta a Biosphere Reserve (Law No. 83/1992) entailed changes in the Delta socio-economic activity, basically to have the local communities and economies adapted to these changes in a coherent manner. One of the major changes was the reorganisation of fishing, since most of the Delta inhabitants are engaged in this activity, as well as in agriculture. Changes in fishing got momentum especially after having this piscicolous resource concessioned, a move that directly affected the population whose fishing-derived incomes dropped; moreover, some rights people had enjoyed before the Reservation came into being and after the catch had to be concessioned. An analysis of the evolution of the fish and fish culture legislation in time, was aimed at a better understanding of this activity and at establishing the best method of exploiting the fish resource by the Danube Delta local communities without disturbing the natural environment; the more so, as the Danube Delta enjoys a Biosphere Reserve status. And last but not least, the local population should be encouraged to practice sustainable fishing by using traditional tools and combine this occupation with alternative activities, such as, tourism, ecological tourism, in particular.

1. INTRODUCTION

Physical-geographical constrains (water-covered areas that limit human settlement, water-imbued soil and vegetation) contribute to restricting human relations, as does the peripheral position, isolation and difficult access (Gâștescu, Știucă, 2008). Geographical constraints also impose a certain distribution of settlements and of socio-economic activities, based mainly on traditional occupations. Since people are not particularly qualified, they are practicing fishing, agriculture and reed harvesting, activities that bring little added value, while other opportunities (e.g. tourism) are not sufficiently well-developed. The socio-economic changes brought about by the economic transition and, moreover, by establishing the Danube Delta Biosphere Reserve, called for the communities and the local economies to better adapt themselves to environmental conditions (Dumitrescu, 2002). After 1992, things changed substantially, most of the Danube Delta population beginning to reorganise fishing, the main income source. The changes experienced in this field, especially after having fishing granted on lease, led to a number of modifications which had a direct impact on fishing-yielded incomes for a large part of the Danube Delta population.

A good management of renewable natural resources is essential for the sustainable development of the Danube Delta and the preservation of traditional economic activities by the local population (Gâştescu, 2009).

The main objective of this paper is to identify and find a unanimously accepted solution to the main problems regarding the fishing activity, problems arising during the concession process, but also after these contracts had finished. The Danube Delta fisherman and the families there are considered to be the most affected, because they are dependent on the fishing resource, the way of exploring and capitalization this resource.

Both the local authorities, and the ARBDD representatives and the local population wish, to continue fishing also in the future, traditional fishing practiced by the locals from generation to

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generation, using traditional tools, this activity being practiced according with the Biosphere Reserve status.

2. STUDY AREA

The Danube Delta lies in the east of Romania, basically in the north-east of the Dobrogea Plateau. The main locality, Sulina, is situated in the easternmost point of the country. The Delta is a triangle with the base-side directed to the Black Sea and the point at Pătlăgeanca, where the Danube River divides into two arms (Chilia and Sulina). The Danube Delta represents the largest part (4,150 sq km^2) of the synonymous Biosphere Reserve, with 3,150 km^2 on Romanian territory (cca 84%), and 640 km^2 on the lefthandside of the Chilia Arm (including its secondary delta) on Ukrainian territory (Geografia României, Vol. 5, p. 577) (Fig. 1). The present settlement system in the area consists of only town – Sulina, and seven communes, that is, 23 settlements in all with a population of over 10,706 inhabitants (2011 Census data).

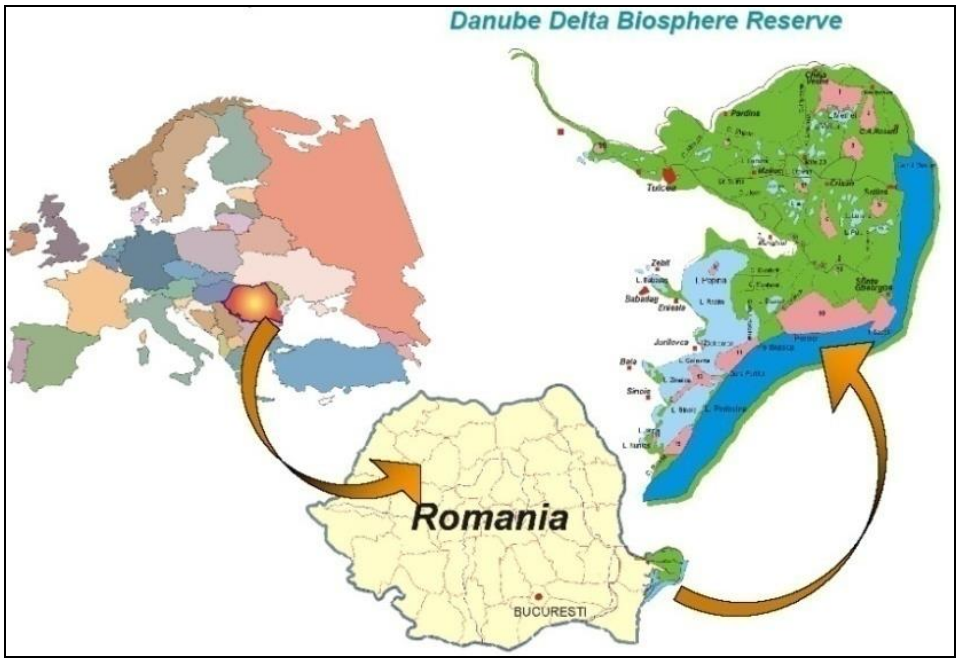

Fig. 1 – Position of the Danube Delta Biosphere Reserve.
Source: http://www.ddbra.ro/en/danube-delta-biosphere-reserve/danube-delta/location.

In terms of surface-area, the Danube Delta ranks third in Europe, after the deltas of the Volga (13,000 km^2) and the Kuban (4,300 km^2) rivers; it holds position 22 on the Globe, and boasts one of the complexmost deltaic biodiversities worldwide.

In 1993, the Danube Delta, and the Razim-Sinoie lagoon complex were declared a Biosphere Reserve (Law No. 82). In view of its importance, the Danube Delta Biosphere Reserve was included on the list of the Biosphere international network, under the Man and Biosphere (MAB) UNESCO Programme, and declared wet zone of international significance, especially as waterbird habitat (Ramsar Convention, September 1991), and listed as World Natural Heritage – UNESCO (December, 1991). The Danube Delta is the only delta in the world to have been declared a Biosphere Reserve for its huge biodiversity: 30 types of ecosystems.

3. MATERIALS AND METHODS

An analysis of the local population's response to activity changes after the Danube Delta was declared a Biosphere Reserve in the 1990s, is based largely on discussions and interviews with the inhabitants of several Danube Delta villages (C.A. Rosetti, Sfiştofca, Crişan, Sfântu Gheorghe, Letea, Mila 23) and Sarichioi at the bounds of the Biosphere Reserve. This several-stage research is connected with the leasing process. Field interviews were conducted particularly in the local fishermen communities, and with the local authorities. The research results were partly included in the World Bank 2005 Global Environmental Facility Project (GEF) (Apostol *et. al.*, 2004, http://www.gefieo.org/sites/default/files/ieo/ieo-documents/lb-case-study-romania.pdf.). The interviews targeted a number of households singled out by income and main occupations (fishing, agriculture and tourism) and were conducted both at the time of granting on lease and subsequently. Discussions focussed on the evolution in time of legislation, beginning with the First Fishing Law, a series of reports and statistical data on the evolution of fish captures and fishing-entailed effects.

4. DISCUSSIONS

4.1. The Human impact on the Delta environment

Insofar as morphohydrography and landscape are concerned, the Danube Delta had evolved in natural conditions until the second half of the 19th century, when the European Danube Commission was set up (1856) and management works to turn the Sulina Channel navigable began. A second impact on the Delta (1903–1960) was caused by scientist Grigore Antipa, who wished to make fisheries more productive. To this end, some channels were enlarged and ten kilometers of new canals were cut to facilitate water circulation between the Danube arms and the Danube lakes (Antipa, 1916, 1930).

The period spanning the years 1960–1970, also called the "*reed period*", was a fist stage in changing the Delta ecosystems.

The interval between 1970 and 1980, a time of piscicolous and agricultural works, is considered the greatest disaster for the Danube Delta.

From 1980 to 1989, a Programme of Management and Integral Exploitation of the Danube Delta Natural Resources was being implemented. That programme was aimed at turning most of the Danube Delta into agricultural and animal breeding territory and have fish-rearing and forest areas extended. A Decree was issued whereby the Danube Delta and the Razim-Sinoie Lake Complex were divided in six economic enterprises for the exploitation of natural resources, subordinated to the "Danube Delta" Central Company sited in the town of Tulcea (Gâştescu, Ştiucă, 2008).

As of 1990, having in view the poor economic efficiency, and the disturbed Danube Delta natural regime, management works were stopped and renaturation measures imposed. Thus, in 1994, the Administration of the Danube Delta Biosphere Reserve (DDBRA) in collaboration with experts from the European Bank for Reconstuction and Development, and benefitting from the PHARE Programme financial support, the ecological reconstruction of some of the impaired sites began (http://www.ddbra.ro/media/master%20plan%20RBDD(2).pdf).

All in all, we might say that the effect of human pressure on the Danube Delta was both of conservation (the practice of traditional activities – fishing, animal breeding, and tourism) and demage, (vast management works for agriculture, fish-rearing, reed culture and transports) (Gâştescu, Ştiucă, 2008).

4.2. The history of fishing in the Danube Delta

As known, fishing is one of the oldest occupations of the Danube Delta population, practiced by more than 50% of the area's inhabitants (http://www.ddbra.ro/activitati/pescuit) from times immemorial, people having made use of this resource. At present, the right of commercial fishing have only the

fishermen authorised for it, the locals being allowed to fish for their own consumption provided they have a licence for it; fishing entails all of the Danube Delta Biosphere Reserve resident families.

In Romania, fishing was reorganised by Law No. 192/2001 on fish fund, fishing and fish-breeding, it representing the legal framework for reorganising this sector of activity. The law stipulated the conservation, control and management of fish resources, licencing, introduction of a satellite-based monitoring system, organisation of the fish market, fish inspection, fish-rearing, state intervention in the fish sector, fishing statistics and international accords.

Currently, fishing in Romania is co-ordinated by the National Agency for Fishing and Fish Culture subordinated to the Ministry of Agriculture and Rural Development.

The main national objectives have in view measures to remake the fishing fleet, develop a fish culture, process and sell fish and the products of fish culture, jobs in the fish sector, create and support the social and economic reconstruction of zones which have to cope with difficulties engendered by changes in the fish sector (Strategia Naţională a Domeniului Pescăresc 2014–2020, Guvernul României, Departamentul pentru Ape, Păduri şi Piscicultură, http://apepaduri.gov.ro/wp-content/uploads/2014/08/Strategia-Na%C8%9Bional%C4%83-a-Domeniului-Pesc%C4%83resc.pdf).

In order to get an insight into the development of centuries-old fishing in the Danube Delta, and realise people's discontent with the modifications made to fishing (one of the main occupations) and of introducing the leasing system (deeply detested by fishermen), one should look at the history of fishing and fish culture in the Danube Delta.

Thus, the first fishing law, named *Law of Fishing,* is dated October 10, 1896. That law set only a few principles in matters of fishing, hence the law was short-lived. According to one of its provisions, the right to fish in state waters belonged to the state (Giurăscu, 1969).

In 1929, a new law was passed: *Law for the general administration of State fisheries and improvements in the Danube-flooded region*, which provided for the unification of the three departments, which used to act separately in matters of improvements of floodable zones and water management, into a single body – PARID (National Institute for Co-operation and Administration). This law was a great success due to the ideas promoted by Grigore Antipa, a scientist known for his opposition to the practice of private leasing in the Danube Delta; in his opinion, people granting in lease were tradesmen who appropriated the state's right without giving anything in exchange, while fishermen were paid a very small price for their fish (PARID, Report, 1929).

According to the decree-law, dated November 23, 1939, on the modification of the law of 1896 all the fish caught in Dobrogea's waters, as well as in any other state-owned water in this country, remained state property, or of its sub-units, until sold out. The 1939 decree-law introduced a new act on the right of fishing, obliging fishermen to have, besides the agreement to fishing bill issued by the owner or the leaseholder, also a fishing licence issued by the state (Anastasiu, 1947). The two documents were very important for the system in which fishing was being organised until 1949. In this way, it was the state who controlled fishing not through the supervision of fishing grounds administrations or leaseholders, but by the fishermen themselves, who were to possess the two personal fishing documents and bring the whole catch to the fishing grounds. Fishing grounds were state-owned, but such private grounds did also exist as well; however, as the 1896 Law came into effect, authorising them implied meeting certain conditions conformably to the regulations in force. Once on the fishing grounds, the fish was weighted by the grounds-master in the presence of the agent from the Administration of the Fisheries, then taken over and carried to the main market of Galaţi Town (Antipa, 1930).

Decision No. 184/1954 stipulated that the fishing right was granted to specialist fishing enterprises on a contract basis; in this way, only socialist economic organisations had the right of industrial fishing, under a production plan.

A fishing regulation, more comprehensive this time, was found in Law 12/26 July, 1972. According to it, fishing and the fish culture became part of the overcentralised economy, the right to fishing in the Danube Delta and the lagoon zone being reserved only to state enterprises (the "Danube

Delta" Central Enterprise founded in 1970). In consequence of Law No. 15/1990, the units that made up the "Danube Delta" Central Enterprise did no longer remain subordinated to the Ministry of Agriculture and Food Industry, but were passed over to the Prefecture of Tulcea County.

Afert the dissolution of the "Danube Delta" Central Enterprise, several trading companies were set up, nine of them being engaged in fish-related activities; most of them continued to exist until the leasing process got momentum (it is the case of Ecodelta, Piscicola Chilia Veche, Piscicola Jurilovca, Piscicola Mila 23, Piscicola Murighiol, Piscicola Sfântu Gheorghe, Piscicola Sulina, and Piscicola Tulcea).

Law No. 82/1993 on the establishment of the Danube Delta Biosphere Reserve provided for the leasing of the natural Danube Delta wealth to economic agents.

After 1990, Law 12/1972 was replaced by Law 192/2001 on fish, fishing and fishaqua- culture. According to this law, fishing is the activity of catching fish and other water-life for commercial, scientific, or recreational/sporting purposes on a licence/fishing permict basis, in places, periods and with legal tools. In 2003 and 2004, a number of modifications and completions followed, and in 2005, Law 113 came into effect, stipulating water resources and fish-aqua-culture. This was the groundwork for establishing the *National Agency for Fishing and Fish-aqua-culture*, a public institution of national interest, with legal person status, currently under the direction of the Ministry of Agriculture and Rural Development. The Agency's tasks were to elaborate a fishing developmnet strategy, fish-aqua-culture and a fish market in keeping with the Government's economic policy, management and structural policy of fishing and fish aqua-culture; the Agency is the authority that regulates the specific legal framework of control and inspection. Increasing control activities requires satellite monitoring of fishing crafts.

Law 117/2009 on fishing and fishaqua-culture stipulated that fish-resources fell under the Administration of the Danube Delta Biosphere Reserve, which took over fish utilisation leasing contracts.

After 1990, three distinct fishing periods in the Danube Delta were recorded:

– 1990–2002, commercial fishing was in the custody of the trading companies that had belonged to the former Danube Delta Central Office, without paying any tax on fishing;

– 2002–2005, access to fishing was a matter of public bidding, the winners being the leasing companies which payed the fishing area due and had to meet certain conditions and specifications; in the meantime, locals were not allowed to practice commercial fishing on behalf of themselves, to do it, one had to be an employee of the respective company;

– since 2005, commercial locals have been allowed to fish on the basis of an individual fishing permit issued by the National Agency for Fish and Fish-aqua-culture through the intermediacy of fishermen's associations.

A key-moment in the development of fishing was the concessioning of the process of valuating fish resources. Under Law No. 82/1993, modified by Law 454/2001, DDBRA granted fishing by leasing within the Reserve. This move was meant, in principal, to protect the fish resource, entailing licencees to participate in the watch-and-control of poaching and pay for the protection of fish species of high economic value to reproduce; the leasees were obliged to invest in fish processing and depositing, and supply fishermen with protection equipment (file:///D:/pescuit_piscicultura_arbdd/ARBDD%20Tulcea.html).

In order to valuate fish resources, a number of 25 areas would be designated according to the following criteria: the unitary treatment of some interconnected water ecosystems to facilitate the evaluation of fish stocks from the respective areas; the traditional use of the respective areas by both leasees and the local population.

Leasing would change the fishermen's status from mere employees whose only task was to fish and deliver the catch, to service-providers. The service providing contracts between user and he/she service provider stipulated the only obligation for the user to pay invoices in terms of the quality and quantity of delivered fish conformable with the bills and invoices issued. In fact, looking at how contracts are drafted and how payments are made, it is obvious that the company had absolute control over the fishermen's work.

As of 2005, by agreement with the leasees, some of their contracts were annulled, because leasing fish and reed resources contravened to the Danube Delta Statute of Biosphere Reserve. However, the leasees did not fully give up using such contracts, they continuing to be entitled to lease sporting fishing, or open private fish-collecting points. Despite the fact that some leasees had to discontinue further activity, fishermen were still disatisfied, because they were obliged to deliver the fish to the same fishery stations owned by former leasees, and at a lower price than the market price.

Therefore, we may safely say that leasing restricted fishermen's freedom to fish in certain zones and deliver the catch to the highest bidder, they have to accept the leasee's offer and the price/kg fish. In this way, their revenues were considerably reduced (even halved to what they had been used to geting before leasing). Thus, fishermen lost both the profit and their occupational autonomy (Stahl, Constantin 2004, p. 95).

Traditional commercial fishing is being practiced in several zones of the Biosphere Reserve, fishing methods and tools being specific to each zone (http://www.ddbra.ro/activitati/pescuit).

Fishing in the Delta proper goes on the year-round (except for a 60-day prohibition period there, and a 90-day one in the Razim-Sinoie Complex).

In 2006, it was for the first time in Romania when sturgeon fishing was banned for 10 years, a prohibition extended to another five years in 2016, a measure implemented also in other Black Sea limitrophe countries (Bulgaria, Russia, Ukraine, Georgia and Turkey).

4.3. Recreation/sporting fishing

Beside industrial fishing, the Danube Delta is also a place for recreation/sporting fishing provided one gets a permit from Agenţia Naţională pentru Pescuit şi Acvacultură (National Agency for Fishing and Fish Culture) and is practiced in the areas designated by it. Sporting fishing licences are nominal and are issued on request from the sporting fishermen's associations. Fishing is limited to 5 kg. of fish, or to one fish alone if it weights over 5 kg.; one may use no more than two fishing lines, or two lancets with two baited hooks each (Figs. 2, 3, 4, 5).

Fig. 2 – Sporting fishing.

Fig. 3 – Sporting fishing.

Fig. 4 – Recreation fishing.

Fig. 5 – Catch fish.

5. RESULTS

5.1. Changes in fish leasing

Before 1990, when the "Danube Delta" Central Company was operating fishing and working conditions in this sector, as well as the types of employment and payment were inscribed in the Work-Book (Carte de Muncă) and based on it, each employee was paid a fix minimum wage. If the minimum fish quantity was exceeded, payment was of the fisherman's price, provided the quantity of delivered fish was in excess of the compilory quota. In winter-time (Decembre–February), it was either reed harvesting, or unemployment which brought minimum wage payment. The fishermen employed received boat and tools, so that damage risks and costs did not devolve on them.

Biginning with the year 1944, private fish collection points started operating, so that fish buying was competition-based. Hence, a certain change in exploitation. The forms of collaboration between fishermen and selling units were distinctively different: some fishermen, employed on a contract-basis, were obliged to deliver the whole catch to the company they worked for, while those who chose to work on their own could deliver the catch to any of the three fishing stations, but they did not benefit from the facilities offered by employers (e.g. medical insurance).

Some other fishermen tried to form family fishing associations, but high taxes made them unprofitable: "it's not profitable ... many gave it up ... taxes finished them" (35 year-old fisherman). "Piscicola" State Company tried to go on until 1999, having much reduced its activity, and practically 'disappeared' (questionnaire-based answers during 2004–2005).

As state monopoly came to an end, any physical person could set up a fishing society and become engaged in fish-trading and employ an unlimited number of fishermen. The employees who were given the employer's tools, received 15–20% from the value of the wholesale delivered fish, while those who had their own fishing tools received 20–50% of the delivery.

At the time when fish was being leased (2001–2005), fishermen functioned either as employees of the leaseholder societies, or as authorised physical persons (AphP). Most fishermen would acknowledge that it was far better for them when they had been employed by the state and benefitted from fishing tools and wages.

In 2012, the first fish-unloading points (UP) and the first fish-sale centres were established. Unloading points are places where fishing vessels and boats unload the catch, which is registered by authorised fishermen and carried first to fish-sale centres (FSC). These are the only legally official places where authorised traders are making the first fish-sale (Table 1, Fig. 6).

Table 1

Unloading points and first fish-sale centre points

year	Unloading points (UP)	First fish-sale centres (FSC)	UP+FSC
2012	26	–	12
2013	48	32	29
2014	47	38	33
2015	43	39	35
2016	42	40	35
2017	44	42	38

Source: http://www.ddbra.ro/activitati/pescuit/pd-cpv.

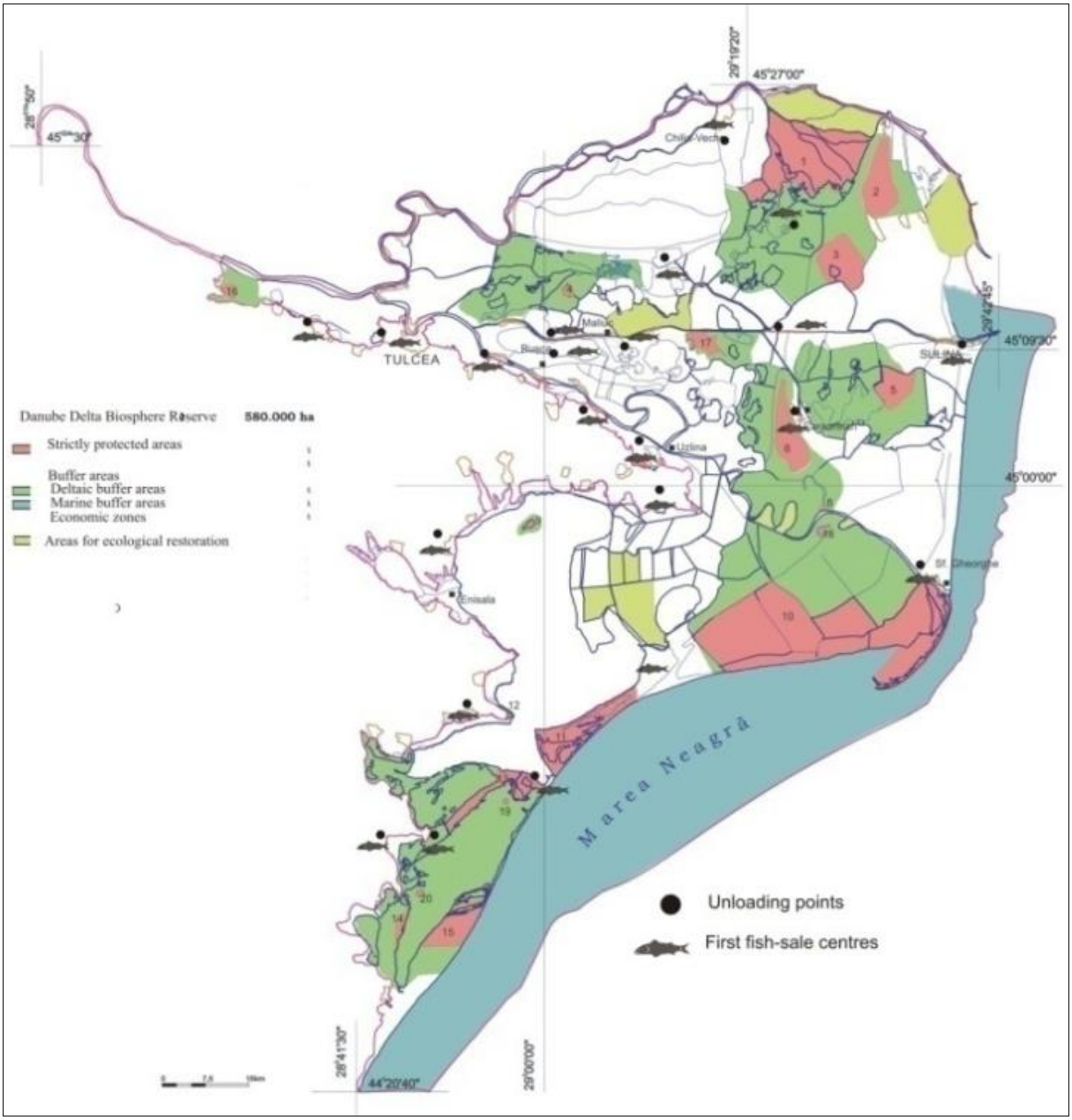

Fig. 6 – Location of the unploading points and first fish-sale centre points.
Source: http://www.ddbra.ro/media/file/hartadd.pdf.

The number of active professional fishermen in the DDBR during 1999 and 2017 varied, with a maximum of 1934 people being recorded in 2004 (Fig. 7).

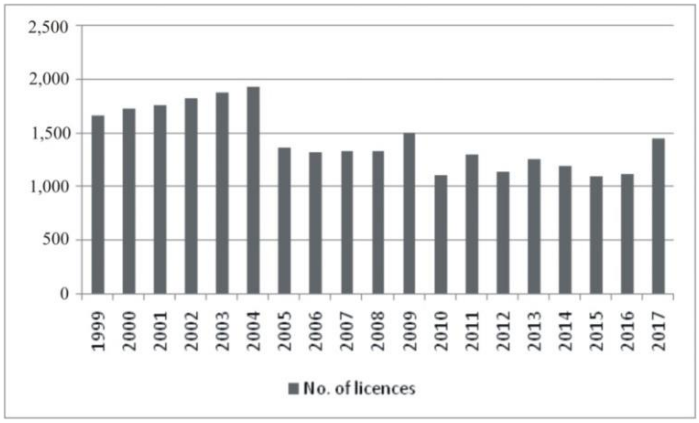

Fig. 7 – Total number of commercial fishing licences (1999-2017).

5.2. Changes in fish price

Among the major modifications brought by licencing was a change of the fish price paid to fishermen. Thus, there were cases when prices fell to half their previous value, the difference resulting from the absence of taxes and duties for fishermen before the leasing system was in place. The lower price of fish reduced the living standard of the fishermen families.

5.3. Changes in the benefits of the Danube Delta local communities

The changes affecting the population were: the quantity of catch/day was limited to 3 kg. for people holding a family fishing licence; fishing water areas allocated to physical persons were at a great distance from their settlements, or in little productive places, making it impossible for tourist boarding-houses to legally obtain the fish they needed.

Apart from the lower price got at the fishing stations, another restriction was the ban on certain legal fishing tools (e.g. the *setci* currently, only "talianul" and "vintirul") are permitted for industrial fishing, but these tools are not up to fishermen's needs.

At present, the number of permitted tools/boat is: 5 *setci*, 7 *ave*, 3 *taliene*, 6 *vintire*, 1 *postrovol*, and one piece of other traditional tools (Figs. 8, 9)

Fig. 8. Traditional tool (*vintir*).

Fig. 9. Traditional tool (*plasa*).

For the Danube Delta people, fishing is both a way of life and a trade handed on from father to son, families making a living from selling the fish they catch.

A positive result of leasing the catch, namely, reduced poaching (that is, fishing in forbidden zones, in restrictive periods and with banned tools) is visible for fishermen, the local community and the authorities.

Before leasing, for fishermen to renew their licences meant receiving a receipt from the DDBR Administration to justify that they had delivered the minimum quota established at 2,500 kg fish/year/fisherman.

5.4. Local economic characteristics

The main occupation of the Danube Delta settlements is fishing (6 months/year), agriculture for local needs and tourism (June-September). There are settlements (e.g. Sfântu Gheorghe) in which the absence of arable land makes agriculture practically inexistent. However, fishing is a source of relatively big revenues compared to the villagers' incomes in Romania. Prior to leasing (2000), a family could earn up to 10,000–15,000 lei/year (out of which some 8,000 came from fishing), these were money exempted from taxation, people having to cover only the losses inherent to fishing.

Fishermen say that it is very difficult to estimate earnings and losses over the year. People here are used to taking risks, working hard and spending much, but ultimately earning does not depend on themselves, "earnings are a matter of luck" (23 year-old fisherman).

After leasing, the fishing-yielded profit would fall significantly, having in view a lower price/kg fish and the taxation of authorised physical fishermen (APF). Fishermen also suffer losses each time a new fishing regulation is issued, imposing modification, or change, of fish tools ("While so far now, I used to fish with a 15-cm net, here is a new law which forbids using fishing nets under 20cm. I must change all my nets, changing rules is a very costly affair for us. No one cares about it ...fishermen have money, they can do it" (34 year-old fisherman).

What is specific about earnings is their seasonal character: fishing brings money especially in springtime; summer is a tourist season (Poruncia 2012, Damian, 2016*)*. People are saving to make provisions for winter. What remains is kept for the next year, when "no one knows if fish will still exist". Only people who still have money even after this last sorting out, afford to invest, usually in buying a house for their children in the neighbouring towns (Tulcea, Constanţa and Galaţi), and more recently making their own village-house more comfortable to offer better conditions to a greater number of tourists. Winter brings no income, and isolated location makes prices soar (Damian, 2013).

5.5. Household incomes

The Delta people relie on fish resources, grazing grounds, agricultural lands and reed to discharge traditional activities, e.g. fishing, animal breeding, the cultivation of land and reed harvesting. Household incomes, based on the exploitation of natural resources, differ with the year (in terms of physical-geographical factors), and each household, depending on the management ability of each family (Rughiniş 2004).

Lands are used for agriculture both by the locals and by the companies that grant on lease. In some of the inner Delta villages, e.g. Mila 23, Crişan and Sfântu Gheorghe, incomes are derived from fishing alone, because agricultural lands are missing, people cultivating only small plots of land in their own gardens.

The Danube Delta Biosphere Reserve inhabitants are allowed a fish quota of 3 kg fish/day. Fishing must be licenced by the Biosphere Reserve Administration, permits being issued annually.

Another household income source is tourism, practiced mostly by settlements like Sulina Town, Sfântu Gheorghe, Mila 23 and Crişan villages, where physico-geographical conditions are particularly favourable for this activity.

People owning tourist boarding-houses enjoy certain physical facilities (cost cuts).

After 1990, people's income sources would change, fish resources steadily depleting, also other activities had to be underteken, such as the transport of tourist inside the Danube Delta (Damian, 2011).

6. FISH RESOURCES

Fish resources in the Danube Delta populate the 104,571 ha of inland waters. Fish species (about 132) are mostly fresh-water ones, but there are some marine and migratory species as well (Năvodaru, Staraş, 1996).

Important changes of quality and quantity have occurred in the structure of fish species. The size of exploitable fish stocks depends on several factors, such as water regime, reproduction conditions, the quantity of the trophic base, the quality of water, the rate of intense fishing, etc. (Năvodaru, 1996).

After 1972, when several areas were dyked, a direct relationship between water level and fish production used to exist. Subsequently, the balance was shattered and the overall fish catch was ever lower by the year, from 10,000–20,000 t/year in 1960–1970 to 5,000–6,000 t/year over 1984–1996. As of 1993, the human impact on fish species dynamics became ever more aggressive, the total quantity of catches stabilizing at ca. 3,000t/year. The 2011–2012 interval witnessed a fall in estimated captures at 2,385 t and 2,033 t, respectively, with increases in the coming years up to an estimated 4,043 kg in 2017 (Fig. 10).

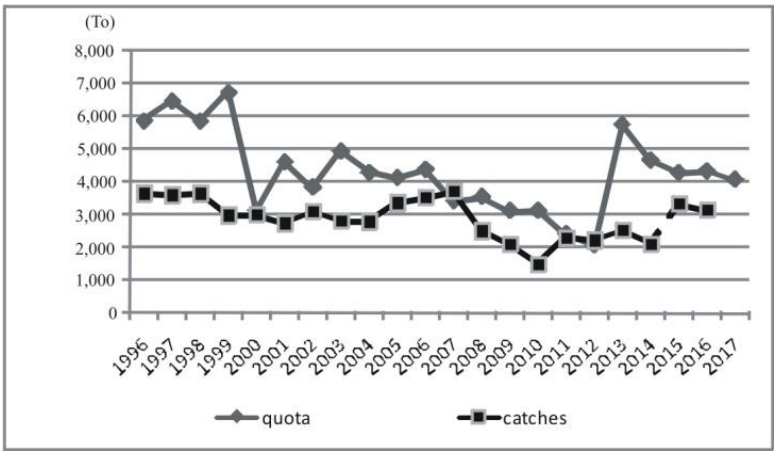

Fig. 10 – The evolution of the fish catch over 1966–2017.
Source of data: http://www.ddbra.ro/administratia/documente-planuri-strategii-rapoarte/rapoarte-privind-starea-mediului-in-rezervatia-biosferei-delta-dunarii-a744

6.1. Fishing-triggered conflicts in the Danube Delta

Conflicts in the Danube Delta occur between those interested in obtaining greater profits from the exploitation of the Delta natural resources, especially fish, and people keen on the conservation and protection of the area's natural environment. The main conflicts between them and the representatives of the DDBR Administration, engaged in protecting biodiversity and promoting sustainable development, are connected with limiting access to various Danube Delta resources.

In our study-area, this conflictual situation is less obvious among the local co-inhabiting minorities, or between the young and the old generations; it usually goes on between the locals and the DDBRA, or between the latter and the economic agents.

7. CONCLUSIONS

Summing up, we might say that fishing continues to be one of the traditional occupations in the Danube Delta; what is needed, is to create real conditions for the area's socio-economic development corresponding to the Danube Delta Biosphere economic potential (Damian, Dumitrescu, 2009). Once a Biosphere status was granted, the main traditional activities suffered some changes, a situation arousing discontent among the locals, who had no restrictions in using and valuating the natural resources in their area (Văidianu *et al*., 2015).

The experience of severl countries in valuating the fish resource has shown that central-based control is the most efficient method in overseeing fishing and sales. The former socialist countries were successful in controlling fisheries. In Romania, state control proved beneficial both in the inter-war period and in socialist times, in the mid-1950s, scientist Grigore Antipa was fiercely opposing leasing the fish resource.

Effects are being made to induce people to undertake traditional fishing, but also to find alternative solutions, having in view that, over the past few years, the fish resource has been depleting, as has the number of professional fishermen. One solution among others would be greater involvement of the local population in developing traditional activities and tourism,organised tourism in the main, with the least impact on the natural environment (Hall, 1993). As far as the fishermen themselves are concerned, attempts are being made (in keeping with the Danube Delta Strategy) to reorganise the fish market and provide them with facilities and adequate conditions for practicing fishig.

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STREET CONNECTIVITY AND MOBILITY: CASE OF SUBDIVISIONS, TLEMCEN CITY, ALGERIA

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Key-words: accessibility, street layout, legibility, public health, walk ability.

Abstract. During the 20th century, the specialization of road function adopted by designers, showed its limits. The main street network is geared towards mechanical traffic and speed, at the expense of walking and public transit. This approach has created enclaved areas and isolated neighbourhoods in the city where the inhabitants are dependent on car. This has created public-health problems related to the immobility of citizens and greenhouse gas due to the saturation of the network. Street connectivity is essential to facilitate and diversify travel modalities. However, we demonstrate that an acceptable connectivity index of the inner subdivision streets remains insufficient for its proper functioning. We show that a hierarchy of roads clearly expressed, legibility, easy accessibility to the subdivision and the continuity of the main streets of the city are a determining factor to facilitate and diversify travel modalities. This provides the mobility of pedestrians and reduces the use of cars. Based on the study of former fabrics and the results of current scientific research, we have deducted the conceptual rules favouring coherence and facilitating the mobility of users. In order to verify the impact and to give a concrete form to these fundamental rules, the city of Tlemcen is chosen as a case-study. This analysis allowed us to show that the performance of the layout of the inner road of the subdivision also depends on the efficiency of the main road network of the city. Both scales must be studied simultaneously.

1. INTRODUCTION

Universally, the subdivision process is one of the oldest modalities of urban space creation; from the Roman cities to the Bastide in the 13th century and the industrial cities of the 18th century to the garden cities theorized by Howard in 1898 (Paquot, 2011). This simple and regular modality allowed these cities to evolve and their urban fabrics to become more complex (Mangin *et al.*, 1999). This traditional street layout, characterized by the grid, was criticized by architects and town planners at the end of the 19th century. It was considered monotonous and not well-adapted to natural topographical features (Handy, 2003; Harris, 2007). The choice was rather focussed at that time on using dead-end streets, curved and discontinuous streets, to discourage vehicle traffic in neighbourhoods. As a result, today in the residential areas of Europe (Héran, 2011), and the United States (Handy, 2003), residential streets are separated from commercial streets. Over time, this practice was popularized and created thereafter residential areas with low street connectivity and representing urban enclaves in the city (Héran, 2011; Yung *et al.*, 2016). By comparison, many old towns were originally purely residential, being transformed into urban centers thanks to their good connectivity permitted by their simple and regular street-network layout. For this reason, Harris (Harris, 2007) and Handy (Handy, 2005a) noted a renewed interest in this kind of design in the United States.

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In several countries, characterized by strong demographic expansion, including Algeria the subdivision was and remains a way to answer the urgent and the increasing need for housing; “it is one of the most appropriate frameworks for citizen participation in the construction effort” (Ministry of Urban Planning and Construction, 1990). The subdivisions have a significant share in this growth process, including the expansion of cities. However, this situation has generated, in a short time, the construction of a great number of subdivisions. These are the conditions that led to the "poor" quality (Ministry of Urban Planning and Construction, 1990) urban landscape of our cities which are already victims of uncontrolled and excessive development (Ministry of Infrastructure and Spatial Planning, 1998).

This work focuses on planned subdivisions as a modality of urban fabric production, specifically the road network role in this process. The infrastructure system should be multipurpose, interconnected and synergistic in the urban fabric (Brown, 2014). This topic arose, following the reports released on the increase of this type of operations in Algeria and the application of the interdepartmental instruction relating to the relaunching of the habitat (Interministerial Instruction Relating to the Revival of Housing No. 1., 31 May, 1994). In addition, this issue is attracting the interest of the scientific community. BETUR (BETUR, 2013) has a study carried out as part of the development of Tlemcen city traffic states plan that: “The flow of Personal Vehicles (PV) is the most common modality and reaches 72.55% (79209 PV) of the total daily traffic, and public transport represents only 13%”. The study states that 45.19% of the trips are not necessary (shopping, visits, ...). The question is: how this urbanization, qualified as “poor and anarchic” by the Ministry of Infrastructure and Spatial Planning, is leading the subdivisions practice in Tlemcen?, and how the road network layout of the subdivision is affecting street connectivity and citizen mobility?

To answer these questions two objectives have been set: The first is to study the role of the city’s main road network in connecting the subdivision to its environment. The second is to explore the impact of the subdivision internal road network organization on the connectivity of its streets and its functioning (mobility, accessibility, etc.).

2. METHODOLOGY

Two scales are processed, the first one concerns the main road network of the city. The objective is to study its role and how it links the subdivision with its environment. This simple and regular modality allowed these cities to evolve and their urban fabrics to become more complex (Héran, 2011). It is also connected to the various entities of the city, including subdivisions. These main road networks structure the districts and organize them. Based on a reading of the layout of various subdivisions throughout history, this work will show how the primary road layout of the city structured and linked the different subdivisions and entities. An evolutionary reading of the notion of subdivision was made. This operation has shown its ability to evolve. It is moving from a purely regulatory kind, which first sought to remedy the insanitary installations, the creation of neighbourhoods and urban centers in their own right. This resulted in the complexity of the urban fabric and the evolution of its road network conditioned by several factors (Garrison, 1990).

After that, it appears therefore necessary to study the second scale, that explores the organization impact of the subdivision internal road network and its connectivity to the subdivision functioning (mobility, accessibility, etc.). In reference to the subdivision morphology, the road network is the determining factor. Additionally, the street layout allowed it to evolve and to move from simply sharing and residential streets to the urban fabric complexity with the diversity of its activities and landscape (Mangin *et al.*, 1999). The residential streets have been transformed in boulevards and avenues, and have become the support for various networks which are still growing (sanitation,

drinking water, gas, phone, etc.). The ever-increasing mobility made streets the areas where networks overlap automobile traffic, pedestrians, cycle traffic and public transportation.

Current studies focus on the relationship between the shape of the road network and its ability to evolve and meet new needs (Mendiolaa *et al.*, 2014). The road network is the permanent element of the urban fabric. In time, everything tends to change and morph in the urban fabric except for the road layout, which is perpetuated and protracted (Brès, 1998). However, streets serve continuous mutation of spaces. Their structure is durable, but their overall configuration must be adapted to accommodate internal new uses, external mobility and the use of the land it serves (Mendiolaa *et al.*, 2014). The physical environment is only one component of lived space (Christens, 2009), but it remains, however, the support of other elements, social, economic and cultural.

The use of the conceptual principles of old subdivision layout allows the emergence of cities with their urban centers, supports of various activities. The regularity, simplicity and the rationality of the street layout network are the principal characteristics of the urban fabric of these subdivisions. They promote street connectivity. This criterion encourages the functional diversification and the complexity, so wanted in old urban fabrics. Street connectivity allows and facilitates access to business areas (Cerdá *et al.*, 2010). This mode of operation offered by the road network, based on the connectivity of roads, is the opposed to monotonous and stereotyped areas. The connectivity assumes the creation of multiple, alternate routes for automobiles and several road options for the pedestrians and the cyclists (American Planning Association, 2006). Also, it makes fear the designers for the risks and the lack of security in residential areas. Creating neighbourhoods with low street connectivity and relocating no residential uses to arterial street appears as a solution to reduce the risk, in reality it transfers the problems of security to other areas which will be more saturated (Dumbaugh *et al.*, 2009). Additional measures must be taken for safest roads between origins and destinations. So streets can be designed not to be only safe, but to be also livable and better for us all (Dumbaugh *et al.*, 2005). Several studies investigating the process for good connectivity have a good perception of street space in favour of the citizens' health and a better mobility (Jiang *et al.*, 2011; Knight *et al.*, 2015; Rahimi *et al.*, 2014; Trovalla *et al.*, 2015; Yang *et al.*, 2011). The psychological and physical dimensions of shared space are very much interconnected (Hickey, 2014).

Mangin and Panerai (Mangin *et al.*, 1999) offer an analysis grid that allows identifying the conceptual subdivision rules. They show that this mode of ground cutting operation has existed for a very long time. Cities were created on the basis of regular agricultural tracings, case of Cairo in Egypt, Gmare in Algeria (Fig. 1) (Bousserak *et al.*, 2018) and the industrial cities in Europe, or the new cities of the United States. The spatial organization laws governing the subdivision arise from these old practices. The study of the road network of these cities and medinas was elaborated. As a result, the street hierarchy and the main road continuity lead to the coherence and functionality of the whole. Many studies show that there is a relationship between urban morphology and mobility (Sung *et al.*, 2015). Mobility results from the configuration of the urban network, at the same time the conditions of the mobility model the configuration of the urban network (Wiel, 2002). Consequently, the shape of a street network facilitates or hinders the mobility of individuals and their mode of travel (Hillier, 1996; Wiel, 2002). Roads interruptions can be an obstacle, it is fragmenting space and obstructing the continuity and consistency between the various entities (Héran, 2011). This hinders the diversity and social equity necessary for the survival of urban centers. It must create functional, coherent neighbourhoods and allow a healthy life for citizens (Lobo, 2010; Mele, 2014).

The specific case of Tlemcen is studied on the basis of this theoretical knowledge. The street layout of the city's old center (Ghoumari, 2009) responds to the principle of spatial organization which we have already observed in the readings of the cities we have studied. But what about its new planned subdivisions?

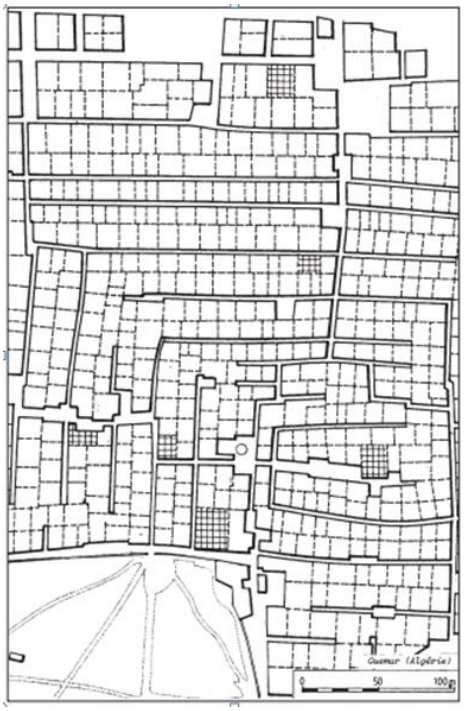

Fig. 1 – Regular street layout executed on the basis of the agricultural tracing. Former core, Gmare, Algeria, (Mangin *et al.*, 1999).

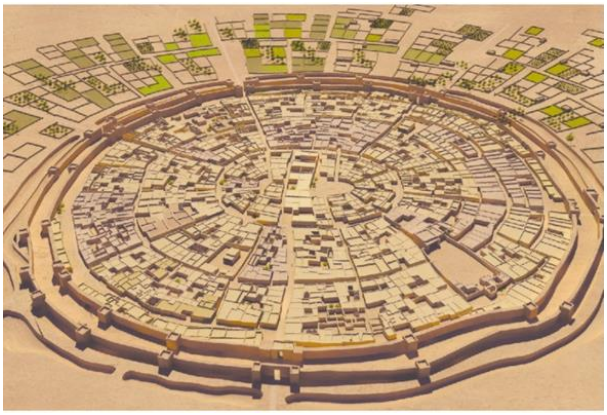

Fig. 2 – Regular street layout of Al-Rawda City, Syria (Kanjou *et al.*, 2016).

2.1. The regulation: the subdivision in Algerian legislation

The subdivision is a tool of town planning having allowed the creation of building land. The way in which the subdivisions were achieved in our country has led to a visible "mediocrity" denounced by the Ministry of Housing and criticized by all (Ministry of Infrastructure and Spatial Planning, 1998). Subdivision is allowed after the approval of the subdivision permit. This must follow the plan, the indications and the recommendations of the Development Plan and Town Planning and those of the Land-use Plan where they exist, otherwise the general rules of town planning (urban planning code, 2014). All these tools have remained powerless against the increase of housing developments generating a multitude of anomalies (urban planning code, 2014). Legislation and regulations tend to rational and balanced land use.

2.2. The subdivision in the theory: conceptual rules of subdivision

Generally, the subdivision operation has contributed to the creation of the city. It, therefore, allows the transition from the simple division of the ground to the urban fabric complexity (Mangin *et al.*, 1999). The regularity of urban plans, the rationality and the simple layout in favour of economy, were subdivision characteristics. Road connectivity favours also the complexity of the urban fabric through time. This is considered as an important criterion of urban sustainability (Gurran, 2011; Stangl *et al.*, 2011). The initially simple tissues of subdivisions, designed to accommodate individual dwellings, became developed and more complex, and had given birth to cities and urban centers (Hadas, 2016).

2.2.1. The role of the main street network and it interaction with the internal street network of the subdivision

Studying several street layout networks of subdivisions around the world has enabled us to understand their organisation mode. They are arranged in connection with the arterial street network of the city, the layout of street which defines their forms. Regularity and simplicity are the street layout characteristics of the old world cities, this promotes pathway connectivity (Omer, 2015). For example, Al-Rawda City cited by Kanjou and Tsuneki (Kanjou *et al.*, 2016). Its geometric layout shows the continuous and straight structuring pathways and connecting the center with the various city gates, as shown in Figure 2.

a. Street hierarchy[1]

A clearly hierarchical network allows an explicit differentiation of the types of itineraries recognizable by the fact that they are both clearly ordered and connected coherently to one another. These components have a clear classification order related to the global spatial arrangement (Marshall *et al.*, 2010). The interaction of the main streets of the city and the internal streets of the subdivision is formalized by the subdivision's distribution roads that originate from the main roads on a hierarchical basis. Hence, the subdivision will have several accesses from the principal street network. The enhanced accessibility ensures better access and at the same time reduces the need for travel (Handy, 2002). Its structuring roads are continuous. They organize the internal distribution and connect different subdivisions together (when it is a question of grouping several subdivisions), or a subdivision with its environment. In addition to street hierarchy, the "legibility"[2] the "imageability"[3] allow to locate you throughout the roads and to discover and understand the morphological and the topological structure of the road network.

b. Streets continuity

The arterial roads of each subdivision of the city structure connect the different operations. Consistency between them liyes in the extension of their main road, from which the distribution streets of each subdivision will be hierarchized. This connecting road must be well designed, so it is not an obstacle and a separation split break between the entities (Handy, 2002). The continuity and regularity characteristics of roads promote the economy by reducing the distance. The road is the support of various networks (sanitation, water supply, electricity, gas, etc.). Reducing its linearity affects the overall cost of implementation and maintenance projects. Mangin and Panerai (Mangin *et al.*, 1999) called this practice "rational" cutting ground.

c. Accessibility

This mode of operation is not only summarized in the economy, it additionally allows a permeability of the urban fabric which facilitate citizen travel. Better accessibility is achieved by fewer network turns (Henson *et al.*, 2003). The configuration of the layout road network, is the main generator of patterns of movement (Hillier *et al.*, 1993). Improving accessibility contributes to the improvement of transportation systems (Handy, 2005b; Straatemeier *et al.*, 2008). Accessibility can also be used as a sustainability indicator in land-use planning (Dumbaugh *et al.*, 2009). When structuring roads are continuous, they organize the internal distribution and connect different subdivisions together. Accessibility and continuity of routes promote access to different areas and increases choice. This street layout so establishes offer a connectivity to the roads service which determines access to

[1] **Hierarchy targeted in this work**: A clearly hierarchical network allows an explicit differentiation of the types of itineraries recognizable that are both clearly ordered and connect coherently to one another. These components have a clear classification order related to the global spatial arrangement.

[2] **Legibility**: Readable network easy to understand (Marshall, 2005). Illustrates its ability to create a perception of the territories, to make it possible to identify oneself throughout the travel whose street network constitutes the support.

[3] **Imageability**: Term used by Kevin Lynch, (Lynch, 1960).

opportunities for physical activity and healthy eating (Handy *et al.*, 2007; Matan *et al.*, 2015). This factor tended to have more walking, biking, and transit use (Marshall *et al.*, 2010).

d. Connectivity and mobility

Mobility is closely-related to connectivity. They are so closely linked that they become inseparable (Wiel, 2002). Mobility resulting from the urban layout, however, these conditions of mobility model the urban layout (Wiel, 2002). The "conventional hierarchy"[4] of roads tends to produce a large mesh that surrounds neighbourhoods and favour speed. So, this road hierarchy favours the mechanical movement (Héran, 2011). For pedestrian movement and to facilitate access to services and particularly emergency service, the network should be finely meshed with an efficient secondary road and continued (Héran, 2011; Litman, 2016). This street connectivity preserves the user's health by promoting walking. Several researches are addressing this issue (Ewing *et al.*, 2009; Lowe *et al.*, 2015; Macintyre *et al.*, 2002; Tribby *et al.*, 2016; Vermotea *et al.*, 2014). Connected street networks provide a framework that produces a social and functional coherence that can provide public services in a highly efficient way and that can adapt to change (Dill, 2004; Netto *et al.*, 2015). Additionally, the flow of traffic can be diversified in many areas, enabling travel choices other than driving. This improves overall mobility and helps to reduce congestion on overused arterial (Handy, 2003). We must create models to achieve reductions in transport energy. The interconnection between service roads offers additionally the possibility of implementation of a more efficient transport service (Handy, 2003; Khan *et al.*, 2014). One can show how the roads interruptions can fragment space and obstruct the continuity and consistency between the various entities (Rifaat *et al.*, 2012). This creates a difficulty to move for pedestrians and access to services. So, the subdivision street layout should allow connectivity of the roads and various spaces of entity. The street hierarchy is then necessary to ensure good permeability of the urban fabric (Jiang, 2009). This facilitates the various travel modalities and encourages walking, which positively affects the citizen's health (Healthy Spaces & Places, 2009). Recent studies have shown the link between the health of the user's and subdivision street connectivity, where for those not connected, residents are depending of the car. However, those well connected favoured residents walking and cycling (Frumkin *et al.*, 2004). A sedentary lifestyle increases the risk of cardiovascular disease, stroke, diabetes, and obesity (Frumkin *et al.*, 2004).

In the United States, several cities require opening the new subdivisions for traffic to facilitate various motions. A connectivity ordinance sets a minimum number of network connectivity. These cities recommend an index of value 1.4 minimum and the value 1.6 is preferred (Handy, 2003). The connectivity index is the ratio between the number of segments and the number of nodes of a network (Handy, 2003).

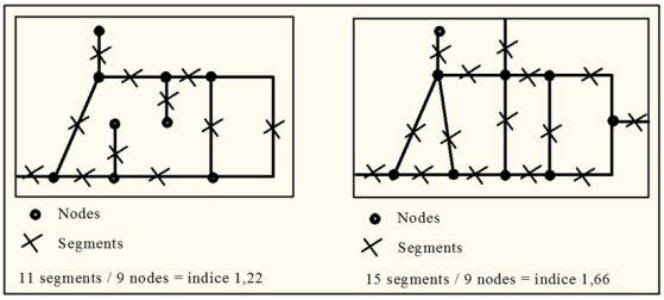

Fig. 3 – Calculation of the connectivity index.
Figure produced on the basis of Susan Handy work (Handy, 2003).

[4] **Conventional hierarchy**: deemed non-functional that promotes mechanical traffic and speed. The main routes in this case represent an obstacle and they enclave the areas they surround (Marshall, 2005).

This figure provides an example of how to calculate the connectivity index. Another constraint is added to this index, it is the limited length of dead ends and blocks most often between 100 m and 200 m (Handy, 2003).

3. RESULTS

The legislative texts and the rules which result from it are in accordance with the design principles of the subdivision: however, the interministerial instructions reveal a non-compliance with what is done in the cities of the national territory in relation to the rules. Tlemcen a town in the Algerian North west, whose population reached about 949.135,0 inhabitants (National Statistics Office, 2016), has not escaped the excessive growth that hit most of its suburban areas. Individual housing occupies most urbanized areas. It then offers an interesting study-case (Fig. 4).

Local application: the subdivisions at Tlemcen

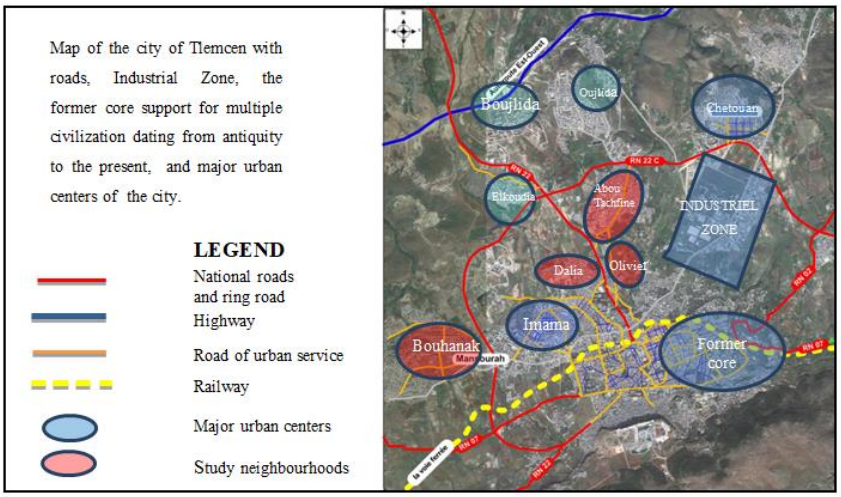

Fig. 4. Functional areas and transport infrastructure of Tlemcen. Map produced on the basis of the plan of urban infrastructure drawn from the traffic plan of Tlemcen BETUR done by the Design Office in March 2013 (BETUR, 2013).

This proliferation concerns older kernels and also new sites on a peripheral belt (Hamma *et al.*, 2016). They form small clusters along the ring road east to west, letting appear "no man's land". This creates a discontinuity or rupture between the different entities in the city. Thus, the difficulty to reach any part of the city is felt. How is this translated into the road network of subdivisions? The observation of the layout of the roads of the different subdivisions of the city and its comparison with the conceptual principles presented above made it possible to draw some conclusions.

3.1. The main roads of the city

Urbanization in Tlemcen was made in the form of subdivision, or in the form of new urban zones of housing environment (ZHUN). Depending on the location, subdivisions are placed in the middle of a city area, either in the clustered form making up an urban entity, or in the isolated form. In both cases the road network must play the role of the authorizing officer. It must structure and connect different parts of it. The notice by observing the urban groups of Bouhanak and of Abou Tachfine for example, that the structuring roads of the city do not cross the group, but bypass it. This involves a problem of subdivision accessibility which is not done directly from the continuous road to urban

centers. The resulting of various bypasses and break of access roads to subdivisions and the absence in most cases of a hierarchy of roads clearly expressed, create difficulties of localization and imply longer distances to do in these groupings. It implies difficulties to identify the shortest street between different points of the subdivision. This leads to saturation of some main streets and crossroads. It should be noted that 45.19% of the trips are not necessary (shopping, visits, etc.). With better access to basic services this percentage can be reduced.

Field data: The following graph shows the movement measure according to the trip purpose (BETUR, 2013) (Fig. 5).

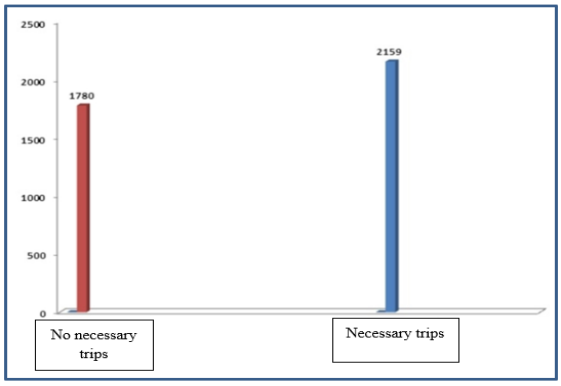

Fig. 5 – Movement measure according to trip purpose (BETUR, 2013).

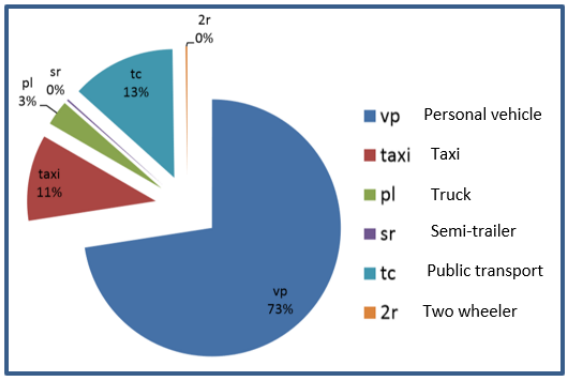

Fig. 6 – Modal distribution of daily traffic(BETUR, 2013).

The study states that 45.19% (1,780 travels) of trips are not necessary (shopping, visits, etc.) vs 54.81% (2,159 travels) of necessary trips (home-work, home-study, work-work, etc.).

Table 1

Modal distribution of daily traffic (BETUR, 2013)

Station	Direction	Personal vehicle	Taxi	Truck	Semi-trailer	Public transport	Two wheeler	Total
1	**1**	14,709	1,011	722	13	2,688	65	**19,207**
	2	12,411	1,445	494	8	2,112	51	**16,520**
2	**1**	10,596	1,457	234	33	1,076	48	**13,443**
	2	9,811	1,188	366	113	850	49	**12,377**
3	**1**	2,084	143	132	8	412	11	**2,789**
	2	2,631	168	152	0	496	11	**3,458**
4	**1**	7,627	2,298	360	5	1,392	0	**11,682**
	2	5,971	1,566	350	5	1,482	0	**9,374**
5	**1**	7,014	1,240	284	15	1,934	0	**10,887**
	2	6,355	1,306	334	23	1,830	0	**9,848**
Total	**1 & 2**	**79,209**	**11,822**	**3,428**	**220**	**14,272**	**234**	**10,9185**
		72.55	**10.83**	**3.14**	**0.20**	**13.07**	**0.21**	**100.00**

Table 1 and graph of Figure 6 above show that:

– The personal vehicle is throughout the most frequent mode, it reaching 79,209 vehicle unit, 72.55% of all the daily traffic.

– The daily flow of public transport, with a value of 14,272 vehicle unit, represents only 13.07% of all the traffic.

– The flow of two-wheeler has a small share and represents only 0.21% of all the traffic.

3.1.1. Abou Tachfine neighbourhood: road layout network

The Abou Tachfine District, located in the geometric center of the city, occupies a strategic area of the city, but very poorly connected with its environment (Figs. 7, 8 and 9). The structuring roads linking this district with the northern and southern parts of the city present problems related to their street layout. This does not structure the district and does not put it in connection with its environment. It is connected to the arterial roads of the city by two roads. The first one is wide and continues to its southern part, in opposite to its northern part, it is narrow, winding and steep (Figs. 10 and 11). The second is interrupted to the north and connected to an arterial street on the city's south side. This causes congestion during rush hours, observed on the ground, and displacement difficulties. There is a lack of a hierarchy of streets that causes a problem of localization and displacement; also no roads legibility (Figs. 12 & 13). It is causing saturation of the main roads with a poor accessibility to the neighbourhood, because the street layout of the neighbourhood does not offer multiple alternate roads.

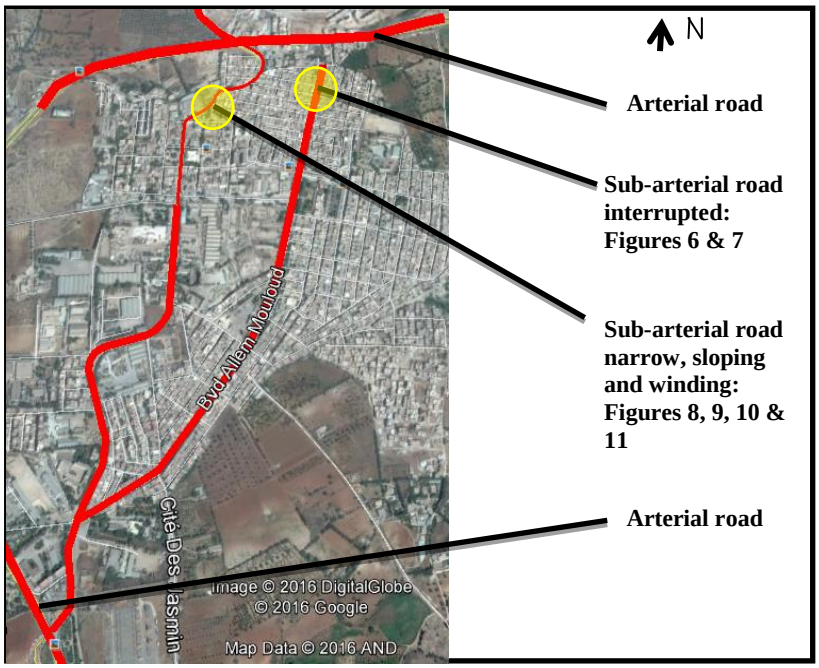

Fig. 7 – Arterial and sub-arteial roads connection of Aboutachfine neighbourhood.
Map produced on the basis of the aerial view 2016.

Fig. 8 – Sub-arterial road interrupted
(Djebbar, July 2018).

Fig. 9 – Sub-arterial road end
(Djebbar, July 2018).

Fig. 10 – Sub-arterial road narrow, sloping and winding (Djebbar, July 2018).

Fig. 11 – Sub-arterial road narrow, sloping and winding (Djebbar, July 2018).

Fig. 12 – Sub-arterial road: no legibility (Djebbar, July 2018).

Fig. 13 – Sub-arterial road: no legibility (Djebbar, July 2018).

3.1.2. Bouhanak neighbourhood: road layout network

Only two accesses connect the district of Bouhanak with the rest of the city from the main armature. It leads to a saturation of these nodes during rush hours. Additionally, several enclaves (student residence, university, residential areas for students, etc.) isolate Bouhanak neighbourhood to its immediate environment. The street distribution of the neighbourhood that should create consistency, continuity and connectivity between the various entities, is interrupted. Consequently, there is a juxtaposition of entities which leads to an urban disorder causing localization and displacement difficulties. This type of operation chosen for its simplicity, economy and rationality, no longer fulfils its role seen the multiplication of imperfections. This is the result of noncompliance of the street layout (Fig. 14).

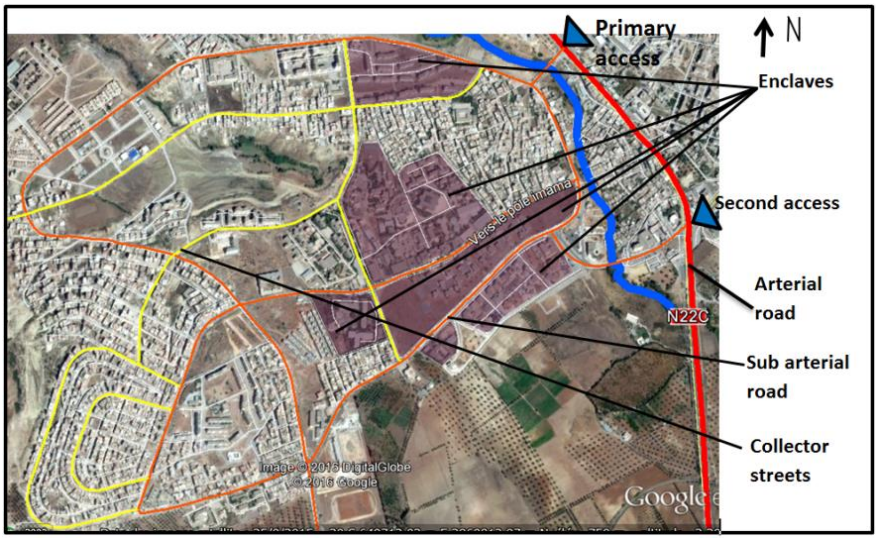

Fig. 14 – Arteriality and accessibility of Bouhanak neighbourhood.
Map produced on the basis of the aerial view 2016.

3.1.3. Dalias and Olives neighbourhoods: road layout network

Figure 15 show that the arterial roads with an important traffic present a rupture between the two districts: Dalias and Olives. This break is accentuated by the presence of a difference of topographical level, which completely isolates the neighbourhood of Olives from its environment. Several enclaves (barracks, student house, university, quoted residential, etc.) isolate Dalias neighbourhood to its immediate environment. Three accesses to the neighbourhood exist over a distance of 1,500 m, which leads to longer distances and reduced the access choice. The absence of a road hierarchy clearly expressed, despite the presence of an urban grid, makes its road layout be random, and it does not facilitate the drainage of flow by a connection between the roadways. This situation generates a saturation of the main roadways caused by the poor distribution of the flow and encourages the use of the car to the detriment of other travel modalities because the two districts are totally isolated.

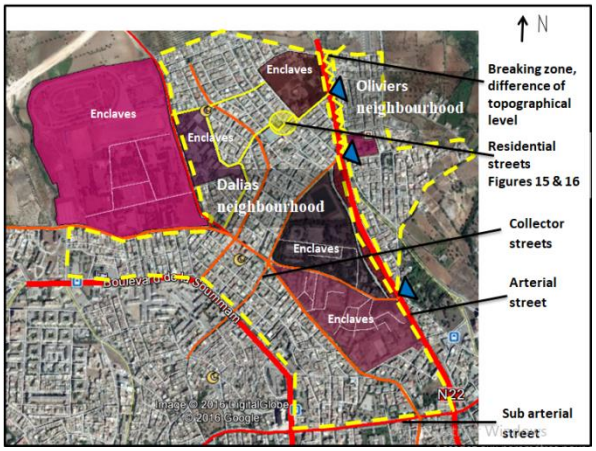

Fig. 15 – Arteriality and accessibility of Dahlias and Oliviers neighbourhoods. Map produced on the basis of the aerial view 2016.

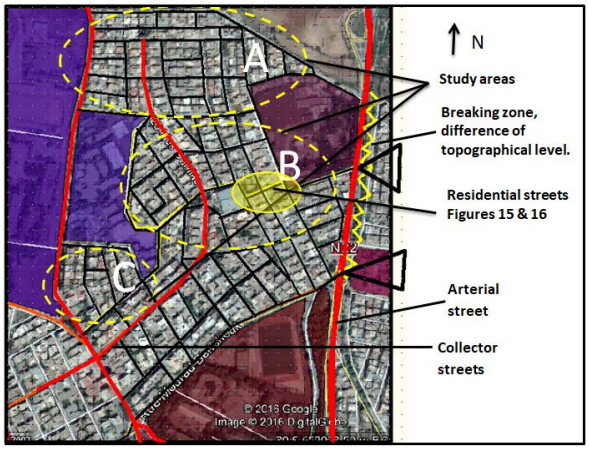

Fig. 16 – Study-areas and inner streets layout of North Dahlias neighbourhoods. Map produced on the basis of the aerial view 2016.

3.2. The internal roads of subdivisions

The street layout of the subdivision should in turn allow connectivity of the roads and different entity areas. By calculating the connectivity index, we will check the efficiency of the road network layout and whether this is sufficient for the proper operation of the neighbourhood.

3.2.1. The neighbourhood of Dahlias: road layout network

The first note is the absence of the street hierarchy. The arterial streets are not connected by secondary roads, ensuring continuity and tissue permeability (Fig. 16). We note, after the calculation of the connectivity index of residential streets, an acceptable index that approximates 1.40 (Figs. 17, 18 and 19). Despite these results, the district remains isolated from essential activity areas. The arterial roads are saturated because the district does not offer alternative travels to fluidify the flow. The first access road from the arterial road is broken, it is difficult to locate us to rejoin the collector street of the neighbourhood (Figs. 20 and 21). Legibility in the area is reduced, the streets do not allow the identification and the understanding of the structure for better use and enjoyment. Recourse to vehicle use is observed to travel to service areas and the trade of first necessities.

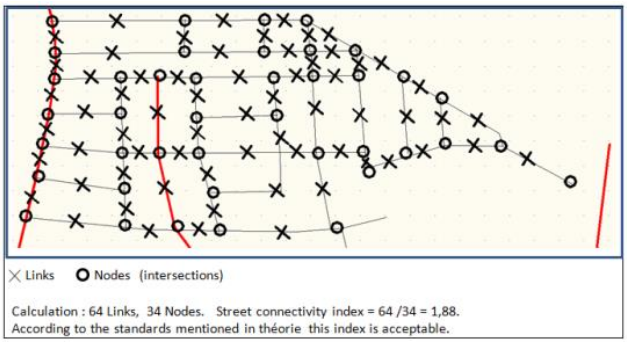

Fig. 17 – Calculation of connectivity index in North Dahlias neighbourhoods, area “A”.

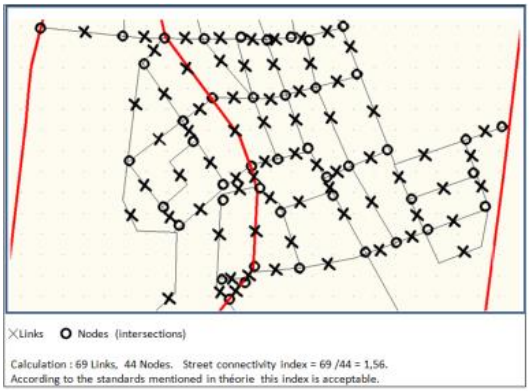

Fig. 18 – Calculation of connectivity index in North Dahlias neighbourhoods, area “B”.

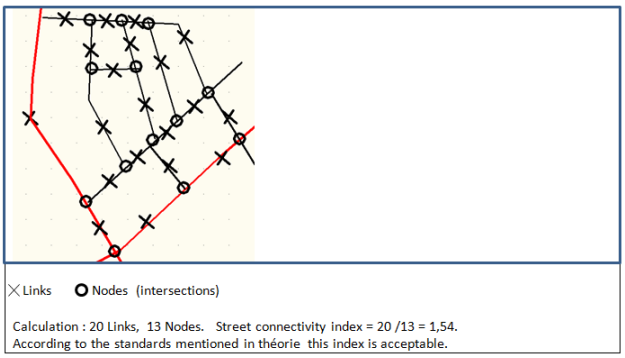

Fig. 19 – Calculation of connectivity index in North Dahlias neighbourhoods, area “C”.

Fig. 20 – No legibility and no imagibility (Djebbar, July 2018).

Fig. 21 – No legibility and no imagibility (Djebbar, July 2018).

3.2.2. The neighbourhood of Oliviers: road layout network

The street layout of this district is regular (Fig. 22), the connectivity index of local streets in the northern part of the district is 1.50, which is acceptable (Fig. 23). This area still remains isolated, the road forms a loop and is not connected to the main streets. This break is accentuated by the presence of a level difference between the area and the arterial road that already is an obstacle, given the large flow it serves. Consequently, residents are using the personal vehicle to go to service.

As for the southern part of the district, the area is isolated. The roads of section "A" form a loop and this section is not connected to its environment (Fig. 24). Section "B" is landlocked, despite the connection of its streets with the main routes (Fig. 24). It is located between an open field and a residential area with no activity. In addition, the connectivity index below the minimum allowed (1.34 and 1.26) (Figs 25 and 26) indicates poor connections of the inner streets.

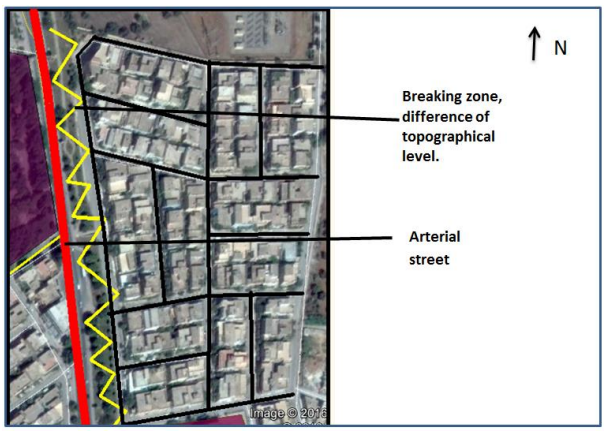

Fig. 22 – Inner streets layout of North Oliviers neighbourhoods. Map produced on the basis of Aerial view 2016.

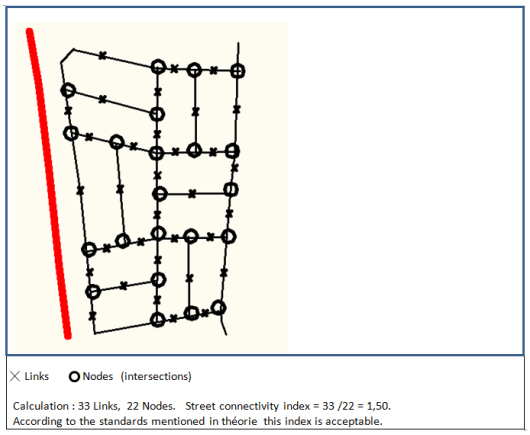

Fig. 23 – Calculation of connectivity index in North Oliviers neighbourhoods, area "B".

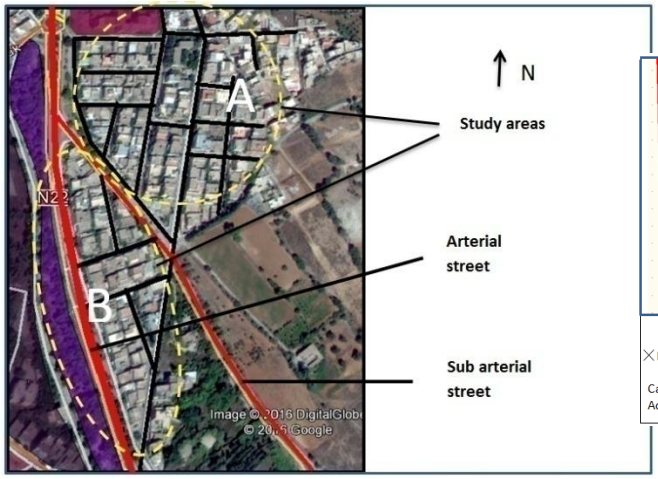

Fig. 24 – Study areas and inner streets layout of South Oliviers neighbourhoods. Map produced on the basis of the Aerial view 2016.

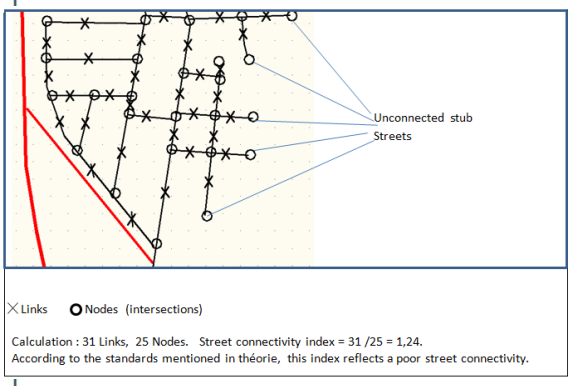

Fig. 25 – Calculation of connectivity index in South Oliviers neighbourhoods, area "A".

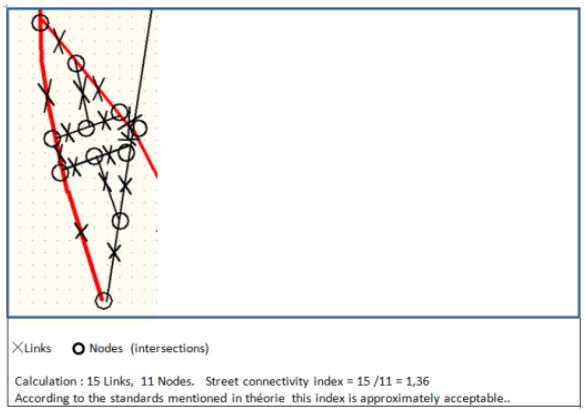

Fig. 26 – Calculation of connectivity index In South Oliviers neighbourhoods, area "B".

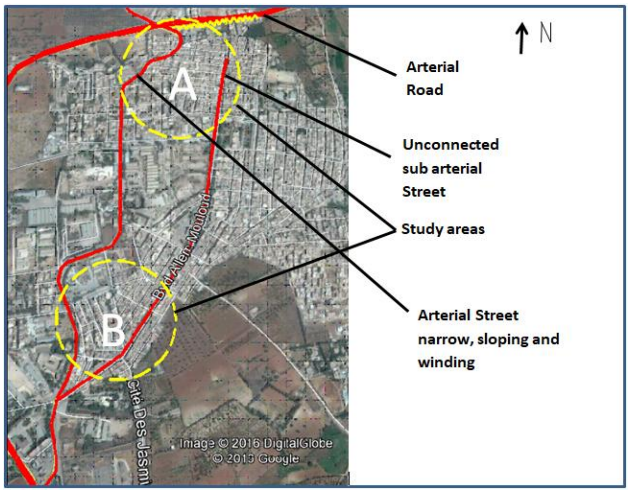

Fig. 27. Arterial roads and Study areas of Abou Tachfine neighbourhoods. Map produced on the basis of the Aerial view 2016.

3.2.3. The neighbourhood of AbouTachfine: road layout network

The absence of a hierarchy of roads and the discontinuity of the central main street are observed. It is leading to the saturation of the only access road to the area from the north (Fig. 27). The latter, being narrow and winding, leads to traffic saturation at the intersection with the main artery of the city. This street layout is not hierarchical, it offers no alternative to drivers to use alternate routes to thin the stream (Figs. 28 & 29). However, the connectivity index of local streets is acceptable (Figs. 30 and 31), the streets are well connected.

Fig. 28 – Inner streets layout of Abou Tachfine neighbourhoods, area "A".
Map produced on the basis of the Aerial view 2016.

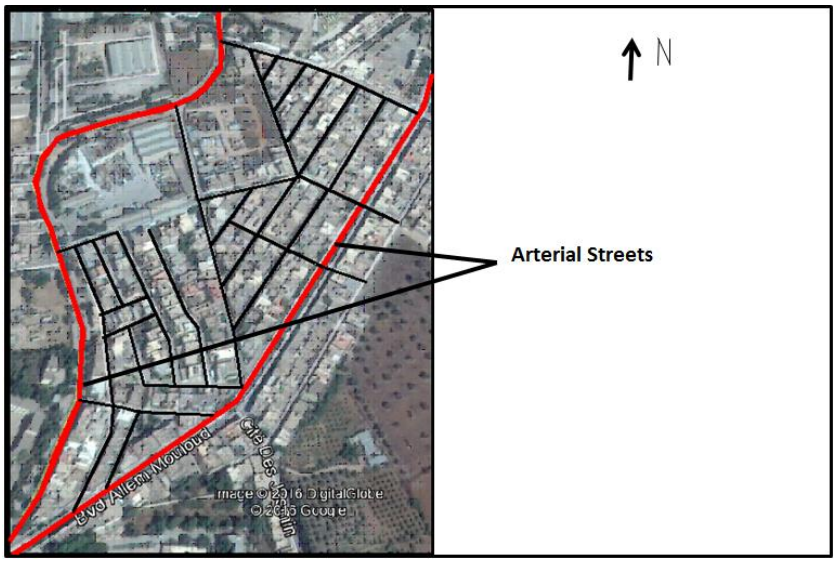

Fig. 29 – Inner streets layout of Abou Tachfine neighbourhoods, area "B".
Map produced on the basis of the Aerial view 2016.

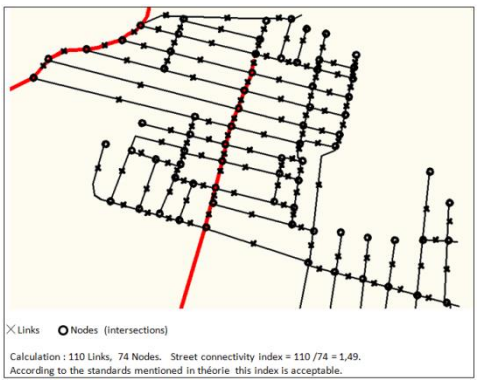

Fig. 30 – Calculation of connectivity index in Abou Tachfine neighbourhoods, area "A".

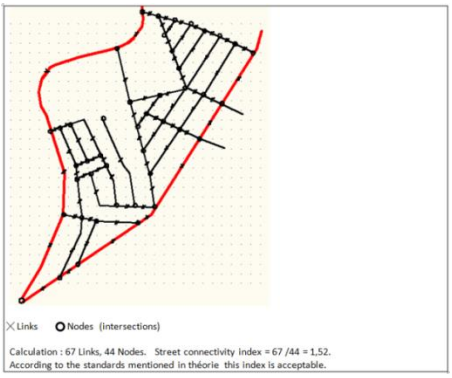

Fig. 31. Calculation of connectivity index. Abou Tachfine neighbourhoods, area "B".

4. DISCUSSION

The structuring roads of Tlemcen city do not cross the group but bypass it. This involves a problem of subdivision accessibility which is not done directly from the continuous road to the urban centers. These various bypass and break of access roads to subdivisions and with the absence, in most cases, of a road hierarchy clearly expressed and roads ligibility create difficulties of localization and imply longer distances to make in these groupings. It implies difficulties to identify the shortest street between different points of the subdivision. In addition, it encourages the use of the car rather than other travel modalities since the district is isolated.

The study results of the different neighbourhoods also reveal that the main roads do not structure the district and does not put it in connection with its environment. This causes congestion during rush-hours observed on the ground and displacement difficulties. It is causing saturation of the main roads with a poor accessibility to the neighbourhood, because the street layout of the district does not offer multiple alternate roads. Additionally, several enclaves generally isolate the subdivision to its immediate environment. The street distribution of the neighbourhood that should create consistency, continuity and connectivity between the various entities, is interrupted. Consequently, there is a juxtaposition of entities which leads to an urban disorder causing localization and displacement difficulties. This type of operation chosen for its simplicity, economy and rationality, no longer fulfils its role given the multiplication of imperfections. This is the result of non compliance of the street layout.

The connectivity index of inner streets indicates acceptable average values. In return, we note the absence of the street hierarchy clearly expressed and the roads ligibility. Also, we observe a poor accessibility to the neighbourhood. Despite these results, the district remains isolated from essential activities areas. The arterial roads are saturated because the district does not offer alternative travels to fluidify the flow. Generally, the arterial streets are not connected by secondary roads, ensuring continuity and tissue permeability. Legibility in the area is reduced, the streets do not allow the identification and understanding of the structure for better use and enjoyment. The recourse to vehicle use is made to travel to service areas and of first necessities trading.

4.1. Synthesis

In Table 2, we observe that the calculation of the connectivity index indicates acceptable average values. The other conditions of functioning (Continuity of main Roads, Legibility of street layout, roads hierarchy, Accessibility and Mobility) are not met, several deficiencies are noted. This led to the saturation of the main streets and the systematic use of the car in all the studied cases.

Table 2

Recapitulative table

Subdivision	Connectivity index of inner Streets	Continuity of main Roads	Legibility of street layout	Road hierarchy	Accessibility	Mobility
Dahlias Area A Area B Area C	 1.88 1.56 1.54	Bad	Bad	Bad	Low	– Saturation of the main roads. – Using the car.
North Oliviers	1.50	Bad	Bad	Bad	Low	– Saturation of the main roads. – Using the car.
South Oliviers Area A Area B	 1.24 1.36	Bad	Bad	Bad	Low	– Saturation of the main roads. – Using the car.

Table 2 (continued)

Aboutechfine Area A Area B	 1.49 1.52	Bad	Bad	Bad	Low	– Saturation of the main roads. – Using the car.
Bouhanak	The subdivisions of this neighbourhood are unfinished. So we could not calculate the connectivity index. The observation was made only for the main network of the city.	Bad	Bad	Bad	Low	– Saturation of the main roads. – Using the car.

5. CONCLUSIONS

Finally, good connectivity does not stop in domestic routes of the subdivision, but must extend beyond for ensuring the continuity and harmony between all entities in the built-up environment. The main road network of the city must additionally play its role in connecting the subdivision with its environment.

The theoretical approach has enabled us to highlight the importance of the street layout in the overall organization of subdivisions and their connectivity. It was a two-scale study. The first scale concerns the main road network of the city. It reveals its role and how it links the subdivision with its environment. Simplicity and regularity in favour of the economy are principle criteria used in the subdivision operation. The various subdivisions are structured by the city's road network. It connects them and determines their morphology. It is from these primary roads that initiated the internal hierarchy of the road. They extend from one neighbourhood to another for the purpose of overall consistency. This creates good connectivity between different entities. By comparing these results with the subdivision operation at Tlemcen, it proved a failure to comply with conceptual rules linking the main street layout of the town. In addition, the internal layout of the subdivision caused low accessibility of subdivisions and poor road connection. Through the examples studied, the road network does not play this essential role of linking subdivisions with their environment ensured by good road connectivity. This explains many failures observed, which are caused by poor accessibility of subdivisions with its inner distribution which does not link them. These failures and the low number of access to urban groups are the cause of the saturation of some roads. The poor connectivity of the main roads, reduces are alternate road for automobiles and roadways options for the other travel modalities. The second scale relating to the internal roads network of the subdivision was explored. This shows the organization impact, of the internal road network of subdivisions and its connectivity, on functioning (mobility, accessibility, etc.). In the subdivision, street connectivity, their hierarchy clearly expressed and the permeability of tissues are identified criteria of the theoretical approach. The regularity of urban plans, the rationality and the simplicity of the street layout are characteristics of the urban fabric of these subdivisions, they promoting street connectivity. This criterion encourages the functional diversification and the complexity lacked by old urban fabrics. Good legibility of the road network and connectivity of routes, facilitate travels and communications between different areas of activity. This promotes walking and reduces the distance travelled by different trip ways. This street layout preserves the health of individuals, encouraging pedestrian traffic and offering more choices for culinary services to users. A decrease in the saturation of some roads is promoted by the use of a well-served existing network. These criteria are the condition for the proper functioning of the entity. These elements allow the fabric to evolve and become more complex and able to respond to possible new needs.

The importance of the street layout in the overall organization of subdivisions and their internal distribution is highlighted in this work. Comparing these results with the production of subdivisions in Tlemcen City proved non-compliance with conceptual rules and procedures that put the relationship of the city street layout and the interior layout of the subdivision. In the examples studied, the street network does not play this essential role of fabric linking and permeability. Generally, the calculation of the connectivity index indicates acceptable average values. Although the other conditions of functioning were not met, several deficiencies are noted. First, the saturation of some roads is observed, induced by the low number of access to urban groups. Second, the route offers few options to drivers to use alternate routes to reduce the flow. Also, this failure is affected by the difficulty of identifying and moving from one point to another. This is due to the presence of many bends in the paths, and lengthening their distances. In addition, one can say that those difficulties in the movement of individuals and the systematic use of the car are prejudicial to the environment and to the public health.

For a better connectivity of the road network in the subdivision, the main street layout of the city must organize the subdivision. The inner streets must be well-linked to the main network of the city from which they are hierarchical. Several accesses should be provided, as well as a good legibility of the network. The connectivity index must be higher than 1.4 and the blocks most often between 100 m and 200 m.

Our contribution illuminates the designers and policy makers on the importance of the arterial street network layout in linking different subdivisions and the overall consistency in the city. In addition, connectivity increases the number of access to different urban groups and relieves pressure on the arteries in thinning the traffic flow. This additionally encourages alternative modes of travel. However, to complete this work, other factors should be studied: density of the road network, population density and streets dimensions (track widths, sidewalk widths).

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THE ENVIRONMENT AND SOCIETY INTERDISCIPLINARY RESEARCHES CONFERENCE,

INSTITUTE OF GEOGRAPHY, ROMANIAN ACADEMY,
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On June the 28th, 2019, the Institute of Geography hosted the Annual Scientific Communications Session titled "Interdisciplinary Researches on the Environment and Society", devoted to *the Anniversary of 75 years from the foundation of the Institute of Geography (1944–2019)*. The event was organised by the Institute of Geography of the Romanian Academy and the cultural-scientific "Simion Mehedinţi" Foundation.

After the welcome speech and the opening one of the session proceedings, held by Mr. Dan Bălteanu, Director of the Institute of Geography, some collaborators of the Institute: Mr. Lucian Badea, Mr. Petre Gâştescu, Mr. Ion Zăvoianu, Mrs. Octavia Bogdan, Mr. Mircea Buza, Mrs. Cristina Muică and Mrs. Maria Sandu were awarded diplomas of excellence; as well as to Mr. Călin Dimitriu for his special contributions to the emergence of the fundamental Romanian Geography works at the Publishing House of the Romanian Academy and to Hermine Maersohn for special contributions in the translation of the publications. Mr. Sorin Geacu, Ph.D., launched his book entitled *"Raul Călinescu, the Founder of Romanian Biogeography"*.

Two full-session communications were held: *The Anniversary of 75 years since the Foundation of the Institute of Geography*, authored by Academician Dan Bălteanu, and *Evoking in Images: Acad. Vintilă Mihăilescu, Acad. Victor Tufescu, Prof. N. Al. Rădulescu, Corresponding Member of the Romanian Academy*, delivered by Prof. Cristian Tălângă.

A number of 30 proceedings were further held, divided in three sections: *I. Physical Geography; II. Environmental Geography and Natural Hazards; III. Human Geography and Regional Development. First Section* deals with aspects connected with climate variability; characteristics in the evolution of drought and summer thermal extremes in the Romanian Plain; an analysis of temperature variability on the surface; seismic geography; dynamics of the upper limit of forests in the Romanian Carpathian Mts.; river management methods, etc. *Section Two* deals with *the Geography of the Environment and the Natural Hazard*, focussing on the evolution of the potential implementation of green solutions in Romania's towns; the estimation of the forest biomass in Romania, teledetection assessment of some dangerous weather phenomena; photo-voltaic parks in the Romanian Plain; natural and management risks; slope instability risk in mining areas, etc. *Section Three* discusses problems of demographic evolutions in Romania; geo-demographic characteristics of the population; the ethnical structure of the population; social development in Romania; urban expansion; the effects of economic restructuring the urban economy on the internal migration flows; the contribution of Romanian geographers to spatial planning, etc.

The audience included scientific researchers and teachers from the Bucharest-based Institute of Geography of the Romanian Academy; the Faculty of Geography of the Bucharest University; "Babeş-Bolyai" University in Cluj-Napoca, the Faculty of Geography; the Craiova University, Department of Geography; "Ion Mincu" University of Architecture and Urbanism, Bucharest; "Ludwig-Maximilians" University of München; Liège University, Faculty of Geology; National Institute of Research-Development in Constructions, Urbanism and Sustainable Territorial Development URBAN-INCERC; the National Administration of Meteorology; Oltenia Region Meteorological Centre, and Teleşti-Ludeşti Gymnasium, Dâmboviţa County.

The scientific session ended with a round-table on the *Prospects for Inter-Institutional Collaboration to Assess the Productivity of Agricultural Systems within a Geographical Context*. Participants: the Institute of Geography of the Romanian Academy; the National Institute of Research-Development in Agriculture – INCDA Fundulea; Ludwig-Maximilians University, München-Germany, and the National Administration of Meteorology.

Mihaela Rodica Persu

Sabina Ispas, Nicoleta Coatu (Eds.), *Etnologie românească: tradiție, cultură, civilizație (Romanian Ethnology: Tradition, Culture, Civilisation)*, The Publishing House of the Romanian Academy, 2018, Bucharest, 344 pages.

One of the most important events in Romania's history is the Great Union in 1918, which represented the unification of all provinces into one national state. In 2018, the year of the Great Union Centenary (1918–2018), the Romanian Academy organized a series of academic activities and scientific events dedicated to the Centenary, including an extensive collection entitled "*Romanian Civilisation*", focused on concise descriptions of all scientific fields.

The volume entitled *Romanian Ethnology: Tradition, Culture, Civilisation,* published under the patronage of the Romanian Academy, is part of this collection and represents a synthesis of the development of Ethnology in Romania, in close view with the national and international development directions in the field. The volume was elaborated by a group of researchers from the "*Constantin Brăiloiu*" Institute of Ethnography and Folklore of the Romanian Academy and "*Petroleum-Gas*" University of Ploiești, Faculty of Letters and Sciences, and is based on the revised chapters of the first 3 volumes of the *Romanian Ethnology: Folkloristics and ethnomusicology* series (2006, 2007 and 2010).

The volume is structured into 4 chapters covering several topics (e.g. conceptual and theoretical aspects about culture, civilization, tradition, folklore and popular culture; ethnological disciplines; methodological and technical issues of investigation), considering the ethnological particularities of Romania. Emphasis was given on the history of Ethnology in Romania and also on the transformations during the last 100 years, including theoretical and methodological issues.

The first part, *Fundamental concepts*, presents theoretical aspects on insights of a wide array of topics ranging from theory and history to many aspects of folklore and culture, identifying the central concepts of Ethnology and describing how each of these concepts contributed to the development of the discipline. The four major concepts, i.e. culture; civilization; tradition and popular culture; folklore, are explained along with the evolution of the Romanian Ethnology. Moreover, after discussing the theoretical development for the last 100 years, the book continues with an overview of the different meanings of the terms in order to avoid misunderstanding and underpin the key meanings in various contexts.

The second part, which is also the most consistent one, is devoted to *Ethnological disciplines*. The authors focused on the following issues: folkloristics, ethnomusicology, ethnochoreology and ethnography. Based on a comparative-historical perspective, this part discusses the development of the ethnological disciplines in Romania and on the appropriate usage of the terminology. The book gives information about the need to answer questions concerning the definitions and the goals of the disciplines, concerning the strands of continuity that existed between the new developments and the old ethnological traditions. This chapter presents an overview of the beginning and the development of ethnography in the various parts of the world, focusing on Romanian ethnography over the last 100 years.

The historical perspective of this discipline includes information related to the scientific activity of Romanian scholars (e.g. George Vâlsan, Simion Mehedinți, Romulus Vuia, Romulus Vulcănescu) who significantly contributed to the evolution and diversification of the ethnographical science. It refers to the identity of ethnological disciplines reflected in the scientific works of preeminent scientists and in the biographical presentations of personalities of the Romanian Ethnology. Examining the historical evolution of ethnography as a discipline, the book provides viewpoints on its relationship with other disciplines, particularly with Geography. In this context, Romanian geographer George Vâlsan is remembered for both theoretical and practical contributions to ethnography, while Simion Mehedinți played an important role in the history of Ethnography, becoming one of the founders of the Romanian ethnography, developing new theoretical approaches in asserting the role of ethnography in education.

The third chapter, *The methodology of concrete research*, describes the main past and current methodological and technical aspects used in interdisciplinary research along with illustrated and worked out examples. This chapter presents a holistic view of the various methods, tools and techniques employed by researchers for the collection of data. During the last 100 years, the methods of inquiring the historical development of civilization have been highly advancing. The described methods and techniques related to interviews, questionnaires, observations, case studies, ethnographies and oral history. Attention is paid to key personalities

in the history of the Romanian Ethnology and how they influenced the changes from the theoretical, methodological and thematic point of views in the evolution of the discipline.

The last chapter, *Folklore archives*, contains numerous aspects related to the conservation of folklore. It focusses on the documentation techniques regarding folk traditions which are relevant for understanding the process through which tradition evolves and changes. The chapter describes the main markers adopted over the 100 years for the conservation of the folklore. They cover issues such as the national archives, where collected folklore can be properly stored and made available, museums or folklore sections in existing museum, harmonization of methods for collecting and archiving, trainings for collectors, archivists, documentarists and other specialists with interests in the conservation of folklore, promotion on scientific research relevant to the conservation of folklore. Of primary importance in this respect is the conservation of the vast narrative and musical folklore which has been collected during the past centuries, and which constitute an impressive national archive.

The volume represents an important synthesis on the development of Ethnology in Romania, in the last 100 years. Its publication on the occasion of the Centenary of the Great Union of 1918 acknowledges it as a reference work for the history of sciences in Romania. The interesting approach to theoretical and methodological issues turns this volume into a valuable scientific contribution relevant across the disciplines of sciences and a source of documentation for both specialists and young scientist of this field.

Laura Lupu