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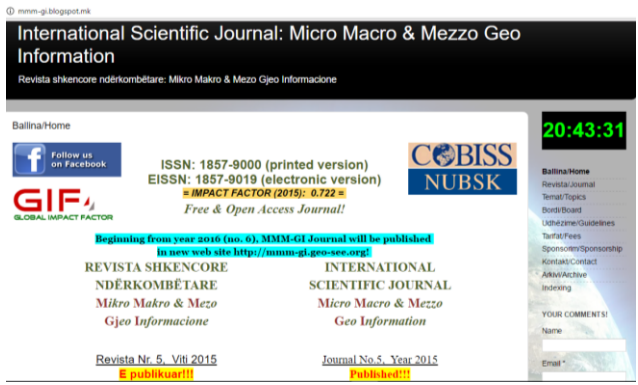


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# COMPOSITION OF COASTAL VEGETATION IN AND AROUND THE TRADITIONAL GRAZING ROUTES OF CAMELS IN KACHCHH, GUJARAT-INDIA

**Ajoy DAS[1] , Pankaj JOSHI[2], Mahendra BHANANI[3] and Ritesh POKAR[4]**

*UDC: 502.211:582]:528.931(540)*

## ABSTRACT

Natural resources provide a range of interrelated environmental interaction and socioeconomic benefits, which support a diversity of livelihood policies for different stakeholders of the local community. The Pastoralist community locally called *Maldharis* who is sifting one place to another place for their survival. Since the land is not suitable for agriculture, conventional development by-passed the region. Some Part of Landscape in Kachchh is considered as a biosphere reserve for its wildlife and plant ecosystem. The nomads tend to migrate with their economic betterment and better livelihood. Both food crops and multipurpose crops are being grown together with livestock management. The people lighting their hopes with the migration process. This region is rich in natural resources and livestock resources. The existing natural resources and the long coastline is also contributing a major part in the district economies. The grazing animals depended on natural vegetation, so need to prepare a cluster level seasonal Grazing route map of Camel pastoralist with the help of a participatory approach. Through the natural resource map, the community will easily find out the areas which are rich in natural vegetation and nearest safe water bodies for the animals on their grazing route. The participatory method helped a lot for this study to identify their temporal grazing location as well as the grazing routes around the largest district (Kachchh) of India. The shrubs and scrubs apart from the Prosopis *juliflora* are not in strength to protect erosions and since considered as an invasive species, should be remove from native habitats of Kachchh. The sweeping high wind velocity and high-temperature increase evaporation both from the soil and all living flora and fauna. Saving land and

[1] **PhD Dr. Ajoy DAS**, ajoydas@gujaratuniversity.ac.in, Cartographer, Department of Geography, School of Sciences, Gujarat University. Tel. +91 953 7753341. Address: Navrangpura, Ahmedabad-380009, Gujarat, India.
[2] **PhD Dr. Pankaj JOSHI**, pankaj@sahjeevan.org, Programme Director, Biodiversity and Conservation, Sahjeevan (NGO). Tel. +91 942 6949523. Address: Sahjeevan, 175-Jalaram Society, VijayNagar, Hospital Road, Bhuj- Kachchh, Gujarat- 370001 (India).
[3] **MSW**. **Mahendra BHANANI**, mahendra@sahjeevan.org, Programme Coordinator, Sahjeevan (NGO). Tel. +91 823 8019933. Address: Sahjeevan, 175-Jalaram Society, VijayNagar, Hospital Road, Bhuj-Kachchh, Gujarat- 370001 (India).
[4] **MSc. Ritesh POKAR**, ritesh@sahjeevan.org, Programme Coordinator, Sahjeevan (NGO). Tel. +91 972 4727757. Address: Sahjeevan, 175-Jalaram Society, VijayNagar, Hospital Road, Bhuj- Kachchh, Gujarat-370001 (India).

maintaining it for better agricultural use in a planned way for eco-system development retaining agrobiodiversity is a need. Wherever the environment is suitable (not affecting the soil water relationships and efficiency) keeping in view rainfed system agro-ecology needs to be developed.

**Keywords**: Natural Resources, Pastoralist, conservation, Participatory, GIS, Wetland.

## 1. INTRODUCTION

Kachchh district has the highest wetland (51.72%) area including seasonal and saline marshy area of RANN among all districts of the Gujarat state. The Kachchh Peninsula located between 22° 44' to 24° 41' North latitude and 68° 10' and 71° 43' East, forms the westernmost part of India and constitutes the Kachchh district of Gujarat State. This district has wide coverage as 45652 sq. km area of the Gujarat state. This district has 10 talukas such as Bhuj, Gandhidham, Anjar, Rapar, Mandvi, Bhachau, Mundra, Nakhtrana, Abdasa, Lakhpat. The total population is 2,092371 and the population density is 46 people /sq. km. The average literacy rate of this area is 70.59%. The western part of the Gujarat state of India is surrounded by the Arabian sea and the other three parts of this state are covered by the dynamic landmasses. The geographical extension of this state is Latitude 20º 06' N to 24º 41' N and Longitude 68º 10' E to 74º 28' E. This region is under the subtropical climate zone and over the whole region, there are several sub climate regions. The monsoon season starts from June and stays up to October, similarly winter months are November to February, summer months are March to June. Few wetlands have safe drinking water but after March due to extreme heat and the regional location, the normal water is converted into the saline water. Eastern and northern part of the region is covered by Greater Rann of Kachchh (GRK) and Little Rann of Kachh (LRK). Kachchh peninsula has four ephemeral rivers as Khari, Pur, Kanaka Vati, and Gjansar (ORG, 1999; CWC, 1997, and Planning Atlas of Gujarat). The Pastoralist community, locally called *Maldharis* who are sifting one place to another place for their survival, has camels, sheep, goats, cattle, and buffaloes; they produce ghee (clarified butter), wool, and handicrafts. The water veins and groundwater flow according to the regional slope aspect. Two types of camels identified in Kachchh district i.e. the Kharai Camels, the unique breed of camels that swim in the sea in search of mangroves, and the other one is Kachhi camel, a breed of the camel that can't swim in the sea, mostly depended on inland grazing. The ecological barriers on the west are the river estuaries and marshy lands. Vegetation in the marshy land and immediate inland is on the verge of collapsing. The north of the middle ridge, a large spread of Banni land, is traditionally devoid of agriculture and suitable only for grasses.

However, people's lifestyles and occupations are predominantly interwoven with the Banni livestock and monsoon grasses. Handicrafts and embroidery of the Banni *Maldharis* are world acclaimed. Cattle largely Kankrej breeds, Sindhi buffalo, camel, sheep, and goat are the domesticated animals. In every aspect of their day to day life, these animals are involved. A strong emphasis is made here for agro-biodiversity and cultivated agriculture development in Kachchh.

### 1.1 Need conservation for Biodiversity development

Kachchh is considered as a biosphere reserve for its unique wildlife and plant ecosystem. Domestication of animals and livestock rearing, using the plant resources, and natural grasses is a way of life. The nomads tend to migrate with their economic betterment and better livelihood. The availability of groundwater and rains has led to a stable life, which, together brought in agriculture. Both food crops and multipurpose crops are being grown together with livestock management.

Kachchh was and continues to be a major livestock rearing center. When an agricultural ecosystem must be interwoven with it the ecosystem needs to be protected, maintained, and further developed. In the present scenario, there is a significant amount of soil erosion both by wind and water. The available land needs to be saved from salinity and desertification. In the mainland undulating hilly part of the district, vegetation of five major composition types can be identified. They are open scrub, dense scrub, grasslands, shrub savannah and tree savannah. Large parts of the landscape support the last remaining patches of natural tropical thorn forests and savannah of the country. Common plant species recorded from the landscape includes; *Acacia nilotica* subsp. *Indica* (Deshi bavar), *Acacia senegal* (Kher, Gorad), *Capparis decidua* (Ker), *Euphorbia caducifolia* (Thuar), *Prosopis juliflora* (Gando bavar), *Salvadora oleoides* (Mithi jar), *S. persica* (Khari jar), *Prosopis cineraria* (Kandho), *Zizyphus mauritiana* (Bor), and *Z. nummularia* (Chani bor) in the top canopy, while *Maytenus emarginata* (Vikaro), *Premna resinosa* (Kundheri), Corida *perrottetii* (Liyar), *Grewia tenax* (Gangni), *G. villosa* (Luska) etc. constituted the under story. As tall trees with high canopy except for Neem, Banyan, and Peepal in small scattered standings, there is no windshield of natural source. The shrubs and scrubs apart from the *Prosopis juliflora* are not in strength to protect erosions. The sweeping high wind velocity and high-temperature increase evaporation both from the soil and all living flora and fauna. Saving land and maintaining it for better agricultural use in a planned way for eco-system development retaining agrobiodiversity is a need. Irresponsible or thoughtless use of technological applications needs to be given up. Fortunately, Kachchh is not much polluted with green revolution setups and a package of practices. Wherever the

environment is suitable (not affecting the soil water relationships and efficiency) keeping in view rainfed system agro-ecology needs to be developed.

### 1.2 The literature of the study

The broad objectives of this study are as follows-

I. A mapping exercise of Natural Resources with Pastoral Community within a 25 kilometers buffer zone from the coastline.
II. Existence Status and Dependency on Natural Resources using GI (Geographic Information) Science technology.
III. Participatory Conservation Management plan through the GIS tools.

Based on these objectives we had focused on the resources and information available on a different website, published and unpublished research reports, articles, etc.

#### *1.2.1 International aspect*

Kachchh district and its surrounding area have unique biodiversity, there is no proportion between one taluka to another taluka. They all are different with their flora and fauna distribution. There are many research works have been done at the global level, here we had taken some recent research findings as references. The increase in grazing pressure implies a reduction in the production of palatable species and increases the proportion of unpalatable as well as woody species (Perrings and Walker, 1995). As per (Anteneh Belayneh et al., 2012) that the traditional medicinal plant species are relevant for human health care as well as for the people living in Ethiopia. Fifty systematically selected informants including fifteen traditional herbalists (as key informants) participated in the study. Semi-structured interviews, discussions, and guided field walk constituted the main data collection methods. The species like Aloe *pirottae*, *Azadirachta indica*, and Hydnora *johannis* were the most cited and preferred species. Aloe *pirottae*, a species endemic to Ethiopia, is valued as a remedy for malaria, tropical ulcer, gastro-intestinal parasites, gallstone, eye diseases, and snakebite. The gel extracted from dried and ground plant material, called SIBRI (Oromo language), was acclaimed as a cleaner of the human colon. A concoction made from leaf, seed, and flower of Azadirachta *indica* was given for the treatment of malaria, fungal infections, and intestinal worms. Root preparations from Hydnora *johannis* were prescribed as a remedy for diarrhea, hemorrhage, wound, and painful body swelling, locally called GOFLA (Oromo language). (Kristine B. Garcia et al., 2014) discussed the potential of the resource for development for the protection of the associated indigenous medical experience as well as the development and effective use of the medicinal plant resource. The status of the Philippines' mangroves, its

current and future threats, and analyzes the mechanisms on how various stakeholders put efforts to address those threats. The similarities in issues around wetland conservation and sustainability in three developing countries using case studies of internationally significant wetlands in Tanzania, Colombia, and Papua New Guinea. Planning processes, socio-economic inequities, and conflicts are significant risks to some wetland values. Mechanisms such as the Ramsar Convention provide a framework to assist in addressing global wetland loss, but implementation at these sites needs to be supported by effective, integrative approaches involving natural resource regulation, conservation, and the development needs of local communities by (Jasmyn J. Lynch et al. 2016). According to (Kathiresan Kandasamy 2017) in the last two decades, mangroves in India have been well maintained without any drastic changes, because of effective conservation measures being implemented in mangrove areas along with the country, despite growing threats by man and natural calamities. (Anna C. Treydte et al. 2017) said that the Afar pastoralists of Ethiopia mainly depend on natural rangeland resources for their livestock. In times of severe drought, migrating with livestock was most common. Participatory land-use mapping and vegetation assessment has been done to identify the most important rangeland locations and their condition in Afar. The average herbaceous cover of rangelands was <25%. Afar pastoralists applied little conservation and mitigation methods, most commonly they removed livestock pressure to allow the pasture to recover. Afar pastoralists applied little rangeland conservation and mitigation effort.

### *1.2.2 National aspect*

When we are focusing on the national level study some people continue to depend on locally available bio-resources for their livelihoods. Such population who are directly dependent on local biological resources. Through their keen sense of observation, practices, and experimentation developed and established a body of knowledge that is passed on from generation to generation. Some are widespread traditional knowledge like cultivation practices by the (National Biodiversity of India, 2009). Defining the spatial limits of biodiversity has evolved a further group of terms; α (alpha), β (beta), and γ (gamma) diversity. This group of terms differentiates between local species richness (‘α’ diversity, the number of species at a location), the regional species pool (γ diversity, the number of different species that could be at a location) and vary between localities (β diversity), (Thompson et al. 2007).(Joshi et al, 2015) suggested that the total population of the golden jackal, about half of the golden jackals were mostly found in the Prosopis *juliflora* dominated habitat with an occurrence of 46.90%. This was further followed by grassland, mixed thorn forest, and open scrubland

with an occurrence of 31.25%, 9.91%, and 6.25% respectively. Minimum numbers of jackals were recorded in the wetland habitats (5.69%). The presence of a greater number of jackals in the Prosopis dominated area can be attributed to the availability of shelter and food which is also comprised of Prosopis *juliflora* pods and Ziziphus fruit. Habitats like Euphorbia scrubs, Prosopis scrubs, thorn mixed scrubs, open scrubs, thorn mixed forests with Acacia *Senegal*, Acacia *nilotica,* and Salvadora mixed considering the high floral diversity and unique vegetation assemblage of this range, it has been suggested that this tract and adjoining sites may be declared as Ecologically Sensitive Areas (ESA), (Joshi 2002). On the other side (Das et. al. 2019) found the threatened habitat area of Kachchh district and suggested the suitable habitat areas for the wild animal with multi-criteria analysis. Some threatened floral species are identified in the region *Limonium stocks, Dipcadi erythraeum, Talinum portulacifolium, Indigofera caerulea var. monosperma* and *Ipomoea kotschyana, Commiphora wightii, Helicrysum cutchicum, Convolvulus stockii* and *Heliotropium rariflorum*, (Patel et. Al., 2018). As per the published report wetland habitat accepting only three threatened species i.e. *Ammania desertorum, Dipacdi erythraeum, Ipomoea kotschyana,* has high preservation substantial. Including this *Limonium stocki* and *Talinum portulacifolium* which were suggested preservation of their habitat for survival, (Patel et. al. 2018). From this region, five species of mammals observed also i.e. *Canis lupus* (Indian Wolf), *Vulpes bengalensis* (Indian Fox), *Hyaena hyaena* (Striped Hyena), *Panthera pardus* (Common Leopard), *Felis silvestris* (Desert Cat), *Felis chaus* (Jungle Cat), *Viverricula indica* (Small Indian Civet), (Pardeshi et. al. 2010). Wetlands consist of diversity according to their geographical location, nature, dominated by flora and fauna species, soil, and sediment physiognomies (Space Application Centre, 2010). According to (A. Rathore et al., 2013) the ecosystem mainly di-vided into few subsystems where desertification is expanding and the temperature making them drier and intolerable in terms of the threatened species. The risk of wildfire is increasing which could change the species biodiversity. Climate change is a threat to the diverse hotspots (Succulent Karoo, South Africa). Many species are very specific and endemic to this ecosystem and are rich natural reservoirs of goods. Based on (Nikunj B. Gajera et al. 2013), observation in this Kachchh region the bird species are widely distributed among various habitats around the western Kachchh region. Various factors associated with different habitat types had a distinct impact on bird species. Likewise, various land use activities especially opencast mining that is being done on a mass scale in the region also affect the bird populations considerably. According to (Nitin Bassi et al. 2014) observation of the wetland wealth of India in terms of their geographical location, the ecosystem benefitted but due to various stresses

like land-use changes in the catchment area, they went under the disturbed or threatened wetland ecosystem. Encroachment of reservoir area for industrialization, excessive diversion of water for agricultural practices is yet a major problem (Verma, 2001). Lack of good governance and management are also the main reason for the wetland ecosystem disturbance (Kumar et al. 2013). India, with its topographical variation, along with the climatic mobility supports unique wetland habitats (Prasad et.al. 2002). National Wetland Atlas 2011, prepared by SAC, is the latest inventory on Indian wetlands. In this report total of 201,503 wetlands were identified and mapped on a 1:50000 scale (SAC, 2010). According to the (SAC,2011) Wetland Atlas reports there are 69% inland wetlands, coastal wetlands 27%, and other wetlands (smaller than 2.25 ha) 4%. The aquatic vegetation in all types of wetlands put together,1.32 m ha (9% of the total wetland area) in post-monsoon and in pre-monsoon 2.06 m ha (14% of total wetland area). The area under aquatic vegetation in Kachchh district is about 59132 ha in the post-monsoon season and slightly high in the pre-monsoon season (60381 ha). A total number of wetlands is 4659 (area 2360909 ha) in Kachchh district, (SAC, 2010).

Many research works have been done by the Govt. Departments as Gujarat Biodiversity Board, Gujarat Ecological Society, Geer Foundation, etc. Except for these organizations some private NGO organization as Sahjeevan, RAMBLE of Banni region, K-Link, Kachchh Unt Uchherak Maldhari Sangathan (KUUMS), Banni Breeders' Association, etc. They are working with the pastoral community and Biodiversity conservation and management sector. The soils of the Banni region are moderate to strongly saline and are subject to flooding/inundation. The Rann is flat, largely composed of salt and mud (Tiwari, C.B, et al. 1994). Due to this inundation factor, there is a variation of vegetation also. The invasion species as Prosopis juliflora has taken a major role to threaten the ecosystem through decreasing the grass areas. This region is dependent on livestock farming. Kachchh district support 1.4 million livestock, which yielded about 12% of milk and 21% wool production of the state during 1994-95 (GEC, 1996). Community based participatory natural resource management is being adopted widely as a possible solution to address complex problems. Also, participation and knowledge of local groups are understood to be a valuable resource in community-level natural resource management, decision making, and policy planning processes (Tripathi and Bhattarya, 2004). However, regardless of its significant contribution to the economy of the district, the grazing requirements of the district could not be met with the existing resources. Increasing grazing pressure is also a major problem for this region so in that position needs a conservation plan. Livestock based income is the mainstay in Banni which was estimated as Rs. 7700/cattle/year and Rs.

13,400/buffalo/year (Geevan et al. 2003). Livestock is the mainstay of livelihood, (Joshi et al. 2009); (GUIDE, 2010). Besides, the socio-economic survey (Joshi et al. 2009) noted that the Banni communities are highly dependent on the natural grassland for various purposes. If this region suffers from the various ecological problem, then it will be very tough for their livelihood. Sahjeevan has tried to collaboration with Sardar Kushinagar Dantiwada Agriculture University (SDAU), Dept. of Animal Husbandry, Govt. of Gujarat for development of the Banni breed which was then registered as 11th Buffalo breed in the country, (Joshi, P.N et al. 2009). Local observations of grassland change and priorities for conservation of natural resources in Banni, Gujarat, India sows the dynamic change of biodiversity by (Das et al. 2018). Biodiversity threat through exotic species monitoring and management using Remotely Sensed data and GIS techniques- A Case Study of Banni (Kachchh) Gujarat, India (K.L.N. Sastry et al. 2003) also shows the threatening species due to influencing various factors. So, using space technology in this region will be a great achievement for the development of the pastoral community as well as its ecosystem also.

### 1.3 Study Area

The study area is the Kachchh district, (Figure no.1) the geographical extension is between latitude 23°13' N to 24°68' North and 68°10' East to 71°80' East longitude. Gujarat State has an arid area of 62,180 km2, of which 73 percent is in the Kachchh district of the State. Kachchh District has an area of 45,692 sq.Km. Kachchh is the largest district in India. The administrative headquarters is in Bhuj which is geographically in the center of the district. Other main towns are Gandhidham, Rapar, Nakhatrana, Anjar, Mandvi, Madhapar, Mundra, and Vondh. Kachchh has 969 villages. The landscape of the area is amazing. A group of hills on the Pachchham outcrop are called Kala Dungar (Black Hill) is the highest point in Kachchh at 458 meters (1,503 ft).

Natural resources provide a range of interrelated environmental functions and socioeconomic benefits, which support a variety of livelihood strategies for different stakeholders of the local community. So the preparation of the Natural Resource map of Kachchh is necessary for the development of the Pastoral community. The Arabian Sea in the west; the Gulf of Kachchh in south and southeast and Rann of Kachchh in north and northeast. The border with Pakistan lies along the northern edge of the Rann of Kachchh, of the disputed Kori Creek. More loosely, the southern portion of the Rann is considered an island, with seawater inundating the land for most of the year.

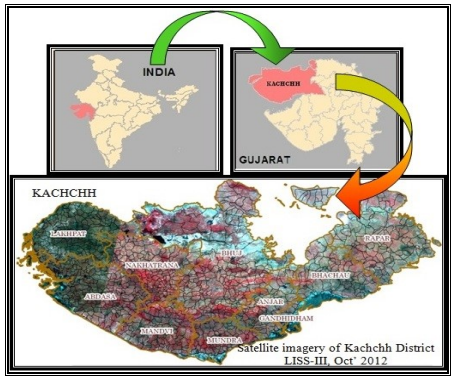


Figure 1: *The Study Area Location Map (not to scale)*

The soils are another main factor to develop the good and healthy vegetation of an area. It shows the heterogeneous character concerning their depth, morphological features, and physiochemical properties. As such a normal process of soil formation has led to the development of shallow to deep, light-colored, calcareous, and salt-rich soils. Kachchh district has a good variety of Natural vegetation distribution. Desert, Thorne forest, Open Grassland, Gorad forest, extensive mudflats, Mangroves in the coast, and numerous wetlands provide a variety of habitats for medium to small carnivores and water owl. The district had a population of 1,583,500 of which 30% were urban as of 2001. Major Crops being produced in Kachchh district are oilseed, bajra, jowar, cotton, pulses, date palms, and brinjal.

## 2. MATERIALS AND METHODS

### 2.1 Sampling

A participatory conservation management plan is defined in this study to manage the seasonal grazing route for the camel pastoral community. The Camel pastoral Community of the Kachchh region travels throughout the year from one cluster to another for grazing their animals. The main objective of this study is to find out the natural vegetation along the seasonal grazing route of camels to find out which cluster has what type of vegetation. How to manage the pastoralists to decrease a load of a specific cluster? because there are some common clusters where 3-4 groups of camel pastoralists gather in a single cluster within different seasons (Summer, Monsoon, and Winter). As per the Pastoralist of this region we got the information through focus group discussion **(Figure no. 4)** that basically they roaming for grazing their camels in and around 25 km from the coast line of the Arabian sea. So, we had taken the bench mark as 25 km buffer

**(Figure no. 9 and 10)** from the coastline to identify the availability of vegetation cover within that buffer zone specially with the help of Resource Sat-2 LISS-III satellite imagery.

### 2.2 Data Details:

Satellite imageries:

For this Study Resource Sat-1 and 2, satellite data (2012 and 2017) have been used for the identification of vegetation composition. The Resource Sat-2 LISS-III satellite data of October 2012 and 12th December 2017, collected from 'Sahjeevan' (NGO, Bhuj), and the rest of the data downloaded for free of cost from NRSC (National Remote Sensing Centre) website, Bhuvan portal, ISRO, Hyderabad of Govt. of India.

Data details are bellowed:

The Resource Sat-1 and 2 satellites have LISS-III sensor with 24 meters. of Spatial Resolution, Spectral resolution of 4 bands (B2: 0.52-0.59, (green), B3: 0.62-0.68 (red) B4: 0.77-0.86, (NIR) B5: 1.55-1.70 (SWIR) and the swath of 141 km. For the cloud-free post-monsoon data December month was selected. This data helped to identify the different natural objects of the earth's surface such as land, waterbody, drainage, forest, mangrove species, etc.

### 2.3 Processes for vegetation map ( Figure 2 ):

This section has been discussed some major step by step procedure **(Figure no. 2)** for the preparation of two classified vegetation map of Kachchh district, one is for whole Kachchh district and another is for 25 km. Buffer zone from the coastline.

### 2.4 Processes for Cluster wise dependency map ( Figure 2 ):

This exercise is mainly developed by applying participatory methods defined as manual GIS. For this exercise, ancillary data has been used and the availability of natural vegetation along the grazing route had used the satellite data. This exercise also follows some major steps to complete the grazing route map. The major steps are defined in **Figure no. 2**.

### 2.5 Participatory Conservation Management plan through the GIS tools.

A participatory conservation management plan is defined in this study to manage the seasonal grazing route for the camel pastoralist. Camel pastoralist Community **(Figure no. 4 and 5)** of the Kachchh region travels throughout the year from one cluster to another cluster for grazing their animals. The main objective of this study is to find out the natural vegetation along the seasonal grazing route of the camel. In which cluster, what type of

vegetation is available. How to manage pastoralists to decrease the dependency of a specific cluster because there have some common clusters where 3-4 groups of camel pastoralists gather in a single cluster for the different seasons (Summer, Monsoon, and Winter).

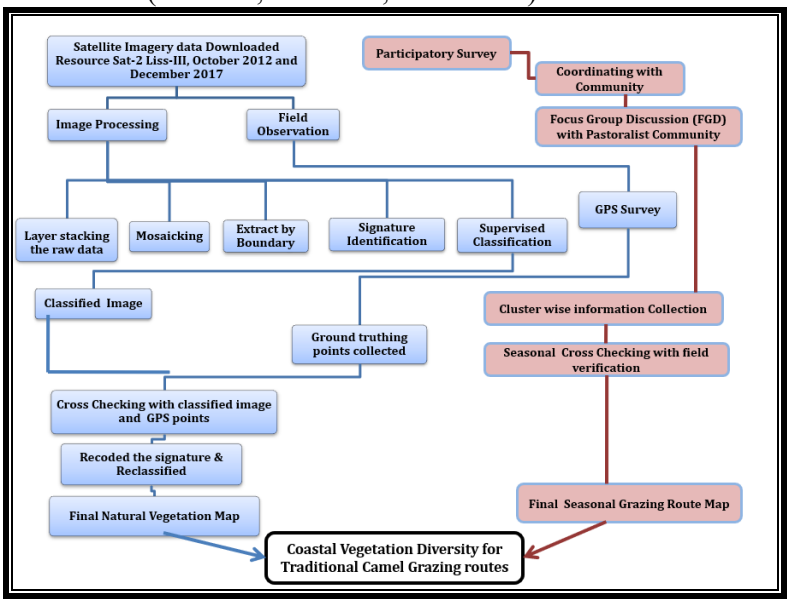


Figure 2: *Methodology for Coastal Diversity vegetation mapping for traditional camel grazing routes.*

Figure 3: *Cross-checking with classified image, Kachchh District, Gujarat*

Figure 4: *Seasonal migration of a pastoralist family Sanosara cluster, Bachau, Kachchh (Source: Sahjeevan)*

*Figure 5: Discussion with camel Maldhari in a grazing camel.*

## 2.6 Existence status and Dependency on Natural Resources using GI (Geographic Information) Science technology.

Kachchh district is rich in natural resources in the form of land resources and livestock resources. Besides these natural resources long coastline is also contributing a major part in district economies. Kachchh district has a good variety of Natural vegetation distribution which is controlled the Pastoral community's growth and development. In Kachchh district according to the census 2011 by govt. of Gujarat total grazing animals are 18,68,290 including Cow, Buffalo, Ship, Goat, Horse, Donkey, Camel, etc. (Figure no.7), and they fully indirectly depend on natural vegetation.

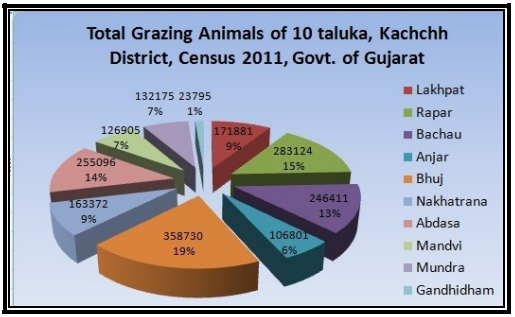


Figure 6: *Total Grazing animals in Kachchh District (Source: Census 2011, Government of Gujarat, India)*

So there is to be a need preparation of cluster-level seasonal Grazing route map of Camel pastoralist with the distribution of available natural resources

of the whole Kachchh region because when the pastoral community moves around the Kachchh district for grazing they don't have any idea regarding the vegetation types. Once the natural resource map will prepare with applying for the advance Remote sensing technology they can easily find out in which area has what types of vegetation on their grazing route. This is very difficult for a pastoralist to find out the actual grazing site or finalize the seasonal grazing route in the whole Kachchh region. Taluka wise grazing animal or livestock resource has been shown (Figure no.6 and 7).

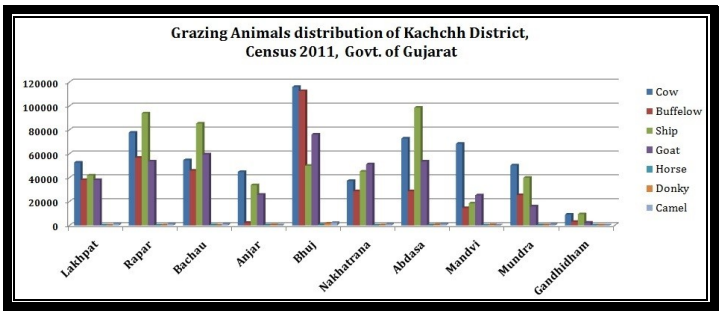


Figure 7: *Taluka wise Grazing Animal distribution in Kachchh (Source: Census 2011, Govt.of Gujarat)*

## 3. RESULT AND DISCUSSION

### 3.1. Preparation of Natural Resource map of Kachchh district, Gujarat.

Kachchh district broadly classified by four distinct regions i.e. (i) The Great Rann, or uninhabited wasteland in the north (< 5 mt.), (ii) The Grassland of Banni (5 to 10 mt), (iii) Main Land, consisting of planes, hills and dry river beds (10 to 465 mt), (iv) The Coastline along the Arabian Sea in the south (0 to 12 mt). More loosely, the southern portion of the Rann is considered an island, with seawater inundating the land for most of the year.
In this exercise, we have categories the vegetation type **(Figure no. 8)** into 8 broad categories (Dense thorn forest, Open *Prosopis juliflora*, Dense *Prosopis juliflora*, open scrub, Grass cover, Mangroves, Saline vegetation, and Agricultural crop/ Horticulture) with 5 other land use categories (Waterbody, Mining area, High Saline area, and Mudflat area). Based on the physiographic characteristic vegetation species also varied region to region. In Bhuj taluka Banni region has a large amount of dense *Prosopis juliflora* distribution in such panchayat as mota luna, Luna, southern Hodko, Northern

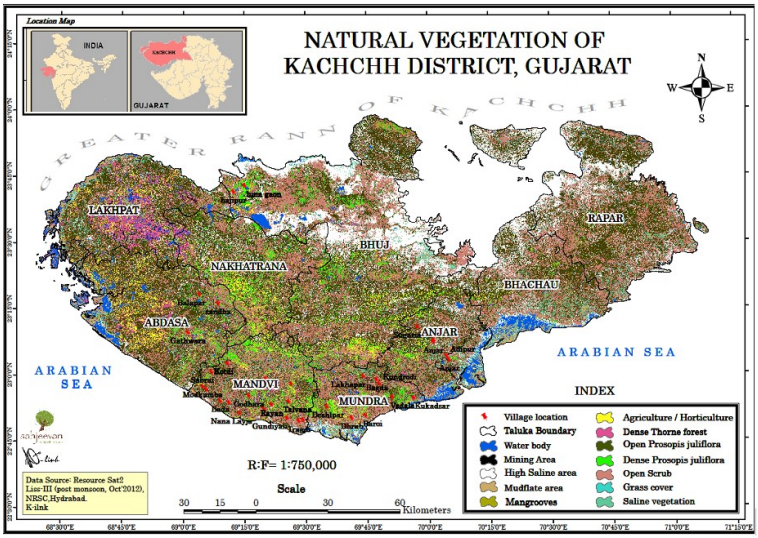


Figure 8: *Natural vegetation map of Kachchh District, Gujarat.*

Shervo, northern Raiyada, and some western part also. In Bachau and Rapar taluka most of the area is covered by the open *Prosopis juliflora* and open scrub due to the physiographic landscape. Only in the Lakhpat taluka has a large area of thorne forest. Another vegetation category found in this region is open *Prosopis* and open scrub rather than in the western part of this taluka has little bit Agricultural / Horticulture activity. Some of the areas are also covered by the Dense *Prosopis juliflora* which is not good for biodiversity conservation because it comes under the invasive species. The southern part of the Kachchh district has found agriculture/horticulture activity largely. In the southwestern part of Mundra taluka, the southeastern part of Mandvi taluka, the southern part of Bhuj taluka, the southwestern and central part of Nakhtrana taluka, southwestern part of Abdasa taluka are very rich in agriculture or horticultural activity. The Eastern and Northern part of Kachchh district is less agricultural activity due to the presence of the Rann area which is very saline.

### 3.2. Preparation of Natural Resource map with 25 km. Buffer zone from the coastline of Kachchh district, Gujarat.

Kachchh district has a huge variety of flora and fauna species and their distribution is also remarkable in the Asian continent. As per the Pastoralist of this region we got the information through focus group discussion that basically they roaming for grazing their camels in and around 25 km from

the coast line of the Arabian sea. So, we had taken the bench mark as 25 km buffer from the coastline to identify the availability of vegetation cover within that buffer zone specially with the help of Resource Sat-2 LISS-III satellite imagery.

In this exercise, we have categories the vegetation type **(Figure no. 9)** into 8 broad categories as Land without scrub, Open *Prosopis juliflora*, Dense *Prosopis juliflora*, open scrub (*Acacia senegal, Acacia nilotica, Euphorbia, Capparis decidua, Salvadora persica*), Dense Mangroves (*Avicennia marina*), Sparse Mangroves (*Salvadora oleoides, Prosopis juliflora, Suaeda sps.*) and Agricultural land and crop/ Horticulture land with 5 other land use categories (Builtup area, Limestone dominated area,

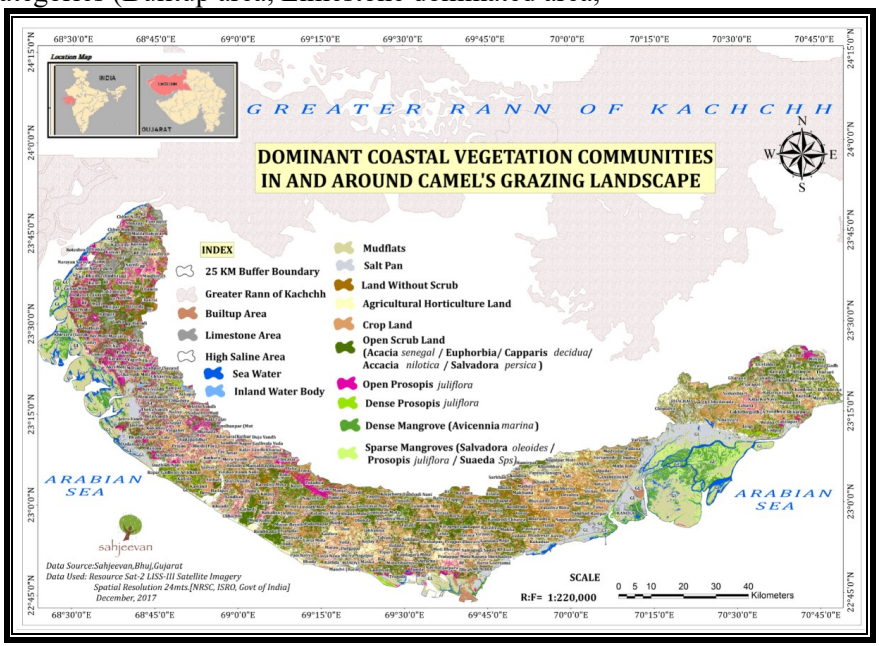


Figure 9: *Natural vegetation map of Kachchh District, Gujarat*

High saline area, inland water body, Salt pan, and Mudflat area). Based on the physiographic characteristic vegetation species also varied region to region. This map is showing the vegetation species distribution along the coastline. There are six clusters **(Figure no. 10)** located within the 25kms buffer zone from the coastline of Kachchi district. They are **(Figure no. 11)** Tundra wandh cluster, Jangi Amliyara cluster, Pipar Jadva cluster, Mohadi cluster, Bhadresar cluster, and Ashari wandh cluster. The cluster-based vegetation map is showing the composition of different types of vegetation species with spatial location.

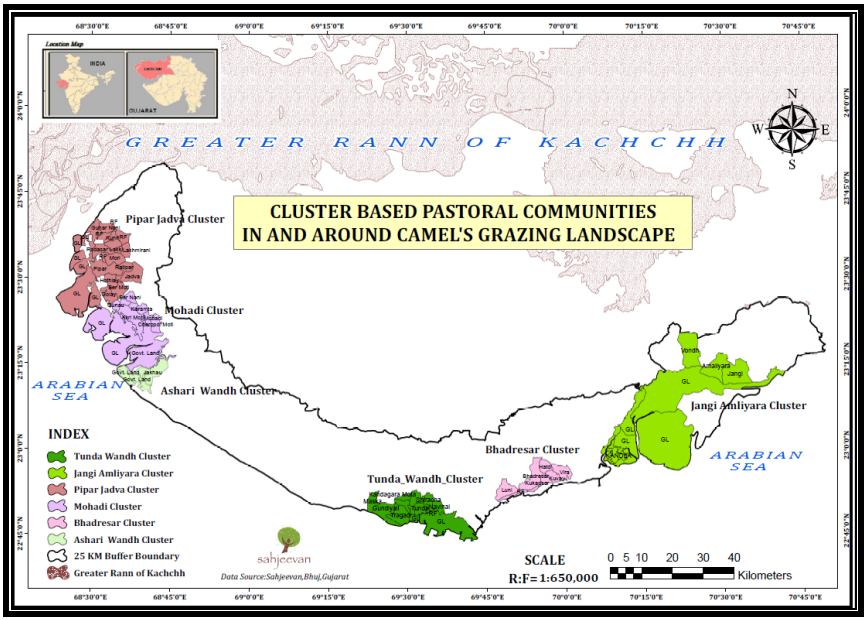


Figure 10: *Different cluster locations within 25 km. Buffer zone from the coastline of Kachchh District, Gujarat*

### 3.3. Preparation of Cluster level Seasonal Grazing Route Map of camel pastoralist with the distribution of available Natural Resources.

Does this exercise have an important value that is according to the summer route find out what type of vegetation is available on their grazing way? From the **(Figure no. 12)** we can easily say the available vegetation type. We can calculate the specific pressure of a cluster on it through how much area it has and How many animal grazing there on a specific season. So in this way, we can show the vegetation distribution and grazing pressure on the summer route through the secondary animal data of a specific cluster.
We had identified their location by phone call and visit their location to collect the information. This may not possible to realize their survival process without staying with them. The Summer season grazing route map is showing the grazing route direction of different cluster in summer season **(Table no. 1)**. There are 11 different cluster named as Balasar (Rapar Taluka), Charidhandh (Bhuj and Nakhtrana Taluka), Jadva (Lakhpat Taluka), Jangi (Bachau Taluka), Jawhar Nagar (Mandvi Taluka), Mohari (Abdasa Taluka), Pachchham (Bhuj Taluka), Pippar (Lakhpat Taluka),

Sanosora (Rapar Taluka), Tundawandh (Manvi, Mundra and Anjar taluka), Vadva Bhopal (Mandvi Taluka).

The winter season grazing route map is showing the grazing routes of in Kachchh region. In this season there are 10 grazing cluster named as Balasar (Rapar Taluka), Charidhandh (Bhuj and Nakhtrana Taluka), Jadva (Lakhpat Taluka), Morgar (Lakhpat Taluka), Jawhar Nagar (Rapar Taluka), Mohari (Abdasa Taluka), Pippar (Lakhpat Taluka), Sanosora (Rapar Taluka), Tundawandh (Manvi, Mundra and Anjar taluka), Vadva Bhopal (Mandvi Taluka).

As per discussion **(Figure no. 13)** with camel maldhari of the Charidhandh cluster we know that how they grazing their animal around the Charidhandh area in the winter season because other maldhari of anther cluster has come for grazing also.

Now to find out which are the common regions for grazing in all three seasons. We must find out the common grazing cluster through GIS mapping. In the map **(Figure no. 12)** you will found the common cluster in all three seasons the camel pastoralists are available. Here in the bellow map overlapping area shows the common cluster and defined the pressure of grazing. As we have seen in the Charidhadh cluster we found more camel pastoralists come for grazing due to available grazing resources. So this cluster has to suffer more pressure on water, grazing vegetations.

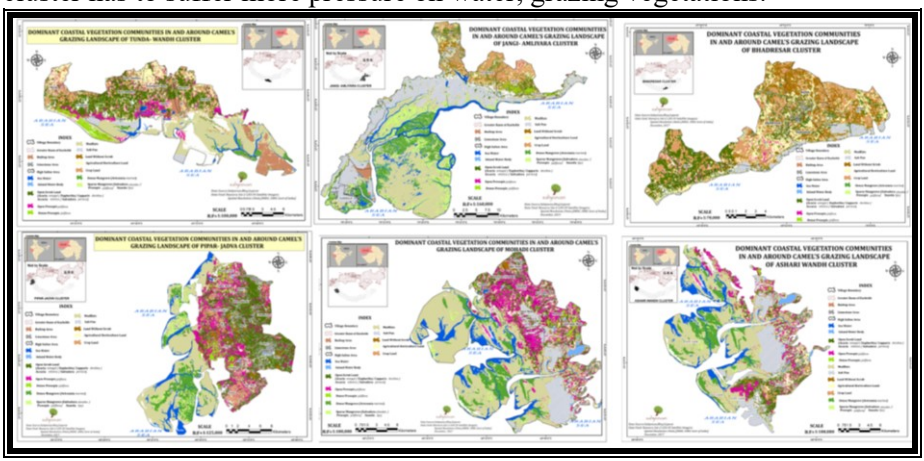

Figure 11: *Vegetation distribution of different clusters within 25 km. Buffer zone from the coastline of Kachchh District, Gujarat*

### 3.4. Proposed plan to develop natural process

The combination of all three season cluster maps **(Figure no. 12 and Table no. 1)** is showing the cluster load of the Kachchh region due to the grazing by camel. From the above map, we found that the Charidhandh cluster has

the maximum load in the overall three seasons. This cluster is for the kachhi camel pastoralist and this region is not suitable for monsoon season except some agricultural places due to the waterlogging. From other cluster's camel

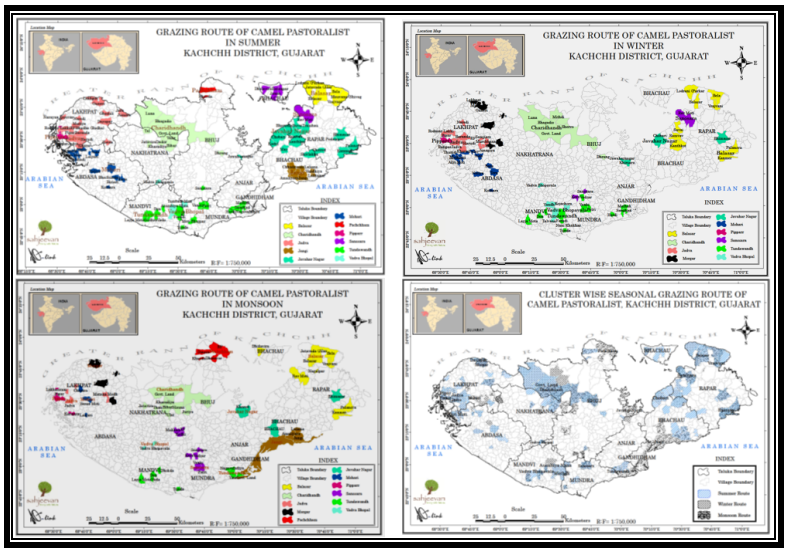


Figure 12: *Grazing routes of Camel Pastoralists in and around Kachchh District.*

Table 1: *Taluka wise seasonal Cluster distribution*

| Name of Taluka | Name of Cluster | | |
|---|---|---|---|
| | Summer | Winter | Monsoon |
| Lakhpat | Pippar, Jadva | Pippar, Jadva, Morgar, Mohari | Pippar, Jadva, Morgar, Mohari |
| Rapar | Balasar, Sanosora | Jawhar Nagar,Balasar, Sanosora | Jawhar Nagar,Balasar |
| Bachau | Jangi | – | Jangi |
| Anjar | Tundawandh | Jawhar Nagar | Jangi |
| Bhuj | Charidhandh, Pachchham | Charidhandh | Charidhandh, Pachchham |
| Nakhatrana | Charidhandh | Charidhandh | Vadva Bhopal, |
| Abdasa | Mohari | Mohari | – |
| Mandvi | Jawhar Nagar, Tundawandh, Vadva Bhopal | Tundawandh, Vadva Bhopal | Tundawandh |
| Mundra | Tundawandh | Tundawandh, Sanosara | Sanosara |
| Gandhidham | Tundawandh | Tundawandh | Jangi |

pastoralists like Jangi,Jadva, Pachchham (in summer & winter) comes for grazing in the Charidhandh cluster. In monsoon season only the Charidhandh

cluster's own Maldhari stay because this area is their residential area. In the Pachchham cluster, only two season grazing is done summer and winter season. There is no other cluster's load. This cluster uses by the Kachchhi camel pastoralist.

Figure 13: *Camel pastoralist in winter grazing site, collection of information through FGD (Focus Group Discussion)*

Other low load clusters **(Table no. 2)** are Jangi, Mohari, Tundawandh, and Jawhar Nagar. These all clusters are using by the Kharai camel pastoralists. Kharai camel pastoralist travel along the coastline area means western Kachchh.

Table 2: *Description of cluster load in all season*

| Name of Cluster | Seasonal Migrant Camel Pastoralist | | | Total Cluster Load |
|---|---|---|---|---|
| | Summer | Winter | Monsoon | |
| Charidhandh (Kachchhi) | Jangi,Charidhadh Jadva,Pachchham | Jangi,Charidhadh Jadva,Pachchham | Charidhadh | 9 |
| Pachchham (Kachchhi) | Pachchham | Nil | Pachchham | 2 |
| Balasar (Kachchhi) | Balasar, Sanosara | Balasar, Sanosara | Balasar | 5 |
| Sanosora (Kachchhi) | Sanosara | Sanosara | Sanosara | 3 |
| Jangi(Kharai) | Jangi, Jawhar Nagar | Nil | Jangi | 3 |
| Mohari (Kharai) | Mohari | Mohari | Mohari | 3 |
| Tundawandh (Kharai) | Tundawandh | Tundawandh | Tundawandh | 3 |
| Jawhar Nagar (Kachchhi) | Jawhar Nagar | Jawhar Nagar | Jawhar Nagar | 3 |
| Morgar (Kachchhi) | Morgar, Jadva | Morgar, Jadva | Morgar, Jadva, Charidhandh | 7 |
| Pippar(Kharai) | Pippar, Jadva | Pippar, Jadva | Pippar, Jadva | 6 |
| Jadva (Kachchhi) | Jadva, Pippar | Jadva, Pippar | Jadva, Pippar | 6 |

Another heavy load cluster is Morgar cluster, here in all-season grass available, here two more cluster's Kachchhi camel pastoralists come for

grazing their camel. The load has given weighted 7 after the Charidhandh cluster (9). Except for this region, one more cluster has been used by the Kachchi camel, Jadva cluster, and in this cluster one more cluster's camel pastoralist comes for grazing their camel. The load has given a weighted 6. On the other way, only one cluster used by the Kachchi and kharai camel pastoralist is Pippar and it has been used by other Kachchhi camel pastoralists as from the Jadva cluster.
This cluster has a weighted of 6 **(Table no. 2)**. Among the entire cluster, this is clear that Charidhandh and Morgar cluster is to be needed more consciousness regarding conservation and management. The other three clusters also needed concentration for conservation and management as Pippar, Jadva, and Balasar.

## 4. CONCLUSION

Participatory conservation management plan defined in this study to manage the seasonal grazing route within the availability of vegetation for the camel pastoralist. This study is impossible without including the pastoral community. We heard from them about their problems during the seasonal grazing and What kind of problem they have faced. They told us that sometimes they do not get fresh drinking water due to the salinity then they have to travel more kilometers for water. Camel pastoralist Community of the Kachchh region travels throughout the year from one cluster to another cluster for grazing their animals. The main objective of this study is to find out the natural vegetation along the seasonal grazing route of the camel. In which cluster what types of vegetation are available. How to manage pastoralists to decrease a load of a specific cluster because there have some common clusters where 3-4 groups of camel pastoralists gather in a cluster in a different season (Summer, Monsoon, and Winter).
So, among all the clusters of this Kachchh region, Charidhandh and Morgar cluster is to be needed more consciousness regarding conservation and management. The other three clusters also needed concentration for conservation and management as Pippar, Jadva, and Balasar.

## 5. ACKNOWLEDGEMENT

We are happy to say that without the cooperation of Sahjeevan and K-Link team members this study will not succeed. The endowment has been provided to purchase satellite imageries and for necessary field visits by the Sahjeevan organization. We are thankful to Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar, and Gujarat Institute of Desert Ecology, Bhuj for their kind support to access their research reports

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# WEIGHING FACTORS IN AN ANALITICAL HIERARCY PROCESS (AHP) FOR DETERMINING POTENTIAL LOCATION FOR DAM CONSTRUCTION IN POGRAXHË IN KOSOVO

**Valon AZIZI**[1] and **Bashkim IDRIZI**[2]

*UDC: 627.8:[519.528.931(497.115)*

## SUMMARY

Nowadays, the collection of geospatial data and analysis through Geographic Information System (GIS) can provide a very valuable analysis which narrows down the most suitable locations for the dam construction. There are no fixed conditions to be used for the Determining of potential location for dam construction. Based on results and solutions presented in many scientific papers, there are some main factors that should be considered in order to obtain the result of analysis in determining the potential location for a dam construction. The number of factors and the priority rank as well are not fixed, and it might change depending on the collected data, study area and priorities that experts recommend to be considered for the analysis. According to Saaty (1977) in analytical hierarchy process (AHP) where in the basis of their significance, factors are weighed and compared to each other. In this case, the result of the analysis will be provided after a multicriteria decision making. An important part of the selected criteria and its priority weight to one another, it is the Determining of random consistency index (RI). According to Saaty (1977) consistency index shows weather the pair wise comparison between criteria used in analysis, are acceptable in AHP.

**Key words**: Criteria, AHP (Analytical Hierarchy Process), GIS, Location, Dam.

## INTRODUCTION

Water is a crucial element for the survival of life on earth (Veldkamp 2017). A dam is a barrier that stops or restricts the flow of water or underground

[1] **MSc. Valon AZIZI**, valon.azizi@uni-pr.edu ,
MSc student in University of Prishtina, Faculty of Civil Engineering,
Address: Feti Vogli, 49, Gjilan, Republic of Kosova . Gsm: + 383 45 669-631

[2] **Assoc.Prof.Dr. Bashkim IDRIZI**, bashkim.idrizi@uni-pr.edu,
University of Prishtina, Faculty of Civil Engineering, Geodesy department.
Address: Str. Djon Kenedi, 25-4/20, 1010 Skopje, North Macedonia.
Gsm: + 389 75 712-998 (*Viber and WhatsApp*), + 383 45 341-098.

streams. Reservoirs created by dams not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability.

A dam is by nature linked to an environment. The morphology of the river valley therefore plays a vital role in the choice of a dam site and the most suitable type of dam (Becue 2002). The selection of Dam site for constructing a dam should be governed by the following factors: Suitable foundation must be available; For economy, the length of the dam should be as small as possible, and for a given height, it should store the maximum volume of water; The general bed level at dam site should preferably be higher than that of the river basin. This will reduce the height of the dam; A suitable site for the spillway should be available in the near vicinity; Materials required for the construction of dam should be easily available, either locally or in the near vicinity; The value of land and property submerged by the proposed dam should be as low as possible; The dam site should be easily accessible, so that it can be economically connected to important towns and cities; and Site for establishing labor colonies and a healthy environment should be available near the site (Selection of Dam Site 2015).

Geographical information system (GIS) and remote sensing techniques appeared as powerful multidisciplinary science which provides easy data access, large area coverage and frequent temporal capabilities for many of its applications in hydrology (Lehmann et al 2014). Generally, dam site selection is conducted by traditional methods, such as conventional decision-making techniques or according to political interests (Jozaghi et al 2018). However, remote sensing (RS), geographic information systems (GIS) and machine learning (ML) techniques are recently emerging as some of the most appropriate approaches to understand dam sites. In recent years, the advancement in satellite and computational power has enhanced the opportunity to manage different hydrologic parameters and terrain characteristics (Al-Ruzouq et al 2019). Applying the geospatial analyses and techniques for modeling with GIS tools, now it is possible efficient displaying of land surface with Digital Elevation Models, TIN models , and shading relief models (Izeiroski et al, 2016). Using GIS approach an attempt has been made to select suitable sites for checkdams for harvesting rain water (Padmavathy et al 1993). Using different spatial analyses with a set of GIS tools in an efficient way are obtained several raster maps with values of slopes (gradients, inclinations) of the land surfaces, raster maps wih aspect-direction values as well as raster maps with shadow analysis of the surface and others (Izeiroski et al, 2016).

This site suitability was evaluated using geospatial technologies using multi criteria as per available ground information for feasibility of the site. All contributing factors such as Topography, Geology, Catchment size,

Precipitation, Distance from roads, Distance from settlements and protected areas, Distance from rivers, and Parcel ownership were studied before selecting a suitable site for the dam, and used in the research based on weigh factors of each criteria related to the case study area characteristics.

## MATERIALS AND METHODS

Weighing the factors that are part of analysis for choosing the most suitable location for the dam construction, shows the importance that each of factors have. 8 factors have been included in this study. By classifying how much each factor weighs, the importance of them is determined because not all of them are of the same importance in determining the most suitable location.
There are a few methods that can be utilized to weigh the factors as part of the analysis. One of the most widely-used methods is comparing factors against one-another, according to the so-called Analytical Hierarchy Process (AHP) compiled by Saaty (1977). Based on their importance, factors are compared against one-another.
The matrix of weights has been set following Njiru and Siriba (2018), where every criteria is compared to another in relation to its importance, on a scale of 1 to 8. The most suitable locations have been ascertained as a result of the sum-up of the criteria. Next, the structure of the Analytical Hierarchy Process has been presented for making the decision for the study area (figure 1).

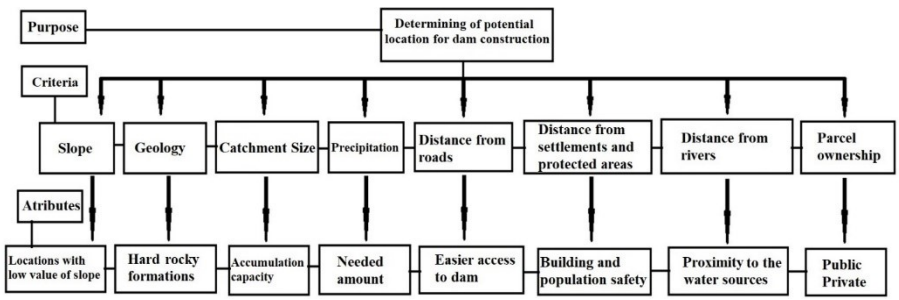


*Figure 1. The structure of the Analytical Hierarchy Process (AHP) for making the decisions for the study area.*

## EVALUATING THE RELATIVE IMPORTANCE OF THE CRITERIA IN RELATION TO ONE-ANOTHER

According to Saaty (1977) in Analytical Hierarchy Process (AHP), determining the importance of the criteria is ascertained trough relating them

against one-another. According to Njiru (2017) the form of listing the criteria and how they are valued is done on a scale of 1 to 8. Value 1 is for factors that share the same importance, whereas value 8 is for the factor that is way more important in comparison to others.

In Table 1 the criteria listed according to their importance they carry have been shown. The scale from 1 to 7 has been presented following Njiru (2017), Al-Adamat (2012) and Law NO. 03/1-039. The land ownership criteria determined by representatives of Ministry of Infrastructure – MI (2019), has been listed number 8, and is linked with the expropriation of properties. The costs of the construction of dams has not been taken into consideration in this paper. Therefore, this factor will be of the least prioritized.

*Table 1: Factors according to the order of importance*

| Factor | Order of importance | Description |
|---|---|---|
| Slope (Topography) | 1 | Slope affects dam safety, thus large slope values increase the danger of landslides, and give a pressure to the dam. |
| Geology | 2 | The harder rocky formations are considered more suitable for the dam construction. |
| Catchment size | 3 | A bigger basin in study area provides a bigger value of water accumulation for the dam. |
| Precipitation | 4 | Large values of precipitation in study area provides a bigger value of water accumulation for the dam. |
| Distance from roads | 5 | Because of economical purposes for easier access to the dam, small distances from roads are considered more suitable. |
| Distance from settlements and protected areas | 6 | Due to safety of settlements and population, distance from dam site should be considered in order to provide safety. |
| Distance from rivers | 7 | Proximity of the rivers is considered economically more suitable. |
| Parcel ownership | 8 | Public parcel ownership in study area, is considered more suitable because of economical purposes. |

## CALCULATION OF THE WEIGHT OF FACTORS IN RATIO WITH ONE - ANOTHER

Having evaluated the factors according to their importance, following Njiru (2018) a comparison has been drawn between each and every factor. The comparison between the factors (table 2) has been done on a scale of 1 to 8 following the matrix of Saaty (1977) so that the weight of every factor can be measured against others.

1 = two factors share the same importance
8 = One factor is way more important than another.

*Table 2: The matrix of the comparison of the factors with one-another*

| **Factor** | Slope (Topography) | Geology | Catchment size | Precipitation | Distance from roads | Distance from settlements and protected areas | Distance from rivers | Parcel ownership |
|---|---|---|---|---|---|---|---|---|
| Slope (Topography) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Geology | 1/2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Catchment size | 1/3 | 1/2 | 1 | 2 | 3 | 4 | 5 | 6 |
| Precipitation | 1/4 | 1/3 | 1/2 | 1 | 2 | 3 | 4 | 5 |
| Distance from roads | 1/5 | 1/4 | 1/3 | 1/2 | 1 | 2 | 3 | 4 |
| Distance from settlements and protected areas | 1/6 | 1/5 | 1/4 | 1/3 | 1/2 | 1 | 2 | 3 |
| Distance from rivers | 1/7 | 1/6 | 1/5 | 1/4 | 1/3 | 1/2 | 1 | 2 |
| Parcel ownership | 1/8 | 1/7 | 1/6 | 1/5 | 1/4 | 1/3 | 1/2 | 1 |
| Total | 3 | 5 | 7 | 11 | 16 | 22 | 29 | 36 |

For evaluating the weights of the factors in relation to one-another the following equation has been utilized following Saaty (1997):

$$Wi = \sum_{j=1}^{n} Pij \,/ (\sum_{i=1}^{n}\sum_{j=1}^{n} Pij) \dots\dots\dots\dots\dots\dots\dots (1)$$

where: *Pij* – is ratio between factors,
*i & j* – is factor, and
W – is primary weight.

Having used the above-mentioned equation for all of the factors, the weights of each factors in relation to one-another has been ascertained. The values of such weights have been presented in the Weights Factors Matrix in table 3:

*Table 3: Weight Factors Matrix*

| **Factor** | Slope (Topography) | Geology | Catchment size | Precipitation | Distance from roads | Distance from settlements and protected areas | Distance from rivers | Parcel ownership | **Primary Weight W** |
|---|---|---|---|---|---|---|---|---|---|
| Slope (Topography) | 0.368 | 0.435 | 0.403 | 0.355 | 0.311 | 0.275 | 0.246 | 0.222 | **0.327** |
| Geology | 0.184 | 0.218 | 0.268 | 0.266 | 0.249 | 0.229 | 0.211 | 0.194 | **0.227** |
| Catchment size | 0.123 | 0.109 | 0.134 | 0.177 | 0.187 | 0.183 | 0.175 | 0.167 | **0.157** |
| Precipitation | 0.092 | 0.073 | 0.067 | 0.089 | 0.124 | 0.137 | 0.140 | 0.139 | **0.108** |
| Distance from roads | 0.074 | 0.054 | 0.045 | 0.044 | 0.062 | 0.092 | 0.105 | 0.111 | **0.073** |
| Distance from settlements and protected areas | 0.061 | 0.044 | 0.034 | 0.030 | 0.031 | 0.046 | 0.070 | 0.083 | **0.050** |
| Distance from rivers | 0.053 | 0.036 | 0.027 | 0.022 | 0.021 | 0.023 | 0.035 | 0.056 | **0.034** |
| Parcel ownership | 0.046 | 0.031 | 0.022 | 0.018 | 0.016 | 0.015 | 0.018 | 0.028 | **0.024** |
| **Total** | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | **1.000** |

The consistency of the factors in relation to one-another as part of this analysis will be evaluated following the equation of consistency ratio calculation (Saaty 1977). There will be an evaluation of the relation of Consistency Index CI and Random Index RI (table 4) for the eight above-mentioned factors. The value of CR is compared to 0.1 and this is the maximum CR value for the acceptable pair-wise comparison (Saaty 1977)

*Table 4: Values for random index*

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

Equation of Consistency ratio: CR = CI/RI .....(2)

where: *CI* = (λmax – n) / n-1

*n* – is number of factors in this analysis = 8

*λmax* – is the sum of the multiplication between each primary vector elements (*Total* column in table 3 and *primary weight* column W ).

Having calculated the CI value **(0.06)** and the given value RI (1.41) from table 4, the consistency ratio CR is **0.04**. The calculated value is below the maximum acceptable value **(0.1)**, and in light of the Analytical Hierarchy Process (AHP), which means that the consistency among the factors used in this analysis is acceptable.

## STANDARDIZATION PROCESS OF THE PRIORITIZED FEATURES OF THE GIVEN FACTOR

According to Njiru (2018), after selecting the features for the analysis and the evaluation of the weights in relation to one-another, it is necessary to perform data reclassification according to the feature priority. It is necessary due to the selected features can contain data that is regarded as primary as well as data that is not regarded as primary and as such not necessary to achieve at the desirable results as part of the geospatial analysis.
The data reclassification as part of this paper is based on literature that illustrates the opinions of the experts of relevant fields accordingly in regards to every factor used in the analysis, as well as the legislation in force in the Republic of Kosovo.

Values from 1 to 5 will be used for the reclassification of data for one feature according to priority order (Njiru et al 2018). Number 5 will be for data with the highest influence, whereas number 1 for data with the lowest influence. This has been done through the ArcMAP software, using the Reclassify option for each feature.

The reclassification of data of the Slope was performed on a scale of 5, and according to Njiru et al (2018) the surfaces with the lowest value of slope are considered as the most suitable areas. That is so because the pressure against the dam is lower and that the construction is cheaper. Thus, low value of slopes are regarded as highly suitable and primary. For example, the terrain slopes with the value 0-9% have been given the number five value. On the other hand, the high value of slopes is 1 and is considered to be unsuitable.

The reclassification of data on the feature of geological layers according to Rusi (2016) mainly relies on the permeability, density and hardness of rock formations. According to Njiru (2017) layers with rock formations that are high in hardness and density will be considered very suitable for reasons of stability for dam construction, with the maximum value of 5. On the other hand, other formations that are softer, which are considered unsuitable, are given the minimum value of 1.

The data reclassification regarding the feature of the catchment area according to Njiru (2017) relies on its size. The larger the catchment area and the more catchment flow it contains, the more suitable it is. That is because this means that the accumulative quantities that will be collected in the reservoir will be larger and thus are given the value of 5. Conversely, smaller-size-catchment areas are given the minimum value of 1 accordingly.

The reclassification of precipitation data according to Al-Adamat et al (2012) is based on the amount of rainfall within the study area. Heavy precipitation areas are considered more suitable as they increase the amount of water in the study area. Therefore, they are given a value of 5. Contrastingly, light precipitation areas are treated as unsuitable and will be evaluated with a value of 1.

Reclassification of data for the settlements feature according to Njiru, F.M. et al. (2018) as well as Law NO. 03 / l-039 protected areas, relies on the distance of settlements and protected areas from the dam site. Taking into consideration the distance for safety reasons, to the appropriate distances will be given a value of 5, whereas to unsuitable distances will be given a value 1.

Reclassification of data for the river feature according to Njiru et al (2018) relies on the proximity of the rivers to the dam site. According to this, a short distance between rivers and planned dam sites are considered as suitable because of economical purposes, to which will be given a value of 5, whereas large distances are considered unsuitable with value 1.

Last is data reclassification of landownership to cadastral parcels. According to the presentation organized by the municipality of Gjilan (2019), the representatives of MI stated that lands of public ownership are very suitable. It was also stated that there is no need for expropriation for these parcels, this way making the lands of public ownership be given a value of 5, whereas private ownership parcels are considered moderately suitable with value of 3. In the following tables are presented the above - mentioned features and reclassification of factors, according to their importance on a scale from 1 to 5: *1 - Not at all suitable, 2 - Slightly suitable, 3 - Moderately suitable, 4 - Suitable, 5 - Very suitable*.

*Table 5: Reclassification of Features According to their Importance*

| Slope (%) | Value |
|---|---|
| 0 – 9 | 5 |
| 9.1 – 16 | 4 |
| 16.1 – 25 | 3 |
| 25.1 – 40 | 2 |
| > 40 | 1 |

| Catchment size ( km²) | Value |
|---|---|
| >2 km | 5 |
| 1.03 – 1.86 | 4 |
| 0.726 – 1.02 | 3 |
| 0.451 – 0.725 | 2 |
| 0.02 - 0.45 | 1 |

| Distance from roads (m) | Value |
|---|---|
| 0- 1000 | 5 |
| 1001-2000 | 4 |
| 2001-3000 | 3 |
| 3001-4000 | 2 |
| >4000 | 1 |

| Distance from rivers (m) | Value |
|---|---|
| 0-500 | 5 |
| 501-1000 | 4 |
| 1001-1500 | 3 |
| 1501-2000 | 2 |
| >2000 | 1 |

| Geology (layers) | Value |
|---|---|
| Amphibolite formations | 5 |
| Quartz formations | 4 |
| Marble and Limestone | 3 |
| / | / |
| / | / |

| Precipitation (mm) | Value |
|---|---|
| >879 | 5 |
| 879- 725 | 4 |
| 724 – 682 | 3 |
| 682 – 600 | 2 |
| 600 < | 1 |

| Distance from settlements and protected areas (m) | Value |
|---|---|
| 3001-4000 | 5 |
| 2001-3000 | 4 |
| 1001-2000 | 3 |
| 500-1000 | 2 |
| 500 < | 1 |

| Parcel ownership | Value |
|---|---|
| Public property | 5 |
| Private property | 3 |
| / | / |
| / | / |

For each classification value from 1 to 5, the representation of the classified features is done with the mapping method in 5 layers of different colors where:

- red represents the extreme minimum value of 1, which is considered unsuitable,
- the orange color represents value 2, which is considered slightly suitable,
- yellow represents value 3, which is considered moderately suitable,
- the light green color represents value 4, which is considered suitable, and
- green represents the maximum value 5 which is considered very suitable.

The following figure shows the reclassification of features according to the above-mentioned values related to the table 5, conducted with the Reclassify option within the ArcMAP software.

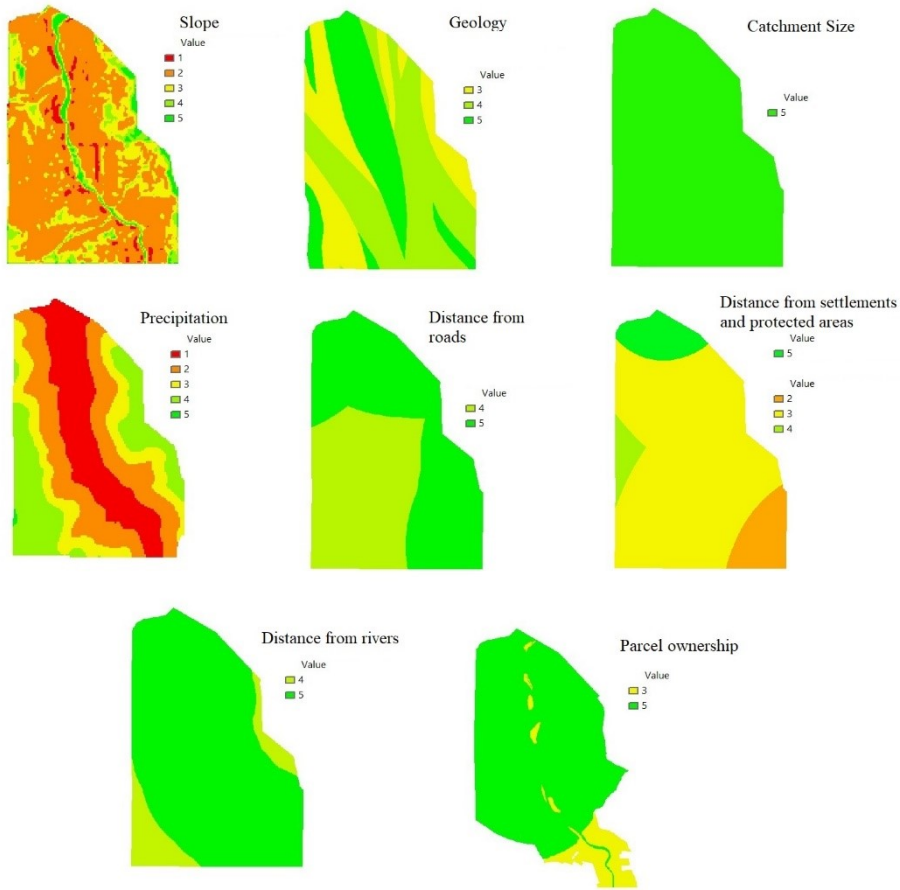


*Figure 2. Reclassification of data according to value of importance*

## ANALYSIS OF THE SUITABILITY OF THE STUDY AREA BY THE WEIGHT OF FACTORS

To create the map of the study area and to analyze the suitability of this area, the primary weights of the -W factors calculated in the matrix of the weights of the factors in table 3 will be used, incorporated in the ArcMAP software for each feature, and expressed in percentage.

*Table 6: Matrix of the primary weight W of factors*

| Factor | Weight W (AHP) | ( %) |
|---|---|---|
| Slope (Topography) | **0.327** | **33** |
| Geology | **0.227** | **23** |
| Catchment size | **0.157** | **16** |
| Precipitation | **0.108** | **11** |
| Distance from roads | **0.073** | **7** |
| Distance from settlements and protected areas | **0.050** | **5** |
| Distance from rivers | **0.034** | **3** |
| Parcel ownership | **0.024** | **2** |

For each reclassified feature according to the values of importance, through the tool of ArcMAP " Weighted Overlay" , the values of primary weight were used, and as result of their impact, the suitability map of the study area was obtained.

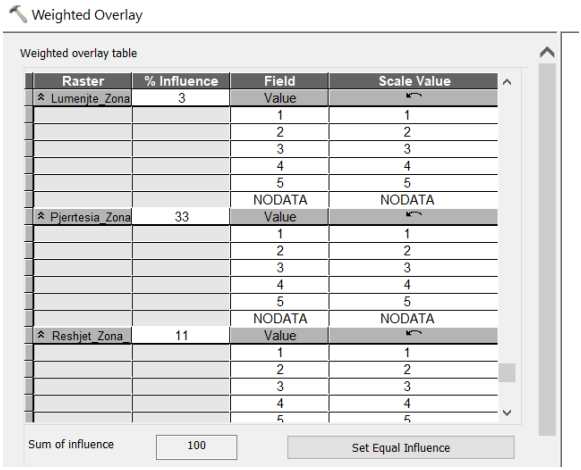


*Figure 3. Analysis of suitability of study area according to the weight of factors*

## RESULTS AND CONCLUSIONS

As a final result of the process of the Analytical Hierarchy Process, and the weighing of the factors used in this process, the layers of features were placed according to their weights and the map of the study area was obtained according to their suitability.

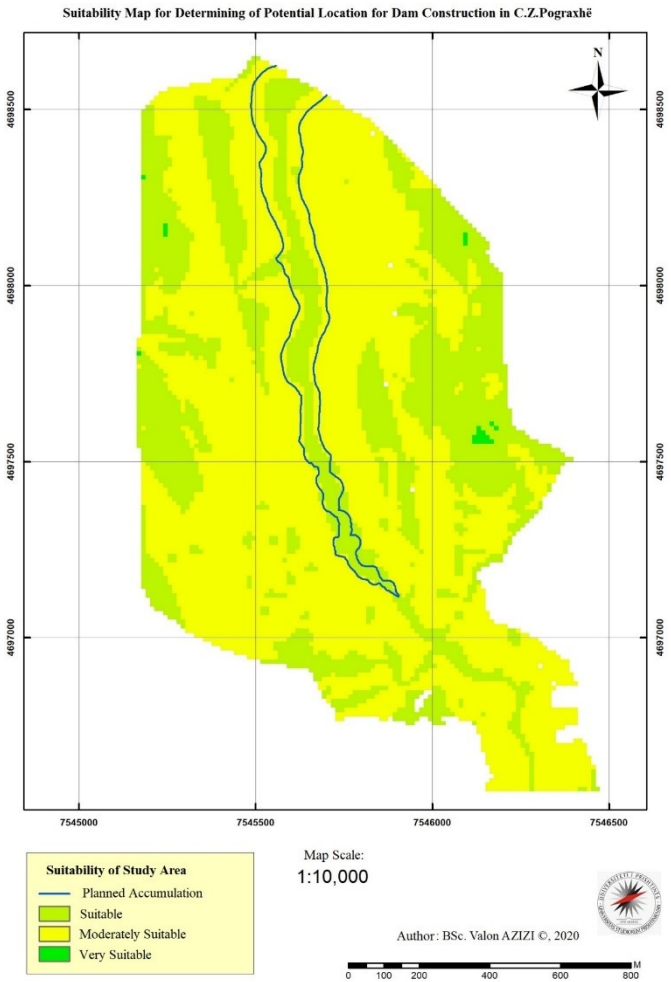


*Figure 4. Suitability map of the study area for dam site selection.*

The purpose of this paper was identifying the suitability of the study area in order to select the most optimum location for the construction of the dam. This

was achieved by utilizing the geospatial analysis using GIS software, based on the Analytical Hierarchy Process (AHP). The weight of deceive factors that are taken into account in doing the analysis and drawing the results.

Results shows that the geospatial analysis done by the GIS software based on PHA, is quite efficient in achieving the results. Research output shows that most of the study area is considered suitable for the construction of the dam, thus answering the research questions posed at the beginning of this paper.

Nonetheless, there are no fixed criteria and no specific factors for selection of the most suitable locations for the dams. Factors that have been considered are those which have been recommended by various local experts and those which have been used more in the literature and the scientific articles which gave this analysis effectiveness and scientific basis in achieving the necessary results. Defined criteria in paper can be used by applying them in various projects aimed for researching suitable areas for the construction of dams.

In addition to the results and conclusions of this paper, it is worth noting that there can be a need to extend and complement such geospatial analysis in the future. The following recommendations would go for any future researches:

- In the Analytical Hierarchy Process implemented as part of the geospatial analysis using ArcGIS software, there are no fixed criteria that are defined to achieve the necessary results in determining the most suitable locations for dam construction. Therefore, in the future, researchers could develop a specific sequence that could clearly define the criteria and weights that would be used in the context of a geospatial analysis for this purpose. Other criteria could also be incorporated, as factors of a certain weights.

- The accuracy of the collected source data has to be defined by a priory accuracy analyses, since it directly affects to the accuracy of the achieved results and the final product of the suitability map of the study area.

- A more thorough geostatistical analysis could be achieved if researchers could extract sufficient data from field studies for each of the factors used in the analysis. That data has to be provided by experts in core fields that would participate in a more detailed analysis of a research area, which would be considered potentially suitable for setting up dams.

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# MAPPING THREE DECADES WATER CHANGES IN NORTH MACEDONIA USING REMOTE SENSING DATA

**Gordana KAPLAN**[1]

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## SUMMARY

As the essence of life, water is one of the most important substances on Earth. In the last few decades, the aquatic ecosystem, has been faced with serious challenges due to overuse of water and negative effects of climate change. Thus, water monitoring is essential for water management. In the last few decades, remote sensing and Geographic Information Systems (GIS) has rapidly expanded and evolved as one of the most important tools and technologies in Earth Observation (EO) studies. This paper investigates three decades' water changes in North Macedonia using remote sensing data. For that purpose, Landsat data from five periods during 1988-2019 were used for mapping the water bodies on national level. The water bodies have been classified using Object-Based Image Analyses (OBIA), as well as indices for water bodies extraction, such as Normalized Difference Water Index (NDWI). The results present the water changes on national level from 1988 to 2019 in the summer period in North Macedonia. Although there has been a rise in the water area after 2000 due to dam construction, there has been decrease in the water areas from 2014 -2019. For future studies, more detailed investigation for critical parts of the study area can be applied.

**Key words**: Water, Remote Sensing, Mapping, Geographic Information.

## INTRODUCTION

Monitoring water bodies is an important part of water resource management. However, monitoring the changes and qualities of water bodies may consume significant time and resources. Surface water is one of the most vital Earth resources undergoing changes in time and space as a con-sequence of land use/land cover changes, climate change, and other environmental factors.

[1] **Gordana KAPLAN**, kaplangorde@gmail.com, Institute of Earth and Space Sciences, Eskisehir Technical University, Turkey,
Address: 2 Eylul Campus, 25555 Eskisehir, Turkey, Tel. +90 536 697 5605.

Remote sensing, as a fast growing science in every field, has been widely used for water monitoring (Shao et al., 2019). Also, remote sensing data may be the only source of providing spatially distributed data at multiple scales and on a consistent and timely basis. Remote sensing instruments and techniques provide information for soil and water studies related to ecosystem sustainability, drought mitigation, water balance, and water quality and land use and land cover changes (Feng et al., 2019). Optical remote sensing imagery like Landsat have been used for water bodies monitoring. Landsat legacy has been widely used as a source of data. Starting from 1984, Landsat 5 has been the longest-operating satellite that stopped working in 2011 and has provided many satellite images today used for time-series researchers.
Researchers used Normalized Difference Water Index (NDWI) and other indices for water area changes. NDWI can also be used for calculating loss of water areas. The drought problem caused by climate change has made it necessary to ensure the effective management of water resources.
Combining Landsat imagery with Object-based Image Analysis, and NDWI, in this paper we investigate a three-decade changes on a national level in the Republic of North Macedonia. For this purpose, four Landsat satellite images from four different periods have been used. Starting from 1988, using one of the most historic satellite image over North Macedonia, we compare the water areas from 2000, 2014, and most recently, 2019.

## STUDY AREA AND METODS

The Republic of North Macedonia is a landlocked country in the middle of the Balkan Peninsula in Southeast Europe (Figure 1). It covers area of 2,571,300 ha, and shares its boundaries with Serbia, Kosovo, Albania, Bulgaria, and Greece. North Macedonia has approximately 2.1 million inhabitants. Located in the north part of the country, Skopje is the capital with more than 800.000 inhabitants.
The geography of the country is defined by a central valley formed by the river Vardar framed with Shar and Osogovo Mountains. Mount Korab at 2,764 m is the tallest mountain in North Macedonia. Although landlocked, North Macedonia is rich with natural water bodies. Approximately 2% of the total area of the country is covered with water. There are about 35 rivers flowing into the Aegean, Adriatic, and the Black Sea, 53 natural and artificial lakes of which the biggest three are internationally-shared water bodies (Dimitrovska et al., 2012). Vardar, with 388 km length, is the largest river in the country (301 km belongs to North Macedonia). The Vardar basin comprises two-thirds of the territory of North Macedonia, and it plays an integral part in the country's economy and development.

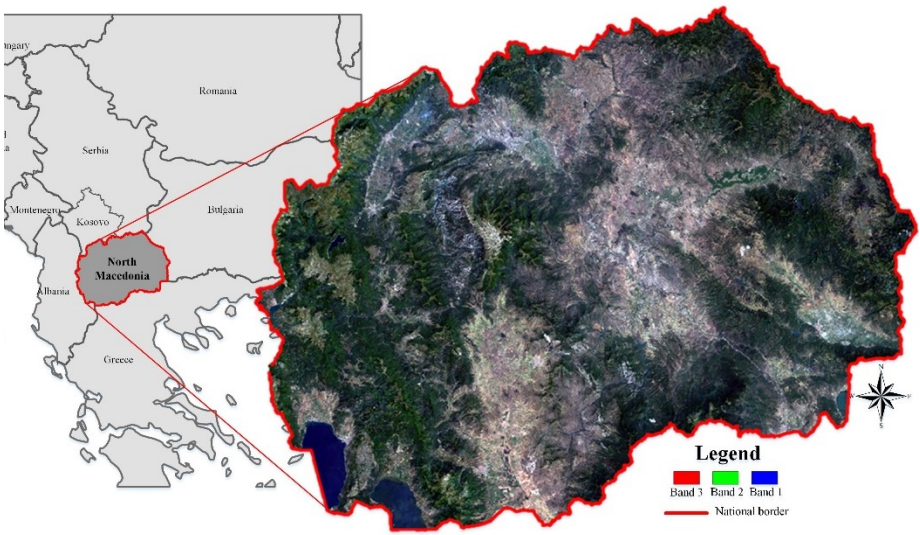


*Figure 1: Republic of North Macedonia; Landsat imagery (RGB - 321)*

The main aim of this study is to map the water bodies over the territory of North Macedonia in five different periods from satellite imagery. For that purpose, two Landsat 5 and two Landsat 8 images have been used in this study.

Landsat 5 and Landsat 8 are part of the Landsat program, the longest-running enterprise for acquisition of satellite imagery of Earth. The Landsat imagery, archived in the United States and at Landsat receiving stations around the world, are a unique resource for global change research and applications in agriculture (Yin et al., 2018, Yin et al., 2020), cartography (Meneghini and Parente, 2017), geology (Amri et al., 2017), forestry (Matcı and Avdan, 2020), regional planning, surveillance and education, and can be freely downloaded from the 'EarthExplorer' website. Spectral and spatial details about the used imagery are given in Table 1.

*Table 1: Landsat imagery details*

| Landsat 5 TM Bands (µm) | | Landsat 8 OLI Bands (µm) | |
|---|---|---|---|
| | | 30 m Coastal/Aerosol 0.435 – 0.451 | Band 1 |
| Band 1 | 30 m Blue 0.45 – 0.52 | 30 m Blue 0.452 – 0.512 | Band 2 |
| Band 2 | 30 m Green 0.530 – 0.610 | 30 m Green 0.533 – 0.590 | Band 3 |
| Band 3 | 30 m Red 0.630 – 0.690 | 30 m Red 0.636 – 0.673 | Band 4 |
| Band 4 | 30 m NIR 0.780 – 0.900 | 30 m NIR 0.851 – 0.879 | Band 5 |
| Band 5 | 30 m SWIR-1 1.550 – 1.750 | 30 m SWIR-1 1.566 – 1.651 | Band 6 |
| Band 6 | 100 m TIR-1 10.40 – 12.50 | 100 m TIR-1 10.60 – 11.19 | Band 10 |
| | | 100 m TIR-2 11.50 – 12.51 | Band 11 |
| Band 7 | 30 m SWIR – 2 2.090 – 2.350 | 30 m SWIR – 2 2.107 – 2.294 | Band 7 |
| | | 15 m Pan 0.503 – 0.676 | Band 8 |
| | | 30 m Cirrus 1.363 – 1.384 | Band 9 |

Total of four images have been used in this study. In the period of 1988 – 2019, two Landsat 5 (1988 and 2000), and two Landsat 8 images (2014 and 2019) have been downloaded and pre-processed for water bodies classification. OBIA has been used for classifying the water bodies from the Landsat imagery. In comparison with pixel-based classification, object-based classification classifies the image based on objects instead of pixels. Its application in the remote sensing field started a decade ago (Makinde et al., 2016). Even though this technique has been generally used for high and very high-resolution imagery, it has also been successfully applied in middle-resolution imagery. In comparison with the traditional pixel-based classification technique, several studies have reported the superiority of object-based image classification (Kaplan and Avdan, 2017, Esetlili et al., 2018). First and one of the most important steps of an OBIA is the

segmentation. Segmentation is the process in which the objects are built. With segmentation, the image is decomposed in many relatively homogenous image objects, or segments (Jensen, 1996). multiresolution segmentation has been successfully used in segmenting middle-resolution satellite images (Benz et al., 2004). This technique starts building a one-pixel object and then grows by merging objects based on the given criteria (Yan et al., 2006). The criteria parameters used in this study are given in Table 2.

*Table 2: Mutli-resolution segmentation parameters*

| **Segmentation Setting** | |
|---|---|
| Image Layer weights | 1 |
| Scale Parameter | 60 |
| **Composition of homogeneity criterion** | |
| Shape | 0.5 |
| Compactness | 0.5 |

After the segmentation, a threshold value to the water index NDWI has been applied in order to separate the object containing water from the other land covers. The NDWI formulation has been given below.

$$NDWI = \frac{Green - NIR}{Green + NIR}$$

With a single value threshold, two classes have been assigned, water and other. For the two classes, accuracy assessment has been made.

## RESULTS AND DISSCUSION

In order to achieve the spatio-temporal monitoring of surface water dynamics over North Macedonia, in this study, remote sensing data and techniques have been used. The visual results of the analyses are presented in Figure 2. As it can be seen, even the smallest water bodies that can be detected with middle-resolution satellite imagery, have been extracted successfully. Since North Macedonia is small and landlocked country, huge water changes over small periods of time cannot be expected. Thus, the biggest difference in the results, can be noticed between 2000 and 2014, when the Kozjak Dam or the multipurpose hydropower plant of Kozjak has been filled with water in the

period between 2003 – 2004. The total reservoir volume is 550 million $m^3$ (Jovanovska et al., 2016).

The statistical analyses are presented in Figure 3. The visual inspection of the results showed that the developed model extracted the water bodies with high accuracy. According to the statistical analysis, there is positive correlation between the water changes and the time period. However, although it may seem as the water changes have positive correlation over the years on national level, there are many studies in the literature indicating local water losses in several parts of the country.

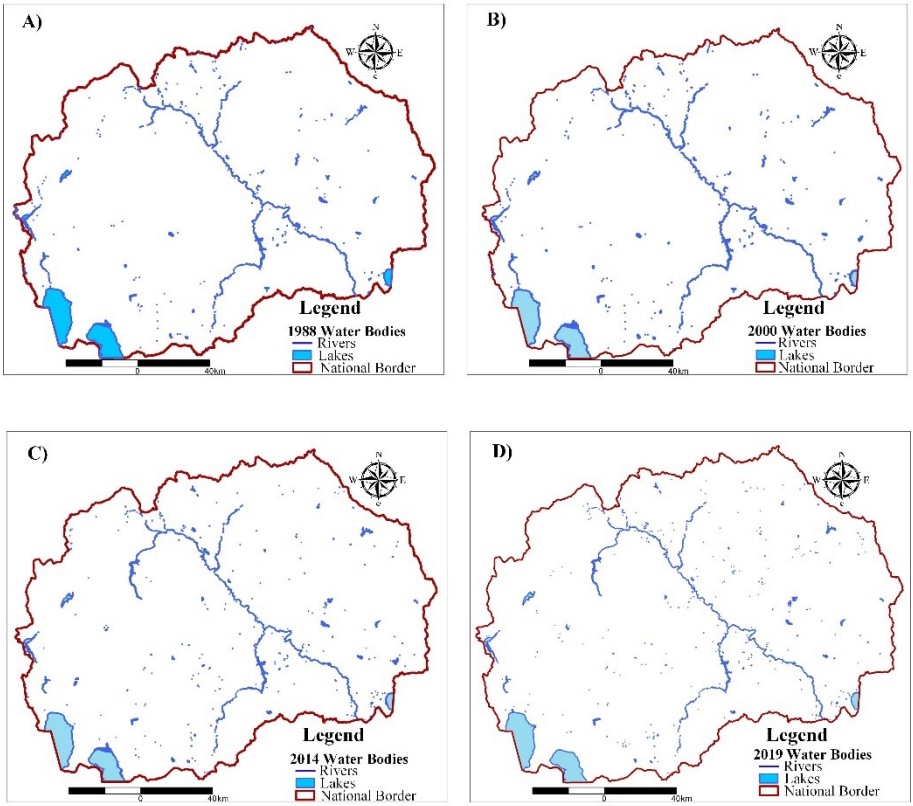


*Figure 2: Results; Water bodies in North Macedonia; A) 1988; B) 2000; C) 2014; D) 2019*

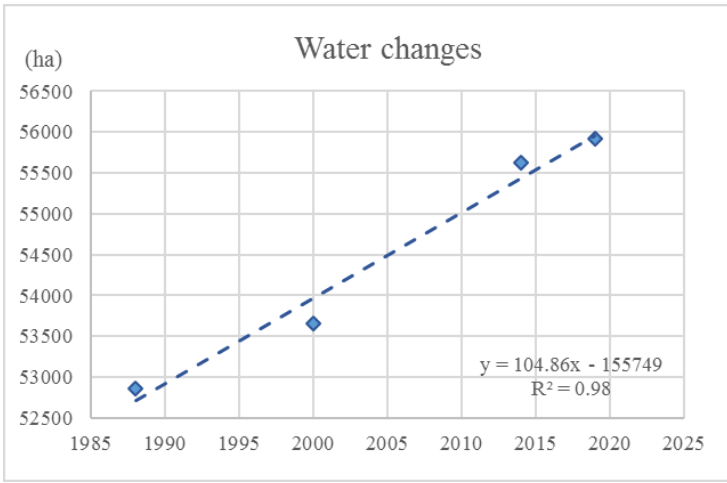


*Figure 3. Water area changes over the years.*

Kaplan et al. (KAPLAN et al., 2020) investigated the changes in Dojran Lake, and concluded that the lake was at its lowest point in 2002, when slowly, with the support of several projects, gained its old water area in recent years. Another study investigated the changes in the second largest lake in North Macedonia, Prespa Lake (Kaplan, 2020). Also, it should be mentioned that with higher resolution, even more detailed analyses can be made, and smaller water bodies can be detected. However, Landsat's resolution, a middle-spatial resolution, is enough in order to investigate the water changes on national level. As a result of the accuracy assessment made in this study, the accuracy of the water class is higher than 90%. Taking in consideration the full area of North Macedonia, and the water area in 2019, it can be concluded that the water area is covering approximately 2.2% of the country.

## CONCLUSIONS

This paper investigates the three-decade water changes on national level in Republic of North Macedonia from 1988 – 2019 using satellite imagery. Four satellite images from four different periods have been used in this study. To the authors knowledge, this is the first study investigating the water changes in North Macedonia using historical satellite imagery as early as 1988. Also, this is the first study that gives clear image about the water cover on national level using remote sensing data. According to the results, on national level, there has been slight rise in the water areas over the years. The main reason for this is the dam construction opened in 2003-2004. The presented results can be of great significances as remote sensed images are a unique source for

monitoring the water body changes. This kind of monitoring can be useful in cases where there is not enough available data on the water level changes, and on national level where data collection can be very challenging. For more accurate mapping of the water bodies, in future studies, Sentinel-2 imagery can be considered for the years after 2015.

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# IMPACT OF THE COVID 19 PANDEMIC ON THE GLOBAL REAL ESTATE MARKET

**Bashkim NUREDINI**[1]

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## ABSTRACT

This paper addresses the effects and impact of the global pandemic caused by COVID-19 on the real estate global market, by presenting the data from the trend of real estate cycles in different countries of the world. All predictions were that after several years of growth across all segments of the real estate market, 2020 was anticipated to confirm this trend. Nevertheless, since late December 2019, a new type of Coronavirus began to spread across the world from China. In February and March 2020, most of the European countries were hit by the pandemic and were forced to impose restrictive measures on their economies and the free movement of citizens. Along the economy, the residential real estate market has also been affected. Undoubtedly, the pandemic caused has a massive impact on financial markets and the economy worldwide. Many investors, property owners, potential home buyers and landlords are therefore asking themselves: Is the Coronavirus crisis also affecting the real estate market? Are the property prices rising or falling?

**Key words**: COVID-19, real estate, commercial real estate, investment, value added.

## INTRODUCTION

Real estate involves the land along with any permanent improvements attached to the land, whether natural or man-made – including water, trees, minerals, buildings, homes, fences, and bridges. Real estate is a form of real property (Chen, 2020). It differs from personal property, which are the things not permanently attached to the land, such as vehicles, boats, jewelry, furniture, and farm equipment. In understanding the real estate, people often use the terms land, real estate, and real property interchangeably, but there are some subtle distinctions between them. The land itself refers to the earth's

[1] **PhD. Bashkim NUREDINI**, bashkim.nuredini@ubt-uni.net,
University for Business and Technology UBT, Law Faculty,
10000 Prishtina, Kosovo

surface down to the center of the earth and upward to the airspace above, including the trees, minerals, and water, while real estate is the land, plus any permanent man-made additions, such as houses and other buildings. By definition, real property implied one of the two main classifications of property such as the interests, benefits and rights inherent in the ownership of real estate.

Broadly speaking, real estate includes the physical surface of the land, what lies above and underneath it, what is permanently attached to it, plus all the rights of ownership, including the right to possess, sell, lease, and enjoy the land. The real property should not be confused with personal property, which encompasses all property that does not fit the definition. The primary characteristic of personal property is that it is movable. Examples include vehicles, boats, furniture, clothing, and smartphones.

The global outbreak of the COVID-19 affects the real estate market in many ways. The managers and owners are concerned how to maintain the value from dropping while facing increased requirements by the government measures to keep the premises safe and clean, including the tenants residing in them. As the phenomenon is ongoing, potential impacts and consequences are difficult to be measured and foreseen, because, the COVID-19 outbreak was an unpredictable event. The pandemics by limiting the movement and visitors has also blocked tourism in many countries, thus decreasing the interest of the buyers/sellers for potential transactions in resorts and related real estate. In this way, the pandemics is not a problem of health but also of many other sectors and professions such as, housing, investment, settlements, and it has disrupted almost all economic sectors and even the system (Nicola et a., 2020).

Apart from what is actually in place as real estate, construction has also slowed down out of the fear that the prices of future real estate may fall as it is not yet known how long the pandemics will last and what its potential consequences are likely to be. However, it is possible to track the initial impact which this paper aims at discussing by focusing on the real estate market. The rest of the paper is organized as follows. After introduction, subsection one outlines the physical characteristics of real estate with a reference to immobility, indestructibility, and uniqueness. Subsection two discusses economic characteristics which are more diversified than physical ones. Types of real estate are elaborated in subsection three. Section two outlines the methods used. Commercial real estate is analyzed in section three, while the section four focuses on investing in commercial real estate through direct and indirect investment. Section five deals with the resulting economic recession of the COVID-19 and its comparison with the 2008-2010 financial crisis where the first is likely to have more harmful effects than the latter which already has gone (Strauss-Kahn, 2020).

**Physical Characteristics of Real Estate**

Land has three physical characteristics that differentiate it from other assets in the economy:
i) Immobility. While some parts of land are removable and the topography can be altered, the geographic location of any parcel of land can never be changed. While the buildings and other structures and assets can be altered, removed or even destroyed, land is immobile and cannot its geographic location. Because of this fixed characteristic, the land is often named simply as immovable property. It use is subject to governmental rules and regulations, which among others, may include long terms lease, e.g. for 99 years.
ii) Indestructibility. Land is durable and indestructible (permanent). This is defined by the area in which it lies, regardless what activities are undertaken above and underneath. In this respect, land as real property is mainly identified by the zone or location. Its value may be determined by time and activities. Sometimes the land may be depreciated while in other times appreciated.
Uniqueness. No two parcels of land can be exactly the same. Even though they may share similarities, every parcel differs geographically. The rest may have a variety of differences, beginning with the zones (urban or rural), type (soil, rocky or hill terrain), use (own or rent), and so on.

**Economic Characteristics of Real Estate**

Land also has some distinct economic characteristics that influence its value as an investment:
- Scarcity: While land isn't considered rare, the total supply is fixed. Land may only become more valuable to meet the demand of raising population and urbanization.
- Improvements: Any additions or changes to the land or a building that affects the property's value is called an improvement. Improvements of a private nature (such as homes and fences) are referred to as improvements on the land. Improvements of a public nature (e.g., sidewalks and sewer systems) are called improvements to the land.
- Permanence of investment: Once land is improved, the total capital and labor used to build the improvement represent a sizable fixed investment. Even though a building can be razed, improvements like drainage, electricity, water, and sewer systems tend to be permanent because they can't be removed (or replaced) economically.
- Location or area preference. Location refers to people's choices and tastes regarding a given area, based on factors like convenience, reputation,

and history. Location is one of the most important economic characteristics of land (thus the saying, "location, location, location!").

1.3.1. Types of Real Estates

The literature on property rights distinguishes five main types of real estate: 1) Residential real estate: Any property that used for residential purposes. Examples include single-family homes, condos, cooperatives, duplexes, townhouses, and multifamily residences with fewer than five individual units. 2) Commercial real estate: Any property used exclusively for business purposes, such as apartment complexes, gas stations, grocery stores, hospitals, hotels, offices, parking facilities, restaurants, shopping centers, stores, and theaters. 3) Industrial real estate: Any property used for manufacturing, production, distribution, storage, and research and development. Examples include factories, power plants, and warehouses. 4) Land: Includes undeveloped property, vacant land, and agricultural land (farms, orchards, ranches, and timberland). 5) Special purpose: Property used by the public, such as cemeteries, government buildings, libraries, parks, places of worship, and schools (Chen, 2020).

Real estate can have advantages and disadvantages. Among others, Garay (2016) lists five advantages and three disadvantages. The first five include the potentials to: i) offer absolute returns, ii) hedge against unexpected inflation, iii) provide diversification against stocks and bonds, iv) provide steady cash inflows, and iv) provide income tax advantages. The three disadvantages are relate to i) heterogeneity, or as described earlier in terms of land, it can be unique by location, use, destination or design, ii) lumpiness, which can constrain investors from creating an optimal portfolio, and iii) illiquidity, or lowering of opportunity to sell it at fair market prices.

One of the major features of all types of real estate is its destination or allocation. Thus the real estate is also heterogeneous by the role it serves such as, construction of office buildings, housing apartments, business premises, renting, etc. This also dictates the benefits to be derived from such an allocation. It has also an impact on potential sale and transactions.

## MATERIALS AND METHODS

The methodology used in this study, consists of data provided on macroeconomic changes and the real estate sector as secondary data were used to provide the basis for analysis and generalization of the prevailing situation. Due to the prevailing situation, during the pandemic, which prevents the smooth conduct of physical surveys in many countries and also including, the assessment and data collection has been carried out mainly based on review reports published by relevant institutions by the real estate market,

publications and news in the mainstream media, as well as all other publications attributed to the impact and effects of the global pandemic on the real estate market and sector.

Commercial real estate (CRE) is property that is used exclusively for business-related purposes or to provide a workspace rather than as a living space, which would instead constitute residential real estate. Most often, commercial real estate is leased to tenants to conduct income-generating activities. This broad category of real estate can include everything from a single storefront to a huge shopping center.

CRE includes several categories, such as retailers of all kinds, office space, hotels and resorts, shopping malls, restaurants, and healthcare facilities. Compared to housing real estate, RCE is more volatile to life cycle arising from the competition between businesses. Prices for CRE rise and fall more quickly that for housing real estate (Glaeser and Gyourko, 2006). CRE also bears more risk if economic activity continues to decline. Commercial property prices in the market experience boom and bust depending on circumstances. This is in part because lenders or investors are more interested in the CRE in order to be more able to generate expected benefits or returns. In determining the value or price of one (housing) versus CRE, supply and demand play a decisive role, but the latter (CRE) is more appreciated or depreciated in short to medium term.

## RESULTS

Experience proves that, commercial real estate investing has been rich with benefits, providing millions of investors with attractive risk-adjusted returns (Fundrise. 2020). As an alternative asset class, it also has a track record of providing powerful portfolio diversification. Because the success of a particular commercial real estate asset is tied to the trends or behaviors of its surrounding local market, a smart commercial real estate investment can be a great way for you to grow your investment along with the local and broader economies.

Investing in commercial real estate can be lucrative and serve as a hedge against the volatility of the stock market. Investors can make money through property appreciation when they sell, but most returns come from tenant rents. There is no limit in the CRE market, but the difference with housing is that transactions in the CRE are made by professional investors who know the potential of generating benefits, or the risk of failure (Gyourko, 2009). The investment in CRE can be direct and indirect.

When we talk about direct investment, we are referring to investments in which investors can use direct investment where they become property owners through the ownership of physical property. People best suited for direct investment in commercial real estate are those who either have a considerable amount of knowledge about the industry or who can employ firms who do. Commercial properties are a high-risk, high-reward real estate investment. Such an investor is likely to be a high-net-worth individual since CRE investing requires a considerable amount of capital.

The ideal property is in an area with low CRE supply and high demand which will give favorable rental rates. The strength of the area's local economy also affects the value of the CRE purchase. Direct investment also involves buying a portion or stake in CRE, which also sets conditions for expected benefits or share in profit. Another source can be debt investing, which implies the loan that is given as a collateral by real estate.

An indirect investment can be the purchase of a property, plant, units in a company or shares without the need to buy the property itself (Chen, 2020). This type of investment is about where investors may invest in the commercial market indirectly through the ownership of various market securities such as Real Estate Investment Trusts (REITs), exchange-traded funds (ETFs) that invest in commercial property-related stocks, or by investing in companies that cater to the commercial real estate market, such as banks and realtors. The risk through indirect investment may be smaller and this often may pave the way for making direct investment or buying the whole property or the real estate.

The ongoing threat of COVID-19 has taken the real estate sector into crisis, a crisis which continues. Much of the work has switched to digitalization and online business, to avoid the risk posed by the pandemics. But that does resolve many segments in the market of real estate without physical contact, transactions, visit, inspection and access to. It is considered a much worse crisis than the global financial crisis of 2008-2010. While during financial crisis the problem was with the lack of money or liquidity, during the COVID-19 the problem is with the real sector where, the money can be available, but many goods and services may not due to restrictions imposed as a defense from the pandemics. And this does again affect the financial sector by reducing the cash flow, returns, and this is reflected across the value chain. Figure below shows how the market for real estate was affected from the beginning of 2019 until March 13, 2020 when national emergency was declared in the US, the until mid-April 2020 or within six weeks.

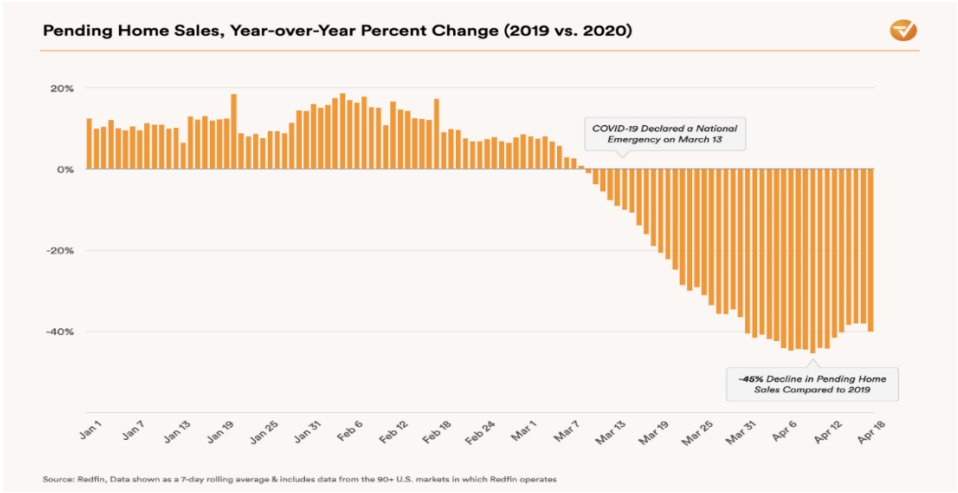


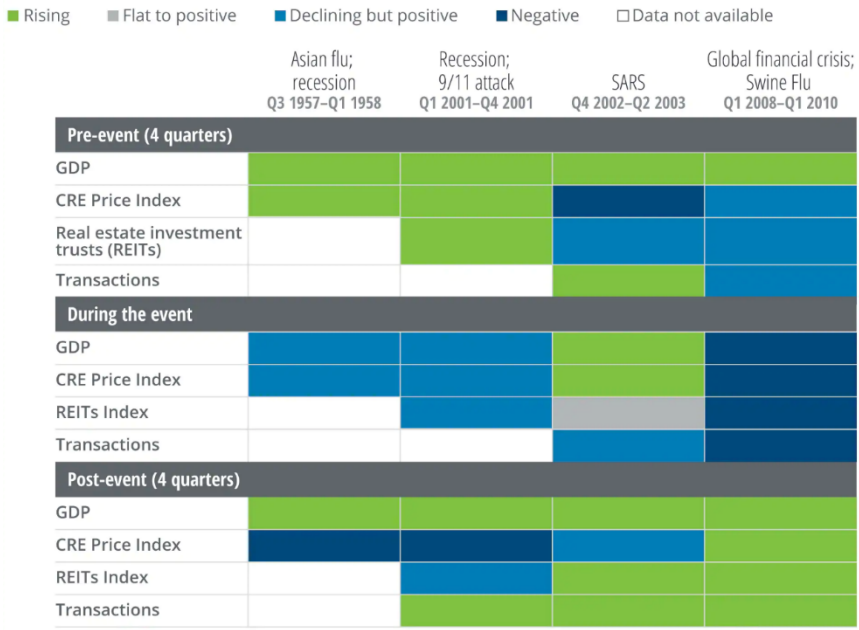

*Figure 1. Growth and decline in the home sales in the US, January 01, 2019 – April 18, 2020 (Taken from Wedlake 2020)*

Within the first month of declaring the national emergency, the sales have dropped by 45% from the base or zero. Otherwise, the fall was even greater compared to 2019 when the average increase was around 10%. This is a much worse situation of housing bubble burst that gave rise to global financial crisis more than a decade earlier. The U.S. commercial property market took a big hit during the 2008-2009 recession, but it has experienced annual gains since 2010. These gains have helped recover nearly all recession-era losses.

There will be minimal appreciation in values, but income returns should remain healthy. However, other indicators suggest the commercial property market has peaked in the post-recession growth cycle. According to California real estate firm, Ten-X Growth, commercial property pricing ended 2018 up just 1% from 2017. A Ten-X report noted that the 2018 final total for commercial properties confirms their view of the late economic cycle pricing. The firm's research found that vacancies are rising, rent growth is slowing, and market interest rates are on the rise. As reported by Forbes, the retail sector, in particular, has proved a pain point in the broader commercial property market, as widespread store closures intensified in 2017 and continued into 2018. For example, popular mall REIT Westfield Corporation saw their stock price shed about 30% between mid-2016 and late 2017 before reversing some losses through January 2018. Unibail-Rodamco SE acquired Westfield for US$15.8 billion, creating Unibail-Rodamco-Westfield (URW) (Berry, 2020). Most firms, however, maintain that the property market remains healthy overall. J.P. Morgan, in its "2019 Commercial Real Estate Outlook," largely echoed CBRE's view stating that 2018 was the ninth year of

increases in commercial property rents and valuations. Morgan predicts this pace will slow but continue and do not see a downturn until after 2019 (Jones Lang LaSalle, 2020). Note that the COVID-19 pandemic, so far, has not really caused real estate value to drop substantially, and property values have remained steady or even have risen, much like the stock market through the Fall of 2020. This is a key difference between the economic fallout occurring in 2020 and what happened a decade earlier.

*Table 1: The impact of previous pandemics and economic downturns in commercial real estate*




Sources: Federal Reserve Bank of St. Louis, "Real Gross Domestic Product," and "Interest Rates and Price Indexes; Commercial Real Estate Price Index, Level," accessed April 2020; Nareit, "FTSE Nareit U.S. Real Estate Index," accessed April 16, 2020; Deloitte Center for Financial Services analysis.

In previous crisis and recessions such as the one in 1957-8 (Asian flu), then September 11, 2001 terrorist attacks, SARS chicken flu in 2002-3 and global financial crisis 2008-10, the GDP growth continued to be positive before the recession taking place. The CRE Price Index was negative before the chicken flu and declining in 2008-10 but positive. When the event of chicken flu came into effect, it lowered the GDP, CRE Price Index and REITs Index in two periods (1957-8 and 2001), recovered in 2002-3, but experienced negative growth during global financial crisis. The CRE Price Index in post events of Asian flu and 2001 was negative, declining but still positive after SARS and

growing once the financial crisis was overs. Although global financial crisis was associated with the swine flu, it never had the effect on real property neither before nor after the event like in the current COVID-19 crisis as shown in Figure 1. That is why the COVID-19, as can be noticed by the comparison of indicators in Figure 1 and Table 1, has far more negative effects than all previous crisis and recessions, including the trends of GDP. It is worth noting that, the economy of Eurozone is forecasted to decline by 6.3%. The downturn will be the deepest in countries that were severely hit by the pandemic – Italy where decline by 9.1% is expected and Spain with expected decline by 8.0%. The German economy, the biggest trading partner of the Czech economy, is forecasted to decline by 7.0% (Skolimowski and Look, 2020). This by no doubt will affect the real estate cycle and prices. Here too, like in the US, the negative impact and consequences of COVID-19 so far have been greater, and likely to continue.

## DISCUSSIONS

The COVID-19 pandemics has already hit the real estate market on a global scale. The quick loss of jobs has been unprecedented since the 2008-2010 global financial crisis. The explanation in aggregate terms is simple: the sudden lock of the countries in the spring 2020 has disrupted a wholesale chain of economic activities, especially the international trade and the peoples' mobility. Despite eased measures undertaken by many countries, the crisis is not over yet and continues to hit hard many sectors like in a domino effect. Real estate transactions continue to be hampered by, among others, the requirement to restrict travel and keep a distance in live negotiations.

Within a matter of weeks, people have been limited to a physical space, and this has created a crisis in real estate, because, the longer the crisis continues, there will be less interest in looking for buying of additional real estate. Lower prices may also not be an incentive indicator to buy. If a business is already constrained in using its premises at fuller capacities than before anti-COVID-19 measures were introduced (and many continue to remain still in force), then it is more likely to buy less additional space. That is in aggregate terms and exceptions do apply.

The economy of Eurozone has been growing for 6 years since 2012–2013 Eurozone Sovereign Debt Crisis. However, this economic boom has been terminated by COVID-19 pandemic that has spread from China to the entire World. Europe was one of the worst hit region, especially countries Italy and Spain. To combat the pandemic severe lockdown (restriction of movement) of economies had to be imposed. The resulting economic recession will be even deeper than 2008–2010 Financial Crisis. Services are hit to greater extent by

lockdown than manufacturing which is evident from developments of purchasing managers' indices.

The rest of large and medium large economies are also expected to witness a decline in the interest, invest and purchase of real estate. In Turkey, one of the world's largest attraction, the COVID-19 outbreak on real estate development is described as an unforeseen event with negative effects in the real estate existing sector, costs estimates, values and rates of return in general, especially by travel bans and restrictions on domestic and foreign tourists, thus causing a decline in revenues, lowering of the volume of transactions, increase in operating costs, decrease of rent collection and investment value also tends to decline (Tanrivermis, 2020).

From the indicators presented, it can be noticed that the crisis in different periods to some extent experience a similar pattern in different categories such as GDP, CRE Price Index, REITs and Transactions before, during, and after the events, with some notable differences. In general, GDP kept growing except during 2008-10 when it went negative, along with CRE, REIT and transactions, but recovered to positive growth. The problem with the COVID-19 is that the crisis is present and cannot be predicted how long it will last, therefore, its pattern is not yet known. While we know how the indicators referred to fared before the crisis, we are missing the period "during the event" because it is incomplete or not yet over, and we cannot even predict a post event because the phenomenon is unique.

To sum this section up, the impact of COVID-19 so far has been more severe than one could anticipate, most likely because it was a phenomenon with a new virus never seen or experienced before. Consequently, it caused a panic on a global scale by locking many people inside the residential premises and closed many businesses. The negative effects were immediate also in the real estate sector by declining prices and fall in investment due to restrictions imposed on the movement of people and capital. Although easing measures by the governments are underway, the risk still persists and this is likely to continue affecting the real estate worldwide.

## CONCLUSIONS

This paper found that the outbreak of COVID-19 pandemics in March 2020 is unique event never seen or experienced before by the scale it affected almost all human activities on a global scale, the real estate market in particular. The sudden closure of the borders between the countries directly affected the international trade and national economies. Furthermore, the great panic forced most countries to impose strict rules of blocking the people inside their residential areas for a certain period of time, and this move negatively affected

not only the economy, but also the peoples' life. The consequences remain to be estimated for the years to come. Although the impact of the pandemics in the economy is multi-dimensional or affecting all of its sectors, this paper sought to discuss the implications on real estate, which so far proved to have negative impacts. The immediate impact of restrictions in the movement of people and businesses was reflected in the fall of purchases and investment in the real estate sector. Despite that the pandemic may be brought under control soon by potential invention of the vaccines, it has already scared both people and businesses who in the near future may be reluctant to either buy new premises and buildings or invest in new one, because, in case of restrictions like the one in the Spring 2020 and being locked, they might think that the rest of their real estate is not worth apart from the one where they are located. In this way, by all accounts, the COVID-19 pandemics is a far greater crisis than the global financial crisis of 2008-2010. During the financial crisis, the problem was with the money, and when it got resolved, the economy continued through a positive moderate economic growth. But in COVID-19 era, the harmful effect is far greater and more complicated as the battle rages on and the vaccine has not yet been invested. In such a situation, the real estate sector is heavily affected, and its future prospect is to depend on battling the consequences which brought about this situation, i.e. a solution to the COVID-19 pandemics. That is also when future research should be focused on. As long as there is an uncertainty how long the negative impact of the pandemics will continue, the attention at this point should be focused on monitoring the measurements of the indicators such as prices and transactions in the real estate market in the ongoing pandemic, so we would have more consolidated data for the period "during" and "after" the event which are missing in this paper as the COVID-19 pandemics continues.

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# URBAN LIFE AND SOCIAL PROBLEMS IN KOSOVO

**Besim GOLLOPENI**[1]

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## SUMMARY

After 1999, population movements from rural to urban settlements and from small towns to large cities increased, and thus urban life began to dynamise. This increase in urban population was expressed as a result of urban industrialisation and the destruction of many houses in rural areas as a result of the recent war (1999) in Kosovo, poor conditions of rural infrastructure, and the search for a better life in cities. At this time, the demands of Kosovar society for housing and business were great, while Kosovo had not yet consolidated the relevant institutions (just emerged from the war) that would design and implement urban development policies and strategies in relation to the demands of society; therefore, the urban population increased, and, at the same time, social–urban problems increased too. Through the method of analysis — comparison and interview (N = 13) with professionals in the urban field — the study reflects the (demographic) urban growth, the advantages of urban life, and the social–urban problems manifested at the beginning of the 21st century.

**Key words**: urbanization, rural, urban, social–urban problems, uncontrolled.

## INTRODUCTION

Looking at history, city planning in Kosovo dates back to the period after the Second World War, but in practice it does not have significant results. During the 1970s, both in developed countries and in Kosovo, strong socio-economic and political changes took place, which influenced the development of cities. The industrialisation and urbanisation of urban centres made the migration of the population from rural to urban areas bring rapid changes in urban development in many countries of the world, while in Kosovo, these changes with special emphasis have occurred in the last two decades, after 1999. The change in population structure has led to two types of internal migration: migration from rural to urban areas and from peripheral areas (small towns) to large cities, especially in the capital of Kosovo, Prishtina (Gollopeni, 2016a;

[1] **Prof. Ass. Dr. Besim GOLLOPENI**, besim.gollopeni@gmail.com,
University of Mitrovica 'Isa Boletini', Republic of Kosovo.

2016b). Many people left the village to get a quality education, find a job, and have a better life in the city. The towns were constantly growing as the villages were depopulated (Gollopeni, 2015).

Urbanisation is a complex process of change of rural lifestyles into urban ones. It showed an almost exponential growth since the end of the 19th century (Bryant et al., 1982; Antrop, 2000; Champion, 2001; Pacione, 2001; Antrop, 2004). Urbanisation and development of urban life in Kosovo with all their pace and dimensions are new, despite the fact that some cities have a relatively long history and tradition. Until the 20th century, particularly after the Second World War, Kosovo accounted for about 15% of the total urbanised population. After this period, life began to be dynamic in all its dimensions, and the urban population was constantly growing. The number of cities increased from 5 (1948) to 30 by the end of the 1980s, and among them there were mixed cities, which were neither village nor city. After 2000, with the decentralisation process, 8 cities were added in Kosovo, and today there are a total of 38 cities/municipalities and 1,466 rural settlements (villages). As a result of population movements, political changes, and lifestyle, the need arose for modifications in the field of spatial/urban planning. In Europe, due to the urgent need to manage changes in planning concepts and strategies, modifications are constantly made. The most important turning point is the awareness that spatial planning is not simply related to the physical division of land for different uses, but that it is a spatial manifestation of the model of economic, social, cultural, and environmental development of society (MESP, 2002).

Kosovo's institutions have been unprepared since 1999 for the socio-economic developments accompanied by uncontrolled migration of the population from rural areas to urban areas. Trends in urban development in Kosovo are not favourable even today. Cities are characterised by major problems, with numerous illegal constructions that have caused problems in infrastructure, loss of agricultural land, unbalanced development, and social problems, which have made life difficult for citizens. In the first decade of the 21st century, every Kosovar citizen who had the opportunity to build did so, without following the law or obtaining permission from the responsible institutions. Due to the high demand for housing and business facilities, especially in large urban centres, construction has taken place in various urban areas, without urban plans (permits) and often accompanied by corrupt acts. Citizens and institutional officials who were obliged to enforce the law were afraid of illegal builders. On the one hand, citizens did not have the courage to denounce illegal builders, and on the other, they did not feel it their responsibility to do so while the institutions responsible for stopping illegal constructions were afraid to confront illegal builders or were their collaborators. Moreover, this situation had gone so far as to kill public

officials, such as the case of the murder of architect Rexhep Lucit, Director of Planning, Urbanism and Construction of the Municipality of Prishtina (2000), who with professional and intellectual potential made efforts to implement laws and urban plans to stop the urban degradation of Prishtina. This situation and others have made people (citizens and state officials) silent out of fear and distrusting of justice institutions, thus causing cities to degrade and socio-urban problems to increase.

Since 2003, with the support of the international community, Kosovo has made symbolic progress in the field of spatial/urban planning, central and local institutions have been established, and laws, plans, and spatial strategies have been drafted, but despite these achievements, in the absence of implementation of law and urban plans, social–urban problems continue to be evident. It is true that life in the city has advantages over life in the countryside; however, during the transitional period that Kosovo was going through, this time did not pass without antagonisms between people from the city and those who migrated from the countryside.

To give a clear picture of the situation, this study aims to present the (demographic) urban growth, the advantages of urban life, and the social–urban problems manifested at the beginning of the 21st century.

## TRENDS (DYNAMICS) OF URBANISATION

Urbanisation is a process whereby populations move from rural to urban areas, enabling cities and towns to grow. It can also be termed as the progressive increase of the number of people living in towns and cities. It is highly influenced by the notion that cities and towns have made better economic, political, and social advancements compared to rural areas (Conserve Energy Future, 2020).

Urbanisation is a social, economic, political, and cultural process, which takes place in a certain time segment. The process of urbanisation varies from country to country, influenced by the different social, political, economic, and cultural conditions of that society. Based on the history of the most developed cities in the world, in Western countries, industrialisation, economic developments (division of labour, professionalism, change of social actions, change of social structure), and population growth are the main elements that have developed Western urbanisation. In Eastern countries, the developments and effects of the economy, education, and civilization have influenced the development of these cities (Likaj, 2013).

Harvey emphasises that urbanisation is an aspect of the created environment caused by the spread of industrial capitalism. In traditional societies, the city had obvious differences from the village. In the modern world, industry blurs

the divide between town and country. Agriculture is mechanised and run simply on the principles of price and profit. Like work in industry, this process also weakens differences in the ways of social life between people in urban and rural areas (Giddens, 2002). Like Harvey, Castells emphasises that the spatial form of a society is closely related to the overall mechanism of its development. Sociologists and anthropologists link urbanisation to human behaviour and the relationships between them. Wirth (1938) says that not only the population makes it an urban place; the influence that urban areas exert on the social life of the people is more important. According to Wirth, it is difficult for the population to define a place as urban. Especially where population density is used, as suggested by Wilcix (1926), it would be meaningless in an urban definition. Mayer (1964) argues that it is the individual that constitutes urban life. Fischer's (1975) idea, on the other hand, differs from that of Wirth's; according to him, urban areas have density, as residents are heterogeneous.

Until the second half of the last century, Kosovo was underdeveloped. The late incorporation of the elements of the capitalist economy, the lack of economic development of the territory, the colonial position of the country, the concentration in the agrarian sector, etc., made for specific urbanisation. This situation began to change in the second half of the last century, with late industrialization, economic development, and advancement in the education and health systems, along with other socio-economic and political advancements in the country. During this period, with the expansion of the municipal system, demographic inflows into cities began. After the establishment of the first public university of Kosovo in Prishtina (1970) and other important institutions, Prishtina began to become more attractive to the population from rural settlements and small urban centres throughout Kosovo, as well as for people from Preshevo, Medvegja, Bujanovc, Northern Macedonia, and other areas inhabited by Albanians.

Urbanisation in Kosovo started in the 1960s, when large urban centres began to extend to small urban centres that were previously rural settlements with a central position, which later received the status of municipal centres. Significant developments in the demographic growth of cities took place until the late 1980s, when there was stagnation due to political developments in the country.

In 1953 the urban population of Kosovo accounted for 15.5% of the total population, in 1981 32.4%, and in 1991 (estimate) about 36%. In the period of 1953–1981, the urban population increased by 388,300 inhabitants or 306.9%, and in the period of 1953–1991, around 600,000 inhabitants or around 480%. In 2011, the urban population in Kosovo accounted for about 40% of the total population (Islami, 2008).

*Table 1: Level of urbanisation in Kosovo in the period 1948–2011*

| Year | 1948 | 1953 | 1961 | 1971 | 1981 | 1991 | 2011 |
|---|---|---|---|---|---|---|---|
| % of urban population | 9.7 | 15.5 | 19.5 | 26.9 | 32.5 | 37 | 38.3 |

Source: For the years 1948–1981, population censuses; for 1991 estimation (Pushka, "Porast stanovništva kosovskih gradova", Stanovnišvo, no. 3-4 / 1990 - 1-2 / 1991, Belgrade, CDI, IDN, p. 181; for 2011, KAS population censuses.

The degree of urbanisation in the seven regional centres of Kosovo, according to the censuses of 1981, 1991 (estimation), and 2011, did not make significant differences, with the exception of Prishtina, which leaves behind other urban centres. But in the first decade of the 21st century, all regional centres of Kosovo recorded urban demographic growth of about 10%–20%. According to our estimates, about half of Kosovo's population lives in urban areas, which is approximately the average of the global population and neighbouring countries in the region.

*Table 2: Urban population in Kosovo and some countries in the region, 2011*

| Country | Urban population | % of total |
|---|---|---|
| Kosovo | 661,586 | 38.3 |
| Albania | 1,747,593 | 53.25 |
| North Macedonia | 1,212,740 | 57.09 |
| Serbia | 3,907,243 | 55.22 |

**Source:** For Kosovo, Kosovo Agency of Statistics (2011); for Albania, North Macedonia, and Serbia, href = 'https: //www.macrotrends.net/countries/MKD/north-macedonia/urban-population'> North Macedonia Urban Population 1960-2020 </a>. www.macrotrends.net. [Accessed 19 Aug. 2020].

Globally, more people live in urban areas (55%) than in rural areas. In 1800, 3.2% of the population lived in cities, in 1850 about 6%, in 1900 about 12%, and in 1950 29.8% (increase of 10 times), while in 1995 45% of the world population lived in cities (Pushka, et al. 2000). Developed countries have reached a high level of urbanisation (over 70%) and now have small urban population growth. By 2050, 68% of the world's population is projected to be urban (UNDESA - PD, 2019). According to our estimates and forecasts, by 2050, about 60%–70% of the total population of Kosovo is projected to be urban.

## RESEARCH METHODS

In this research, 13 semi-structured interviews were conducted, with an interview duration of about an hour and a half, with professionals in the field who were researchers or have engaged in drafting projects/urban plans and development policies in the last two decades in Kosovo. The age of the respondents varied from 29 to 60 years old. Of the total number of respondents, nine were male and four female. The interviews were conducted in Albanian. In order to understand as many of the interviewees as possible, we conducted free conversations so that the interviews would be cheaper and more tiring, and at all times notes were kept that were then selected and systematised as needed. Each interview has an identification code (P1–P13).

*Table 3: Descriptive data on the sample of respondents*

| Number of respondents | Total 13 |
|---|---|
| Gender | Male 69%<br>Female 31% |
| Average age of respondents | 47.3 years |
| Average years of experience | 14 years |
| Education level | University studies 45%<br>Master studies 41%<br>PhD studies 9%<br>Other 5% |

We do not claim that this small sample is statistically representative, but based on the experiences of the interviewees, the involvement of key experts at the national level, and personal experience and research in this field, we can come to conclusions.

## RESULTS AND DISCUSION: URBAN LIFE AND ANTAGONISMS

The process of urbanisation in Kosovar society is in a dynamic form, because it is still very anomic for all groups and social stratifications, for both migrant groups and the early inhabitants of the city. Rural–urban migrations have led to a breakdown of socio-demographic homogeneity and the creation of new socio-professional structures and special regional-demographic types. In the process of this transformation, it was possible to observe an increasingly small

percentage of the agricultural population with the transition to non-agricultural activities through professional mobility and schooling of new generations, but also directly, without professional and educational training (Islami, 2008). "Urban migrations, in addition to the transformations they have brought, have led to the clash of rural and urban cultures" (49-year-old female, P13). Many families migrating from the countryside to the city brought with them their traditional rural culture through the elements of living; large family communities; the way of organisation and functioning of their homes; the fencing of high-walled yards; the construction of accompanying structures that in most cases served as warehouses, garages, fire houses, or stables; drying clothes by placing them through the wires of balconies, etc. In such situations, the city or city life resembles a 'ruralism'. Some cities in terms of level of urbanisation and functioning resembled a village. The average number of members per household in Kosovo is 5.8, in urban areas 5.1, and in rural areas 6.4 (KAS, 2013). Although the culture of life in the city differs from that in the countryside, it nevertheless has its own similarities, when it is known that we are dealing with cities - mixed towns neither village nor city. According to Durkheim and Merton, these social complexities form anomic urbanisation. Anomic urbanisation is formed as a consequence of norm loss (Durkheim defines norm loss as normless) and irregularity (according to Merton). The social structure undergoes a significant transformation in itself. The anomic situation is formed by changes in the social and cultural structure of city life, and the incompatibility of these two structures forms what Merton calls irregularities in the city structure, which is also reflected in the process of urbanisation (Likaj, 2013).

What makes the urban way of life special and controversial to some extent is the discrimination and segregation manifested between people of urban and rural origin. When bad things happened in the city, the people from the city blamed those who had migrated from the villages, while the latter did the same for the people from the city. Thus, deep antagonisms were created between citizens from the city and migrants from the villages. Citizens who migrated to large cities were often not welcomed by the local society, because after a long time of social and cultural homogeneity it is extremely difficult to accept social and cultural diversity. Another factor is that these social actors had formed their own social identity and were not prepared to share it with other social actors. These divisions further evolved, leading to identifications and labelling as 'peasants', 'mountain men', and 'uneducated', and even the identification of cafes, restaurants, and public places such as of peasants or of citizens, leading to social–urban division and inequality.

Kosovar society faces many problems, challenges, and anomalies. In recent years, we encounter an urban discourse that has to do with the categorisation of people based on the drinks they consume, categorising them into two types:

a) citizens and b) villagers. This local discourse has made a large part of the bars in the capital but also in some other cities not serve drinks, such as Fanta, Sprite, or even juices, just not to be categorised or identified as villagers. It has been considered a shame to consume such drinks in Prishtina for years. This fact brings to mind the a-culture and counterculture of the 1960s in the US, where 'Coca-Cola was produced for white people, and Pepsi for black people' (40-year-old male, P1). These situations are expressed as a result of the superior feeling of the locals in relation to the citizens of rural areas. And, naturally, such situations contribute to divisions, inequalities, and social differentiation in the city.

## ADVANTAGES OF URBAN LIFE (IN THE CITY) AND SOCIAL PROBLEMS

Urbanisation is a social process that affects social relations in urban life and creates advantages and disadvantages for the urban environment. Through the placement of modern industries in cities, more people have been attracted to migrate from rural to urban areas due to better employment opportunities. Industrialisation has increased employment opportunities by giving people the opportunity to work in modern sectors in job categories that allow for economic gain. In cities, there are better physical infrastructures, educational opportunities, health services, and social life. For this reason, more and more people are encouraged to migrate to cities to receive a wide variety of social benefits and services that are not available in rural areas. Such a situation has led many people in Kosovo to leave rural settlements and settle in cities. This is due to the fact that cities offer countless opportunities, such as:

- **Better education infrastructure and opportunities** - Cities offer a variety of schools and educational programmes with higher quality, which makes the choice easier and greater for pupils and students. 'Villages were forgotten by institutions after 1999, and people from villages were forced to migrate to the city in search of a better life' (43-year-old female, P10).
- **Better health infrastructure and services** provide specialised and higher-quality health services, which are not available in the villages.
- **Greater employment opportunities** - The opportunity to find a job in modern sectors and with higher economic benefits is many times greater in the city. The city offers employment opportunities for all categories of society, which are not available in the villages. 'In the absence of jobs in the countryside, people saw the city as a place of opportunity, and so it happened' (55-year-old male, P6).

- **Culture and sports** - The city provides the most suitable infrastructure for cultural and sports activities, offering citizens a variety of opportunities for development and entertainment.
- **Social emancipation** - For conventional societies such as Kosovar society, the city is a good opportunity to emancipate. To have a dignified life, people are forced to attend higher education or schools/vocational courses, which lead to better and greater employment opportunities and thus, detached from community life, close social ties and progress towards social emancipation.
- **Public transport** is not developed in cities as in developed countries; however, it is more available than in the countryside and creates greater convenience.
- **Better opportunities to meet new people** - Due to the larger number of people in the city and cultural diversity, there are better opportunities to meet new people and benefit from social interaction in various forms. These are opportunities that one can hardly find in rural life in Kosovo when dealing with a homogeneous population.
- **Dynamic life** - The city is characterised by dynamic life. People are in school, in courses, employed in one or more jobs, and have little free time.
- **Shopping centres** - Mainly large shopping centres are located in urban areas, and these have enabled shopping in one place and at more favourable prices for people. So they have enabled easy access through public transport, a short car ride, or even walking.

Industrialisation, the establishment of administrations in cities, economic zones, tourism, etc., provided jobs, which has led many people, especially qualified young people, to migrate to the city. Cities are equipped with modern communication technologies, with social facilities, school infrastructure, health, ways of dressing, emancipation, and freedom of women in particular, and people believe they can lead a happy life in cities. Historically, urbanisation has been accompanied by significant economic and social transformations. For example, urban living is associated with higher levels of literacy and education, better health, lower fertility and longer life expectancy, greater access to social services, and greater opportunities for cultural and political participation (UNDESA, 2014). However, rapid and widespread urbanisation mainly results in negative effects and social problems. The rapid growth of Kosovar cities from rural to urban migration has led to:

- **Lack of housing** - The demand for housing was high in the first decade of the 21st century as a result of the destruction of houses by the recent war in Kosovo and migration from the countryside to the city. Large demands for housing, on the one hand, and the lack of consolidation of institutions to design and implement urban plans and strategies, on the other hand, have led to illegal construction and superstructure in cities, thus causing urban chaos. 'Cities became places where many people intended to make a living or do

business, and thus, by not enforcing existing laws and urban plans, built out of place, causing urban chaos' (57-year-old female, P7).

- **Increase in the cost of rental price of apartments, especially in Prishtina** - Very high demand for housing has resulted in an increase in the price of rent. The rent of apartments was very high in relation to the average salary in Kosovo and unaffordable for households with one employee.
- **Air/environmental pollution** was present especially during the winter season and was mostly detected in cities such as Prishtina, Fushe Kosovo, and Obliq. Causes of air pollution were power plants for electricity production, heating of households with coal, and cars (urban traffic). 'One of the problems worth mentioning is environmental pollution, where pollution figures are alarming, especially in Pristina' (60-year-old male, P2). Poor air quality has significant health consequences, as it produces higher rates of respiratory and heart disease and higher mortality rates in cities (Stylianou & Nicolich, 2009).
- **Lack of water (in some cities)** - A significant part of cities have a lack of water, especially during the summer season.
- **Lack of schools and large number of students in the classrooms** - School infrastructure is missing in a significant part of cities, especially in Prishtina, as a result of urban growth. Schools are missing in some neighbourhoods of the city, and classrooms were overcrowded with students (over 40 students per class), causing dissatisfaction with the quality of education. Such a situation is still present today in many cities of Kosovo, as a result of urban growth.
- **Noise** - In the absence of law enforcement by relevant institutions and civic silence, noise has taken place in Kosovar cities day and night, causing turmoil and civic insecurity. Noise caused by cafes, restaurants, and citizens with a minimum of civic education was present at all times. 'To be honest, in recent years there has been a civic awareness. After 22:00, there is no more noise as there was years ago; however, institutions still need to do more to take action against premises and citizens who do not respect the law of noise' (53-year-old male, P8).
- **Occupancy of public and private property** - After 1999, as a result of the war in Kosovo, many families were left without housing and, in an attempt to settle housing, migrated to the city. Many citizens usurped private and public property for material gain. This situation has led to social conflicts, causing fear and civic insecurity. For years, many citizens were denied property rights as a result of the usurpation of their property. This situation progressed after the intervention of local institutions and support from international organisations.
- **Lack of parking** is present in most cities in Kosovo. In the absence of parking lots, people park their cars in the wrong place (in green spaces,

sidewalks, etc.), often leading to interpersonal conflicts, thus causing fear and insecurity for citizens.

- **Illegal constructions** became an integral part of Kosovar society. In the absence of implementation of laws and urban plans, many citizens built without following laws and urban plans, causing urban chaos. Illegal construction became an obstacle for citizens to have a dignified life. 'Today, we encounter houses, buildings, and entire neighbourhoods built in Kosovar cities that require urban revitalisation as a result of field construction. Illegal constructions have prevented the expansion of roads, sidewalks, and green spaces, and this situation brings stress and nervousness to citizens' (29-year-old female, P3).
- **Public transport** - In most cities, except Prishtina and some other cities, there is a lack of public transport (interurban). This is because most cities are small in area and in terms of demographics; however, this has also happened in the absence of urban policies. Although public transport in Prishtina is organised, it is still far from the standards of developed countries and thus does not meet the requirements of citizens. 'Inadequate itinerary, lack of public transport coverage of all neighbourhoods of the city, and inadequate conditions have made people not use public transport, causing chaos in urban traffic' (43-year-old female, P12).
- **Organised crime and corruption** - In Kosovo, there are over 300,000 illegal constructions. Illegal constructions have taken place in urban centres, suburbs, and urban parks throughout the territory. Illegal builders are natural persons, legal entities, and organised groups who, for material benefits, have destroyed cities and made life difficult for citizens, without facing the law to the proper extent.
- **Lack of green spaces and physical infrastructure for cycling** is present in most Kosovar cities. This situation makes it impossible for citizens to enjoy green spaces (for recreation, relaxation, and entertainment), and people who ride bicycles in the absence of physical infrastructure risk their lives, as fatalities on urban roads in Kosovo are not uncommon. 'Recently, some municipalities have begun to pay attention to the construction of physical infrastructure for cycling; this is to be welcomed — better late than never' (45-year-old female, P4).
- **Lack of family privacy in the city** - Many buildings are built close to each other, so that, in some cases, it can be easier to communicate from the living room to the neighbour in the other building than with family members in the same apartment in the next room. This situation has led to a loss of privacy/intimacy for the family, causing nervousness, stress, and social dissatisfaction.

Stress, in turn, impairs the mental health of urban residents. Much research finds that urban residents have more mental health concerns than rural

residents. In particular, they have much higher levels of mood and anxiety disorders and of schizophrenia (Lederbogen et al., 2011). This situation, created over the years, has occurred as a result of non-implementation of law, urban plans, and lack of institutional action to stop illegal builders.

According to Islami (2008), looting, usurpation, threats, aggressive behaviour and various offenses, willingness to create chaotic situations, disregard for urban norms, throwing garbage through windows, spilling water, noise in the late hours of the night, lack of urban education, etc. are an integral part of the process of 'ruralisation' of our cities since mid-June 1999. Immigrants from rural areas established in urban areas, without any preparation for city life, continue to live a rural life and cultivate a rural mentality in all its dimensions (Islami, 2008).

'The uninterrupted movement of the population has aggravated the urban areas, which, in turn, are developing without any control of construction and spatial development. The most fertile rural areas, located in the lowlands, valleys, and terraces of rivers and lakes, are increasingly being occupied by houses and yards, factories, roads, mines, schools, hospitals, and other facilities, all unplanned constructions and often illegal' (D'hondt).

Urbanisation also has the effect of dissolving the traditional family (leading to a family with a smaller number of members). A joint family cannot be kept in the cities due to the high cost and way of life. People prefer to live in the nuclear family. According to Wirth, the city's way of life has some social peculiarities, such as the replacement of close social ties with secondary ties, the fading of strong tribal ties, the fading of family importance in the social context, the loss of a sense of bond formation close to neighbours, and the fading of traditional social solidarity (Alver, et al 2007; Likaj, 2013). A possible explanation is that cities in Kosovo were faced with a more or less forced urbanisation of rural people with a very traditional and nearly tribal character, not knowing how to live together and to develop a new public realm in cities (D'hondt).

## CONCLUSIONS

Rapid urbanisation and migration from rural areas and small towns to larger urban areas has changed the social structure. First of all, rapid urbanisation has brought economic, social, and cultural changes. The industrialisation of cities allowed the transition from the old agricultural economy to a modernised economy and enabled the creation of new jobs. It is difficult to exactly determine the process of urbanisation in Kosovo, but we can conclude that it began in the 1960s and continued until the 1990s. It then stagnated due to the political situation in the country until 1999. After 1999, accelerated

urbanisation began, with many changes in the political, economic, social, and cultural structure, which have influenced the Kosovar society in general. At this time, there was a rapid increase in the urban population. Currently, about half (50%) of Kosovo's population lives in urban areas. People migrate to cities to gain a better standard of living. They are influenced by urban pull factors (education, employment, better life) and rural push factors (dissatisfied with rural life: poor physical infrastructure, poor-quality education and health, unemployment). Urban life provided better employment conditions, education, and health services than in rural areas, as well as greater access to social services and opportunities for social, cultural, personal, and family development activities. This situation has contributed to the antagonisms of citizens from the city and the countryside, creating unpleasant situations and deepening social differentiations and divisions in cities.

Despite some institutional progress made in the urban area, these changes were not enough to better manage the urban situation. After 2005, Kosovo drafted urban development plans and strategies; however, the lack of quality and implementation of these plans, which would provide solutions to many social–urban problems that plague Kosovar society, remains a matter of concern.

The urban situation is not at the level of urban standards. There are cities and neighbourhoods that do not meet even the minimum urban criteria and require revitalisation in order to create conditions for a quality urban life. In the absence of commitment of competent institutions, in cities we have uncontrolled and illegal developments, imbalance, urban pollution, heavy traffic, noise, urban chaos, crop matches, lack of water, and lack of adequate school and health infrastructure, causing social problems. This situation lasting for two decades now requires the special attention of the policymaking and leadership class, higher commitment and activation of experts in the field, and public awareness. Government and policymakers must plan for and manage the impacts of urbanization. Only by addressing these interconnected issues, and both the technical and political barriers to change, can they ensure a good quality of life for urban dwellers.

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# RESPONSE TO THE CHALLENGES: THE FIRST TWO DECADES OF A NATIONAL GI ASSOCIATION (1994-2015)

**Gábor REMETEY-FÜLÖPP** [1]

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## ABSTRACT

The 'big bang' of spatial data thinking began in the 90's, with the concept of multipurpose cadaster, along with advances in information systems, and operational applications of remote sensing, especially in agriculture and environment. All of these developments imperatively called for cooperation in: standardization; creation of interoperable spatial data infrastructures; capacity building; new models in data sharing; and strengthening the ongoing development of interdisciplinary Geographic Information (GI) communities at national, regional and global levels. This paper describes the circumstances that triggered establishment of Hungary's multidisciplinary Association for GI, HUNAGI, and brings to light the major stages of its evolution in the first two decades, namely the networking of domestic stakeholders, and the forging of links with novel international communities such as EUROGI, GSDI and later ISDE. According to HUNAGI's mission, the focus of their effort was to engage major players and arrange professional forums that together offered opportunities for its growing members to collaborate on international projects, promote their achievements, and facilitate dialogue and sharing of experiences. HUNAGI intensely communicated information on best practices and lessons learned, in areas of data policy, capacity building, legal aspects, and last but not least, promotion of innovative technologies applicable for societal benefits. All this was achieved by advocating the use of Spatial Data Infrastructure (SDI) and the Earth Observation (EO) data, as well as promoting the adoption of Acquis of the EU and sustainable development supported by geospatial and EO data.

**Key words**: HUNAGI, Networking, Spatial Data Infrastructure, Earth Observation, Sustainable Development.

[1] **Dr. Gábor REMETEY-FÜLÖPP**, gabor.remetey@gmail.com,
Member, Hungarian Association for Geo-information (HUNAGI).
Address: Zöldlomb utca 52-54, 1025 Budapest, Hungary

## INTRODUCTION

The Anniversary General Assembly of the Hungarian Association for Geo-Information (HUNAGI) was devoted to recall the 25 years of the Association. Held in Budapest on November 8, 2019 the author (past Secretary-General of HUNAGI) delivered a lecture addressing the first 21 years, followed by a presentation given by the recent Secretary-General Dr. György Szabó, discussing the most recent follow-on years. This paper is a short retrospective of the period 1994-2015, in personal viewpoint of the author, who took an active part in the daily activities from the very beginning, at every level, from domestic to international, always aiming to achieve the goals defined by HUNAGI at the time of its establishment in 1994. The events, achievements and new challenges of the follow-on years are reflected by the Association's refreshed website (HUNAGI, 2015).

## FLASHBACK ON THE HUNAGI ESTABLISHMENT ERA

To develop and operate a wide-range of GI-based, interoperable information systems and services for multipurpose societal benefit requires:

- an approved strategy,
- strong political support,
- visionary leadership,
- coordination,
- quality data, and
- interdisciplinary cooperation

In Hungary, the growing importance of geospatial information was recognized in the 90's by the State Committee for Technological Development (OMFB), in gathering the emerging GI communities of data suppliers, solution providers, industry, academia and end users, including governmental agencies. At that time, aside from the Geospatial Service of the Home Defense, government agencies and certain companies were already well-experienced in the use of GI, especially in the field of land administration, including the Department of Lands and Mapping in the Ministry of Agriculture and Regional Development (MoARD), the Institute of Geodesy, Cartography and Remote Sensing (FÖMI), the Land Office network. Some universities made significant efforts to develop expertise in GIS as part of their core curricula and in assisting development of applications for industry (Table 1.).

*Table 1. Some major actions in the 90's, where the government promoted and supported GI-related developments*

| *Action* | *Location, date* | *Features* |
|---|---|---|
| Computerisation of the Land Offices under EU Phare and Twinning framework | Countrywide in the 90's | Under the leadership of the Department of Lands and Mapping at Ministry of Agriculture and Rural Development (MoARD) |
| Establishment of AM/FM GIS Hungary, lead by Dr. L.Csemniczky supported by OMFB | Budapest 1991 | With focus of development on geospatial technology applications for utilities |
| Study on the applicability of spatial data and related services | Budapest 1992 | Lead by the State Office for Technological Development (OMFB) |
| International Workshop devoted to GIS in local governments and urban data management | Budapest 1993 | Arranged by OMFB, with experts from local governments from USA, Denmark and Hungary |
| Launch of GIS projects for local government | Countrywide 1993- | Orchestrated by OMFB |
| Annual Central European GIS/LIS Conferences supported by OMFB | Budapest, 1993-1996 | Participated by leading international experts in GIS/LIS from European institutions, organisations and EU member states |
| As a Hungarian GI landmark, establishment and use of the national Digital Base Map, related standards, and continuing remote sensing programs with apps in agriculture and environment | Countrywide in the 90's | Act on Surveying and Mapping Activities. Line Ministries (MoARD and MoHD) Assigned flagship institution: Institute of Geodesy, Cartography and Remote Sensing (FÖMI) Base map standards MSZ 7772-1:1997 and MSZ 7772-2:2000 issued by the Hungarian Standard Organisation |
| Textbook on GIS of the Budapest University of Technology | Budapest 1994 | Authors: Prof. Ákos Detrekői and Asst.Prof. György Szabó |
| Translated and extended Hungarian version of the NCGIS Core Curriculum | Székesfehérvár 1996 | Edited by Prof. Béla Márkus Director of Faculty of GEO University of Sopron |

## INFLUENCING CIRCUMSTANCES LEAD TO THE ESTABLISHMENT OF THE NATIONAL GI ASSOCIATION

Some triggering impacts from the EU side included:

- The White Book of Jacques Delors on Competitiveness, Employment and Growth published by the European Commission in 1994
- The Bangemann Report discussing the importance of SDI, 1994
- European Commission (EC DG XIII) facilitated the setting up of the European Association for Geographic Information (EUROGI), 1993
- Under the patronage of Prof. Martin Bangemann (EC DG III) and Bruce Babitt (DoI, USA) the Global Spatial Data Initiative (GSDI) has been created and collaboration between North-Carolina and Northrhein-Westfalia on SDI started in 1993-94, and
- Establishment of national/regional GI associations in Ireland (IRLOGI), Germany (DDGI), Nordic countries (GI Norden). The European Association of Remote Sensing Companies (EARSC) was set up also in 1994. In the same year the Hungarian Association for Geo-information (HUNAGI) was launched with governmental (OMFB, MoARD) support. The British AGI was taken as foregoer.

Hungary's domestic environment was favorable and supportive as well:

- Some academic societies, NGOs, the Hungarian Space Office and the HUNGIS Foundation realized their mutual interest in 1994 to form a National GI association under the auspice of OMFB. One aim was to join the just established EUROGI and serve as an international arm of HUNGIS Foundation.

Champions included Minister without portfolio, Prof. E. Pungor, S. Bottka, V. Bognár all of OMFB, M. Havass of Federation of Societies of Technical and Natural Sciences, Academician Á. Detrekői of Budapest University of Technology and Economy/ Hungarian Academy of Sciences/HUNGIS Foundation), T. Tenke of Geometria Ltd. and R. Berencei of HUNGIS Foundation provided notable support.

## FEATURES OF THE ASSOCIATION AND MISSION GOALS

The inauguration meeting was held in November 1994. HUNAGI was then established as an interdisciplinary umbrella organization, with the stated mission goal to promote, stimulate, encourage and support development and use of GI, associated technologies and related services, as well as to strengthen

the institutional links between GI communities in Hungary and abroad via the European Umbrella Organization of Geographic Information (EUROGI). Preparing the legal establishment of the Association, the following founder organizations participated the General Assembly in November 1995:

- Hungarian Space Office (HSO),
- HUNGARNET Association
- Hungarian Association of Public Administration Informatics
- Technology Transfer Centre (TTC)
- Association of AM/FM GIS Hungary
- Hungarian Society of Settlement Developers and Renovators (MTFT)
- University of Forestry and Timber, Faculty of Surveying and Land Consolidation (later: University West Hungary Faculty of Geoinformatics)
- HUNGIS Foundation for the GIS in Hungary
- Hungarian Society for Urban Planning (MUT)
- John von Neumann Computer Society

Objectives of the Association (revisited in 2007) include: to represent the interest of the Hungarian GI community in EUROGI, to build bridges with other similar associations, to strengthen the competitiveness its members by providing information dissemination service, forging the cohesion between the geospatial data and solution providers, GI users of government, academia, industry and civil sector, as well as to elaborate GI strategy and other background documents applicable in decision making. and contributing to the tasks derived from Hungary's membership in the European Union.
Motivating external drivers included the National Program of Adoption of the 'Acquis Communautaire', the common rights and obligations that are binding on all EU countries (to ensure readiness for EU accession in 2004), the acceleration of developments in Information and Communication Technology (ICT), the challenges of the digital transformation towards an information society, and the Big Data era impacted the GI/EO field largely from locational based services to EO apps. Special emphasis was given to open source software, data sharing and knowledge-transfer by collaboration in combining best practices and lessons learned. Together this paved the way for implementation of the European data-sharing legislative frameworks, INSPIRE for SDIs and Public Sector Information/Open Data directives. HUNAGI accessed to the European Network on Geographic Information Enrichment and Reuse (eSDI-Net+ in 2007. The rise of the Association and the setbacks caused by the financial/economic recession after 2008, is reflected in Figure 1. Significant number of members had to leave. But,

despite this, the activities grew, thanks to the Association's inspired and committed leadership and their resilience to these changes.

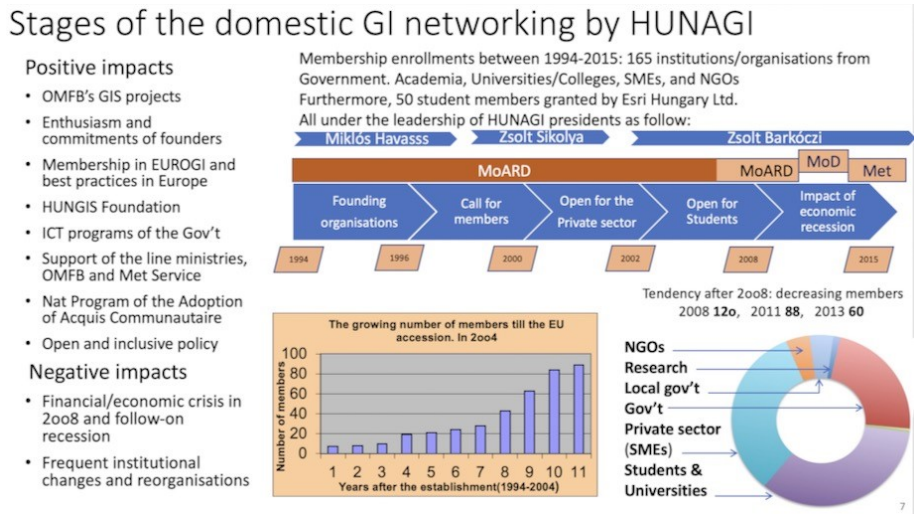


*Fig. 1. Impacts on the growth and supportive governmental bodies*

## SETTING UP INTERDISCIPLINARY PARTNERSHIPS

The inclusive nature of HUNAGI became a major strength that steadily expanded collaboration with domestic activities. The areas covered by these partners range from land management to Earth Observation, and from location-based services to urban/regional development, as illustrated in Figure 2. Then in 2001, there was a comparative analysis of EUROGI, based on models of national GI associations in Europe in assessing five entities: AGI-UK, DDGI- Germany, HUNAGI-Hungary, RAVI of the Netherlands and AFIGÉO-France. In the case of HUNAGI, it was acknowledged by the project lead, Koen van Biesen, how effective such as HUNAGI can be, even with limited resources.

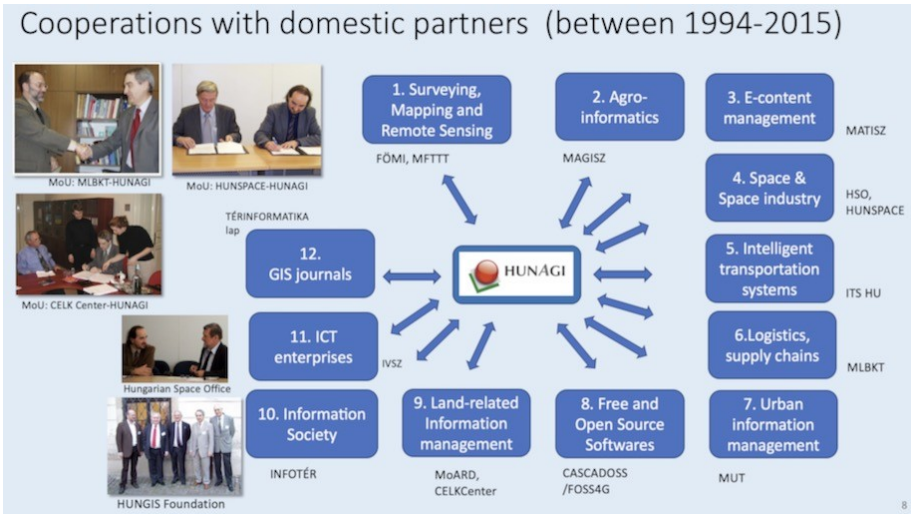


*Fig. 2. Horizontal partnerships with NGOs, learned societies governmental agencies and space industry cluster.*

Partnership activities included (with organization in brackets) arranging joint seminars (MLBKT), international workshops, fora (FÖMI, HUNSPACE), study works (HUNGIS, KPMG, COWI), contributions to conferences/exhibitions (CELK Center, MUT), drafting legislation (MoARD), advocate promising, innovative technologies (ITS Hungary), encouragement to publish in journals (MFTTT, MAGISZ) and represent HUNAGI in the governmental space research council (appointed by HSO) and Hungarian Standard Organisation's Subcommittee on GIS (MSZ) via MoARD.

## FORGING LINKS AND COLLABORATION ON REGIONAL AND GLOBAL SCENES

According to the strategy revisited yearly by the general assembly of HUNAGI, the Association made steady progress to strengthen its international links. Consequently, HUNAGI became a member of four organisations as follows (includes year of enrolment):

- Geographic Information Systems International Group - GISIG (Genova, Italy), 1995- (A highly successful coordinator of EU projects having 100+ members across Europe)
- EURopean umbrella Organisation for Geographical Information - EUROGI (Amersfoort, The Netherlands), 1996- (Leading interdisciplinary NGO in GI in Europe). See Figure 2.

• Global Spatial Data Infrastructure Association – GSDI (Orono, Maine, USA), April 2005– April 2018 (HUNAGI participated the world conferences of GSD Initiative since 1996). See Figure 3.
• International Society of Digital Earth - ISDE (Beijing, China), 2006- (HUNAGI participated ISDE symposia since 2003).

Moreover, the Association signed the international 3D Ethics Charta in January 2015 and maintained working contact with ISPRS, FIG and the GI Working Group of the United Nations.

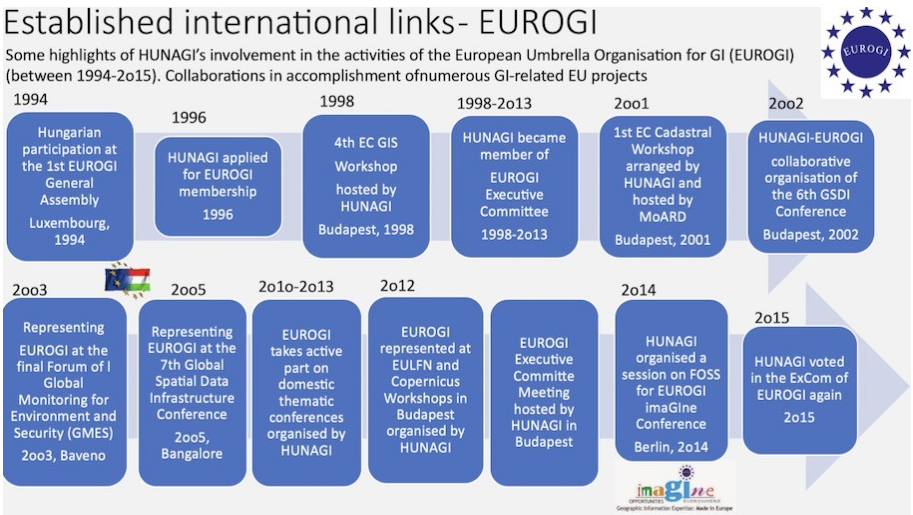


*Fig. 3. HUNAGI participation in EUROGI activities and some related actions*

Full membership in EUROGI meant that HUNAGI was being updated every Members' Day on the achievements of other national GI associations. So HUNAGI was informed of plans and efforts by the European Commission (EC) at an early stage. The jointly articulated feedbacks/messages of the GI community became even more effective at the Annual General Meetings held in Brussels, in presence of civil servants of EC. As an advisory partner of EC, EUROGI elaborated several thematic trend-analysis (since 2014) for National use and for European institutions. EUROGI led or participated with its members on numerous GI-related EU projects and joint actions, where members of HUNAGI benefited, including GIS/LIS Central Europe, PANEL-GI, ABDS, 4th EC GI/GIS, 1st EC Cadastral Workshop, E-ESDI/INSPIRE, GSDI-6, GINIE, HUMBOLDT, ETEMII, CEE-SDI, ePSI Platform, eSDI-NetPlus, EURADIN, LAPSI, European Location Framework (ELF), and Copernicus Market-Pull-Pack (MPP).

As far as HUNAGI membership in GSDI Initiative, and later in GSDI Association is concerned, representatives took part and contributed in most case, by delivering presentations on HUNAGI at GSDI's world conferences in addressing the following themes (also see Figure 4):

- The Emerging GSDI (1996)
- Towards Sustainable Development Worldwide (1997)
- Policy and Organizational Frameworks for GSDI (1998),
- Engaging Emerging Economies (1999)
- Sustainable Development: GSDI for Improved Decision-Making (2001)
- From Global to Local (Budapest, 2002),
- Spatial Data Infrastructures for a Sustainable Development (2004)
- The Role of SDI's in an Information Society (2005)
- Geographic Information: Tool for Reducing Poverty (2006)
- The Role of Spatial Data in Supporting a Sustainable Future (2008)
- Building SDI Bridges to address Global Changes (2009)
- Realising Spatial Enabled Societies (2011)
- Spatially Enabling Government, Industry and Citizens (2012)
- Spatial Enablement in a Smart World (2016).

Two strategic meetings were arranged in Cambridge (UK) between 1999-2000 to set up the policy and organizational framework needed for the establishment of GSDI Association, where HUNAGI was invited, as well as to the Think Tank Meeting on the topic SDIs and Cultures organized by GSDI and the Atlantic Institute hosted by MIT in 2005. This particular meeting was participated in by some pioneers of the multipurpose cadaster, a concept which is considered to be the cradle of the spatial data infrastructure.

GSDI was represented by HUNAGI at the plenaries of the Working Group Information Systems and Services of the Committee on Earth Observation Satellites (CEOS WGISS) between 2006-2015 and at the plenaries, workshops of the inter-governmental Group on Earth Observation (GEO – hosted by UN WMO) between 2007-2015.

After 2015 GSDI led the UN GGIM Geospatial Societies (earlier the Joint Board of GI Organisations) and closed the operation of its own association, the tasks of which were essentially taken over by the UN GGIM, the UN Committee of Experts on Global Geospatial Information Management.

Doug Nebert's SDI Cookbook and the GSDI small grants, supported promising SDI applications that attracted worldwide attention by the GI communities, including that of Hungary. One of the winners was the Institute of Ecology and Botany of the Hungarian Academy of Sciences (HAS).

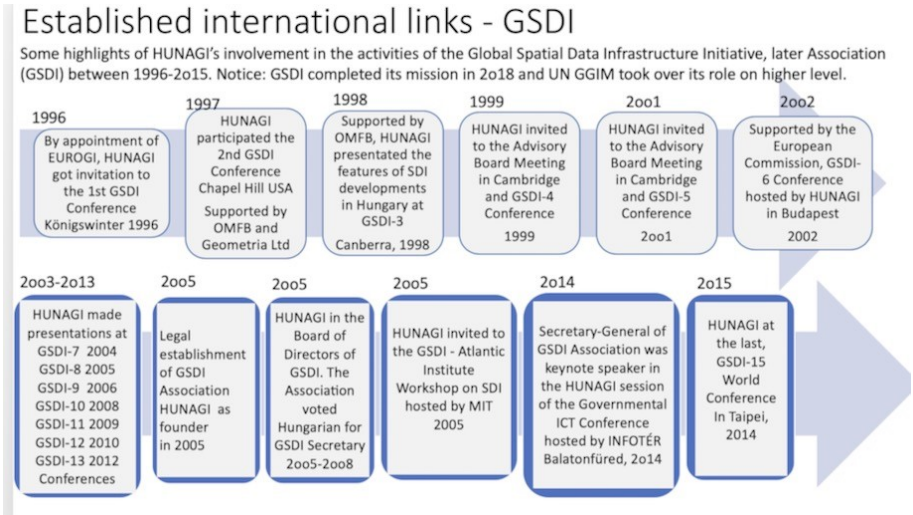


*Fig. 4. HUNAGI contribution to the activities of the GSDI Association*

In line with the strategy of HUNAGI, the International Symposia on Digital Earth (ISDE) attracted HUNAGI and some its members, in large part due to the visionary concept Al Gore made in 1998, and the proactive support of that idea by the Chinese Academy of Sciences (CAS) based on the principles of the Beijing Declaration on Digital Earth in 1999. Thereby, ISDE promoted international cooperation on the development and realization of Digital Earth (DE) vision and the enabling of technologies in accessibility and usability of information in the georeferenced, virtual representation of the Earth.

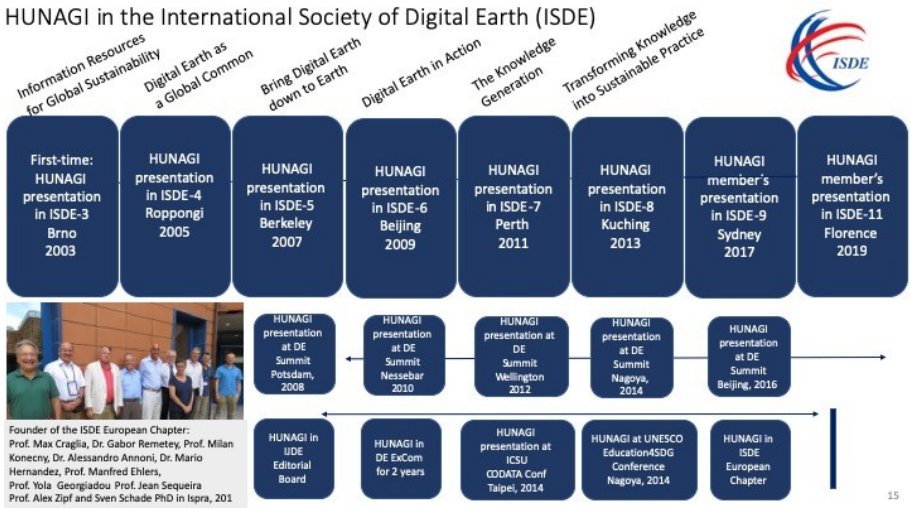


*Fig. 5.: HUNAGI contribution to ISDE activities by reporting and sharing on applications of DE technologies*

The idea was that this would help the digital transformation towards the knowledge-based information society, and play a major role to meet the challenges (e.g. sustainable development) from local to global. HUNAGI, FÖMI and CELK Center, took part in the ISDE Symposium, held for the first time in Europe in 2003.

During the next 12 years and beyond, HUNAGI played an active role in the ISDE activities, while also supporting the Executive Committee and the International Journal of Digital Earth. Some HUNAGI members and partners, including the Budapest Corvinus University, MoARD, Institute of Soil Sciences of HAS and Debrecen University, engaged with the DE community work. Meanwhile, in 2006 the International Society of Digital Earth had been established in Beijing and hosted by CEODE (later RADI, today AIRI) of CAS. The original concept was revisited by a task force in 2011 that elaborated 'Digital Earth Vision towards 2020' and was published in the Proceedings of the National Academy of Sciences (PNAS USA) and Int'l Journal of Digital Earth (IJDE, Beijing). Most recently the presidency of ISDE has been taken over by Alessandro Annoni, one of the INSPIRE Directive leaders, who also became head of the Digital Earth and Reference Data, and the Digital Economy units at the European Commission Joint Research Centre, JRC. HUNAGI's involvement in the DE Symposia and Summits is shown in Figure 5.

## RESPONSES ON THE DEMAND OF THE DOMESTIC GI COMMUNITY

### Building bridges abroad

The office of HUNAGI was hosted in its first 13 years by the Lands and Mapping Department of MoARD. Many actions of the Association had the aim to support the international relations of the land administration. Based on links with UN ECE MOLA (later to become the Working Party of Land Administrations -WPLA), HUNAGI cooperated with JRC and EUROGI to host the first International Workshop on Cadastre of the European Commission in 2001 a year before the 1st Cadastral Congress in the EU as arranged by Spain, where EUROGI disseminated a report on the state of the art for digital cadasters in Europe, compiled by HUNAGI. MoU-based cooperation with the highly successful Central European Land Knowledge Center (CELK Center - a joint venture of MoARD and the World Bank) enabled knowledge transfer in the region and gathering LIS/GIS experts from the Baltics to the Balkans, and from France to the Caucasus. HUNAGI paved the way for MoARD to take part in the work of the Permanent Committee on Cadastre of the European Union.

### Participation in preparation of INSPIRE (the legislation framework of the European SDI)

Thanks to the GSDI Association, HUNAGI was invited by EC to the INSPIRE Expert Committee in 2001. Later, at the INSPIRE Meetings hosted by the European Commission and European Council, Hungary was represented by the Ministry of Environment and MoARD, while for the INSPIRE Technical Drafting Groups, HUNAGI assisted to encourage Hungarian experts to participate. HUNAGI arranged the National INSPIRE Days as hosted by FÖMI. HUNAGI was acknowledged as part of the Spatial Data Interest Community (SDIC) by the Joint Research Centre in 2009. In addition to JRC, the Association forged links with other European Institutions, including DG Envi, DG Research and EUROSTAT.

Additional activities included: building bridges with neighbor countries, i.e., participation in Exhibitions in Urban GIS and Centropa workshop in Schwechat, AGEO meetings held in Vienna, GIS Conferences in Cluj, Romania, together with HUNGIS Foundation and Dennis Gabor College.

**Actions in the V4 framework and in the South-East Europe region**

HUNAGI was invited by CZAGI and SAGI in a project called GRAPPY, but the project proposal was not granted. HUNAGI participated in another V4 project proposal, CASCADOSS, based on an open source theme that successfully applied for the grant. As far as the Balkan region is concerned, HUNAGI took part with presentations in ICA, SEE SDI and ISDE meetings in Bulgaria, a World Bank conference in Serbia, SDI meeting in Northern Macedonia (organized by Geo-SEE), WPLA Meeting in Albania, ISPRS, UNGIWG, GEO SEE meetings in Istanbul as well as FIG and SDI workshops in Greece. An interesting project idea was elaborated by EUROGI and HUNAGI to apply a novel, Data Cube approach for the multi-country cooperation along the River Danube. The concept attracted positive attention by JRC in Ispra, by ESA and even by the EC's Danube Conference in Ulm. But due to the lack of preparedness and engaged key players, this 2015 project proposal failed. Some years later a similar Data Cube project was launched for the Mekong Basin supported by CEOS and managed by the Vietnam Academy of Science and Technology (VAST).

**Collaboration with UN institutions and working groups**

Invited by Presidents of HAS and the National UNESCO Commission, HUNAGI took part in the 2-year work of the National Committee of the International Year of the Planet Earth. Important activities were related to the UN Geographic Information Working Group where, by invitation, HUNAGI contributed several times to this work at plenary meetings of GI experts of UN agencies. Advocating by HUNAGI, the Gyöngyös Campus of Eszterházy University became a member of OGC. In 2006, as recommended by top FAO experts, HUNAGI arranged to set up the third UN SDI National Coordination Office, after those in Netherland and Spain. The mandate was received to run the UN Spatial Data Infrastructure Hungarian Coordination Office (UNSDI-HUCO) from the leading stakeholders at a Meeting jointly organised with and hosted by FÖMI on 28th September 2006. The UNSDI-HUCO stakeholders were the following organisations and institutions:

- Hungarian Association for Geo-information
- Hungarian Meteorological Service (OMSZ)
- Hungarian Space Office,
- Ministry of Environment and Water
- Institute of Geodesy, Cartography and Remote Sensing (FÖMI)
- Hungarian Geological Institute
- Mapping Service of the Hungarian Defence Forces
- Ministry of Defence Mapping Company
- Ministry of Economy and Transport
- National Directorate General for Disaster Management
- Research Institute for Soil Science and Agricultural Chemistry of HAS
- University West Hungary Faculty of Geoinformatics
- VÁTI Hungarian Public Non-profit Company for Regional Development and Town Planning
- Department of Natural Resources, Ministry of Agriculture and Rural Development
- Department of Land Administration and Geoinformation, Ministry of Agriculture and Rural Development

The global meeting of the UN SDI stakeholders was held at ESA in Frascati. Although the elaborated UN SDI study was discussed there, another concept supported by the regional surveying, mapping and cadastral associations (such as EuroGeographics) was accepted, followed by the establishment of the UN GGIM in 2011. This expert community continues to work efficiently, providing support to implement the Sustainable Development Goals of the UN 2030 Agenda and advocating the necessity of integrating EO/geospatial data and statistical information to improve decision-making procedures.

**EO-oriented actions where HUNAGI, its members and partners played roles**

Along with the NGO HUNGEO, HUNAGI's links to the Ministry of Water and Environment (MoWE) facilitated the opportunity to host two CEOS Working Group meetings on Information Systems and Services (WGISS), and Calibration Validation (WGCV) in 2006. After HUNAGI gave a 30 minutes presentation on GSDI, and the Hungarian GI/EO community was introduced in frame of an arranged special session participated by the top Hungarian governmental players from HSO to Meteorological Service and from the Geological Institute to MoARD, and the flagship programmes of FÖMI and

MoWE, the Chairs of WGISS and Executive Director of GSDI Association agreed to set up permanent liaison between the two communities, via HUNAGI. This tremendous partnership enabled HUNAGI to deliver liaison update records on GSDI developments almost twice a year until 2018, and later on by the Hungarian Space Office (HSO), which is today the Department of Space at the Ministry of Foreign Affairs and Trade (MFA).

GSDI realized the importance of Earth Observation and the role of the inter-governmental organization GEO in the SDI context and therefore delegated Esri, the Federal Geographic Data Committee (FGDC) and HUNAGI, members from its board of directors, to represent the GSDI Association at GEO plenary and ministerial-level meetings organized by GEO Secretariat. HUNAGI received the mandate, in some cases, to lead the delegation, as well as participating in compilation of GSDI statements for GEO plenaries from 2007 on. All these activities were reported for the HUNAGI community. Especially the XIIth Ministerial Meeting of GEO was a milestone, where the continuation of GEO was agreed and the GEO Initiative 'EO for the Sustainable Development Goals (SDGs) had been launched. A volunteer group of the HUNAGI member MFTTT (Hungarian Society of Surveying, Mapping and Remote Sensing) was formed to keep contact with the GEO EO4SDG with the aim to raise awareness in domestic decision-makers for how essential the EO/geospatial data and integrated statistical information are in facilitating implementation of the SDGs (Mihály, 2017).

The NASA Ames Research Center- Politecnico Milano-HUNAGI collaboration began in 2012 with Patrick J Hogan, NASA World Wind (WW) program manager and Prof. Maria A. Brovelli, a GIS leader promoting opensource and also ISPRS personnel of the Politecnico di Milano, Como Campus. The objective was to demonstrate WW capabilities in analysis and visualization of open source applications. The strategic design of the Europa Challenge for students and young professionals came about via brainstorming with NASA developers in Como in concert with GIS by experts from around the world. Hungarians from Budapest University of Technology, FÖMI, St. Stephen University, Hungarian Geological Institute were present. The yearly WW Europa Challenge (WWEC) was promoted worldwide and the Crystal Bull Award ceremony was integrated as part of the INSPIRE Conference (Florence, 2013), the European Conferences on Free and Open Source Software hosted by the Jacobs University in Bremen (2014) and the Politecnico Milano, Como Campus in 2015, with an even larger group of Hungarians, led by Dr. Zoltán Siki, mentor of WWEC participant Krisztián Takács. HUNAGI members served as WWEC judges from the beginning until 2018, the last WWEC.

**Domestic tasks and projects accomplished include**

As a GSDI member, HUNAGI was invited to deliver a presentation at the 1st World Summit on Information Society of the United Nations in Geneva participated by 175 countries and Organisations (2003). One year later, HUNAGI intervened in the interest of the GI community at the Strategic Planning Meeting for the Information Society supervised by the Ministry of Informatics and Communication. Their contribution was to elaborate an SDI Strategy for Hungary. It was accepted, giving HUNAGI the mandate to start with the work of interagency collaboration with 14 agencies and organisations participating. The National SDI Strategy was completed and presented to the Committee of Geodesy and Geoinformatics of HAS by Dr. László Alabér, and submitted to the Ministry of Informatics and Communications in 2006, just before this Ministry was disbanded by the government due to institutional reorganization. At the annual National Civil Parliament in 2012, the HUNAGI proposals were approved. HUNAGI contributed to the EU Social and Economic Committee at its meeting in the Hungarian Parliament. After 2014, the Association was then invited regularly to the annual conferences devoted to government-related ICT developments, organized by the NGO INFOTÉR. This enabled HUNAGI to establish closer links with the National Council for Telecommunications and Informatics (NHIT) and the ICT Association of Hungary (IVSZ).

Some domestic projects enabled HUNAGI to work with the State Audit Office, the Ministry of Water and Environment, the Budapest Transportation Center, and the Local Government of Törökbálint. Assistance or networking support was provided to MoARD, FÖMI or Celk Center in association with the Phare program on Computerization of the Land Offices, the National Program of Adaption of Acquis Communautaire (NPAAC) including the Control with Remote Sensing (CwRS) and the Land Parcel-based Information System (LPIS/MePAR) of the EU Integrated Agricultural Control System (IACS), Action for Cooperation in the field of Economics (ACE), VineyardGIS (VINGIS), and with the West Hungary University in OLLO, SDILA and NatureSDIplus. HUNAGI assisted to arrange participation of MoARD at the final GINIE Conference on Under State-Secretary level and paved the way for a study tour in the USA with top decision makers of MoARD and FÖMI with the aim to visit the Cartographic Division of UN, the Map Archive of the Library of Congress, the FGDC at USGS and the World Bank.
HUNAGI and its members participated many of the annual GITA and Fény-Tér-Kép (Light-Space-Image) Conferences organised by GITA Hungary and

GeoIQ Ltd devoted to AM/FM and remote sensing/ image processing respectively Some domestic events arranged or assisted by HUNAGI and its members between 1995-2015 include:

- CERCO (today: EuroGeographics) General Assembly (1995)
- 4th EC GIS Workshop Budapest (1998)
- ISPRS Commission VII Symposium (1998),
- 1st EC Workshop on Cadastre (2001)
- GSDI-6 World Conference 'From Global to Local' Budapest, (2002),
- European Agricultural Informatics Conference, Debrecen, (2003)
- CEOS WGISS-21 and WG Calibration and Validation Meetings Budapest (2006)
- 1st HUNAGI Conference on 'Spatial Data Management with Open Access' Budapest, (2010)
- 2nd HUNAGI Conference on 'Harmonisation of Spatial Planning Data – best practices in EU regions and municipalities' with Plan4All-JRC-EUROGI. Budapest (2011)
- CEOS WGISS-32 Meeting Budapest (2011)
- HUNSPACE-HUNAGI Space Forum Visegrád (2011)
- 3rd HUNAGI Conference with Exhibition on 'Mobile GIS and Related Data Services'' (2012)
- ESA-HSO Space Exhibition (2013)
- 4th HUNAGI Conference devoted to 'What we can do with GI/EO for a more liveable environment?' (2013)
- EU Location Framework Workshop Integration of location in e-Government'. Budapest, (2013)
- Copernicus MPP Workshop Budapest, (2013)
- Copernicus MPP Survey (for Hungary, completed by Dr. Szabolcs Mihály INSPIRE Coordinator) (2013)
- Innotrend Conference. Budapest (2014)
- Challenge on Mobile Apps with Awards. Balatonfüred, 2014
- INFOTÉR Conference. Balatonfüred (2014)
- Conference on 'Integrated geo-spatial information technology and its application to resource and environmental management towards GEOSS' (IGIT) Székesfehérvár (2015).
- Legal Aspects of Drones. International Conference Budapest (2015)
- ESA Accession Event Budapest (2015)
- GIS Open Székesfehérvár (2015)
- GIS Conferences and Exhibitions Debrecen, (2014-2015)

## Visibility and communication

From the very beginning, the Internet was used to strengthen visibility and ensure communication with the GI community, both domestically and

internationally. Between 1995-1998 the Eötvös University Department of Cartography and Geoinformatics hosted information on the activities of HUNAGI, while FÖMI provided space on its website from 1998 to 2006, but this service was then terminated. The rich HUNAGI content created during that very significant time period is still available today, but via external storage only. Although HUNAGI established its own website in 2003, due to lack of resources the former content was never uploaded again (HUNAGI, 2015) To use Internet capabilities more effectively, a thematized blog system has been set up to address the major issues of the elaborated draft for a National Strategy of Implementation of SDI. This blog system is still accessible (HUNAGI Napló 2006). During 2006-2015 more than 3000 news, actions, reports and links have been posted, and all can read in foreign languages using in-built machine translator. The blog content for the period of 2006-2015 is frozen in time and can be considered an archive. See Figure 6.

HUNAGI used the opportunity at domestic/international meetings, conferences, exhibitions to disseminate permanently updated leaflets, brochures introducing the Association with its mission goals and objectives, its members, and the previous year's retrospective activities, in Hungarian or English, depending the event. Several hundred of double-sided A4 format leaflets have been compiled and printed. Newsletters were circulated for the vast number of interested list members on regular basis. HUNAGI's visibility was strengthened by the fact that HUNAGI, as an affiliate, was on editorial boards or as the co-editor for special issue in journals such as Geodézia és Kartográfia (Budapest), GIS (Heidelberg), GIM International (Lemmer, NL), IJSDIR (Ispra), IJDE (Beijing), JoAgricultural Informatics (Debrecen, later Budapest), Geocarto International (Abingdon, UK), MMM-GI (Skopje). HUNAGI actions were reflected by INSPIRE Forum (Ispra) and the popular journals Térinformatika (Budapest), GEOConnexion (UK) and Geomatika (Budapest).


*Fig. 6. Communication was effective tool to keep contact with its GI community*

## CONCLUSIONS

During its first two decades of operation, HUNAGI achieved the major goals of the founding organizations. The Association established productive relationships not only with the major domestic players of golden triangle, government academia and industry, but also built bridges and became an internationally acknowledged organisation, thanks to the collaboration with EUROGI, GSDI and ISDE.

HUNAGI successfully assisted to accomplishing governmental tasks at the international level, from land administration to Earth observation, and from INSPIRE to networking, and in engaging stakeholders at all levels. For the benefit of its members, HUNAGI encouraged participation for dealing with ICT developments, novel technologies (e.g. IoT, drones, LIDAR, EO, Data Cube, Big Data solutions, cloud services) and increasing awareness of the needs of government. HUNAGI's efforts to engage students and young professionals, by challenging them to take an active role in providing real solutions serving real needs were productive steps to advocate the sharing of spatial data and solutions with the communities from local to global. HUNAGI well represented the data sharing principle of INSPIRE, GEO and ICSU CODATA. These efforts accented the common nature of solutions of the global community as well.

## ACKNOWLEDGEMENTS

The author expresses his gratitude to all HUNAGI members especially his colleagues in the Executive Committee including Presidents Miklós Havass, Zsolt Sikolya and Zsolt Barkóczi for their committed and supportive cooperation during the 21 years when he was serving the Association as Secretary-General. Many important players, actions and impacts were not mentioned here due to length limitation. Finally, appreciation is given to Patrick Hogan, NASA Earth Scientist Emeritus, for his time to review the manuscript before submission.

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MMM Geo Information

# PROF. DR. MUHARREM DRAGOVOJA (PEOPLE'S TEACHER) – THE FOUNDER OF ALBANIAN GEODESY

**Pal NIKOLLI**[1] and **Bashkim IDRIZI**[2]

*UDC: 528-057(496.5)*

## IN MEMORIAM

On April 26, 2014, Professor Muharrem DRAGOVOJA passed away. He was born in the city of Shkodra on July 11, 1928, in a simple and patriotic family originating from Malësia e Madhe. He completed primary and secondary school in the city of Shkodra, city with cultural traditions. At the age of 16, as a participant in the fight for the liberation of the country, he became an effective member of the IV Kosovo Brigade, while at the end of the war in 1944, at his request, he moved from the Kosovo area to the Shkodra Regional Command. After graduating from high school, he worked for about 15 months as a teacher in the village of Dodç in Malësia e Madhe. In the period November 1948 - July 1953 he completed his higher studies with the grade of "excellent" in the branch of geodetic engineering of the Higher Institute of Geodesy, Aero photography and Cartography in Moscow. After returning to Albania (1953), he was appointed senior geodetic specialist at the sector of Geodesy, Geology, Bridges and Road of the Ministry of Construction. In the period 1953-1954, he contributed to the construction of geodetic networks in the coal region of Kërrabë - Pullumbas and in some facilities of hydropower plants on the river Mat. During the period of work in the above sector, has contributed to the performance of geodetic works in several projects such as geodetic networks for large scale surveys of cities and

[1] **Prof.Dr. Pal NIKOLLI**, pal.nikolli@unitir.edu.al,
Professor of Cartography and GIS/Remote Sensing, department of Geography,
University of Tirana

[2] **Assoc.Prof.Dr. Bashkim IDRIZI**, bashkim.idrizi@uni-pr.edu,
University of Prishtina, Faculty of Civil Engineering, Geodesy department.
Address: Str. Djon Kenedi, 25-4/20, 1010 Skopje, North Macedonia.
Gsm: + 389 75 712-998 (*Viber and WhatsApp*), + 383 45 341-098.

industrial areas, geodetic networks in some industrial and hydropower plants, etc.

At the beginning of September 1954, he was appointed lecturer and head of the geodesy cabinet at the Faculty of Engineering of the former Polytechnic Institute, founded in 1951. This cabinet covered the subjects of geodesy and topography in the branches of construction, geology and mining of the above faculty. In the academic year 1956 - 1957 the branch of geodesy was opened at the former Higher Polytechnic Institute and in September 1957, with the establishment of the State University of Tirana on the basis of the above institute, prof. Muharremi is appointed head of the Department of Geodesy - Geography established at the Faculty of Engineering of this university. The effective pedagogues of this department were: Muharrem Dragovoja (head of department), Pandi Geço, Ndoc Luli, Vasil Naçe, Ibrahim Meçule and Agim Shehu. In the academic year 1958 - 1959, the branch of geography was attached to the faculty of History and Philology, while the branch of geodesy was joined by the branch of geodesy in mining. In 1960, the branch of geodesy in mining was annexed to the Faculty of Geology - Mining, while the Department of Geodesy remained at the Faculty of Engineering with its head prof. Muharem Dragovoja. In 1964 the branch of Geodesy was closed, so the Department of Geodesy covered only 3 courses in the Faculties of Engineering, Geology - Mining and History - Philology. The Geodesy branch was reopened in 1969 to continue to the present day. For excellent work in in leadership of the Department of Geodesy and for the high level of his pedagogical-scientific preparation, prof. Muharrem has been given the title "Docent" since 1971 and later the title "Professor". He was honored with the order "Naim Frashëri", the work order of the third and second class, as well as a series of other medals. With the establishment of the association of Surveyors, Photogrammeters and Cartographers of Albania, prof. Muharremi is unanimously elected its "Honorary President". For the highly commendable work, on the proposal of the Faculty of Civil Engineering of the Polytechnic University of Tirana, in 1996, the President of the Republic awarded him the high title "Teacher of the People".

Prof. Muharrem headed the Department of Geodesy for about 32 years, from its founding (1956) until 1988. Two years later he retired, and in 1994 he returned to Moscow with his family. He visited Albania several times, until he passed away on May 3, 2014.

Prof. Muharrem Dragovoja gave an extraordinary contribution to the establishment and development of the branch of geodesy, in terms of preparation of plans and curricula of this branch, in the preparation and publication of lectures and texts of geodetic - cartographic subjects, etc. During his teaching-scientific activity he has prepared dozens of books of university and postgraduate level which have been published, reworked and

republished several times (Geodesy, General Geodesy, Polygonometry, Geodetic Interruptions and Analytical Networks, High Geodesy, Manual of Geodesy etc.). He has prepared hundreds of scientific articles published in scientific bulletins of the country and abroad. He has prepared monographs and scientific studies, is a co-author of the encyclopedic dictionary published in our country, etc. It has never been detached from participating in the design and implementation work of the Department of Geodesy in cooperation with the country's institutions. He has participated in the design of geodetic works for the development of works in the Hydropower Plants of Ulza, Shkopet, Bistrica, etc.

He has led the design and implementation of works for the development of geodynamic polygons in some seismic regions of the country, for the study of the Adriatic Sea Shelf, etc.

Thanks to his work, the Department of Geodesy which he led for over 30 years, grew and developed by preparing over 500 surveyors, as well as diplomas and scientific papers. During these years of his leadership, over 20 dissertations were defended in the Department of Geodesy by the members of the department and by foreign specialists of the country. In the same years, the Department of Geodesy has published dozens of textbooks, has held several scientific sessions where numerous references and papers have been held, etc.

Prof. Muharrem Dragovoja is a well-known man in the Albanian academic world up to the international arena with studies and geo-cartographic analyzes materialized as matter (several hundred study pages, documents, etc.); as fields of study (geodesy, cartography, photogrammetry, history of cartography, etc.); as a subject (published, in manuscript, translated, adapted) etc. It is difficult to find a publication or study in the field of geo-cartography (1954 - 1990), which are not related to the name, interest and finally to the contribution of Prof. Muharrem Dragovoja.

Prof. Muharrem was distinguished as the organizer and coordinator of all academic and scientific activities of the branch of Geodesy. He was always noted for his simplicity, sincerity, exemplary correctness and dedication. He will remain in the history of Albanian higher education as one of the most excellent methodologists, who with his model lectures, has left an indelible impression on all students who were fortunate enough to attend his fluent and concise lectures and in high scientific level. We all remember prof. Muharrami, wise and calm and who never got tired of explaining and teaching his students. He never spared to give his help to any specialist in need; we all remember his resounding and pleasant voice in the explanations in the university auditoriums. Wherever he went, wherever he worked, wherever he stayed, he left behind only good impressions, he left behind only friends and

people who loved and respected him. Such figures as Prof. Dragovoja, one of the giants of Albanian geodesy, is by no means forgotten.

Prof. Muharrem Dragovoja with his work and scientific and human personality, will be remembered with a deep sense of gratitude and respect for that precious scientific legacy he left us, for that rare model of human and scientific behavior and communication that few have the privilege to achieve, for that unparalleled commitment to transmit geo-cartographic knowledge to his students and all other specialists. He will long remain in the memory of generations not only as a prominent surveyor and cartographer, but also as a tireless and visionary leader in the field of geo-cartographic studies and the history of Albanian cartography.

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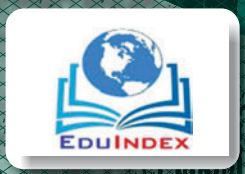




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