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VALORISATION OF THE BIAMBARE CAVES- »PL BIAMBARE«

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ABSTRACT

Protected areas of nature are the basic way to preserve geographic and biological diversity. As they present the most valuable natural phenomens, they are at the same time tourist attractions. Biambare Caves- PL Biambare represent the central motive of the protected area. The aim of this article was to identify and valorisate geomorphological and management value of Biambare Caves as well as their tourism importance. Therefore were determined primary and secondary indicators in order to assess scientific, additional, economic and ecological value. Biambare Caves are representative karst&speleological phenomen which is used thrue the protected area for educational, recreative and tourist purpose (eccotourism). However, an optimal use of potentials requires investing in scientific and infrastructure foundament. It is nessesary to focus on the promotion tools and tourist offer/ tourism product especially tourist reception inside and nearbye protected area.

Key words: Protected landscape of Biambare, Biambare Caves, ecotourism, promotion.

INTRODUCTION

According to IUCN criteria implemented at the area of Canton of Sarajevo, there are following protected areas*: Spring of the Bosna river, waterfall Skakavac and Protected Landscape of Biambare* (Đug, Drešković, Hamzić, 2008). Elaborate «Valorisation of natural values at the PL Biambare», whose initiator was Ministry, and the bearer Cantonal Institute for Conservation of Cultural and Natural Heritage of Sarajevo, in cooperation with the Centre for Ecology&Natural Resources, Faculty of Science, University of Sarajevo, it confirmed high natural values of wider area of Biambare. The area of 367,36 ha was declared a protected area under The Law on Nature Protection- UNEP Bosnia and Herzegovina (SN FBiH br. 33/03). The proteced area of Biambare fell into the V category of International Union for Conservation of Nature (IUCN): protected landscape- PL.

THEORETICAL BACKGROUND

Location and Spatial Concept/ Plan of PL Biambare

PL Biambare is located 25 km of air distance to the north of Sarajevo, between villages Nisici and Krivajevici, on the northeast area of Black River plateau. This area include the smaller plateu of Nisici (1500 m), which is located between Biambare Caves (N), Motika (E) & Duge Strane, Borka (S). PL Biambare is the part of municipality of Ilijas that is surrounded with mountains: Zvijezda (N, NE), Ozren (S, SE) & Cemerska mt. (W, SW).

Table 1: The basic geographic data of PL Biambare

IUCN-category: V	Protected landscape: area with significant ecological, biological, cultural and scenic value and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values
Total area	367,36 ha
Year of establishment	2003
State	Bosnia&Herzegovina
Entity	Federacija BiH
Canton	Sarajevo
Municipality	Ilijas
Distance from the city centre	Sarajevo-40 km, Tuzla-80 km

(Dreskovic&Associates, 2015. IUCN. Prepared by Authors)

PL Biambare is divided into 3 functional zones:

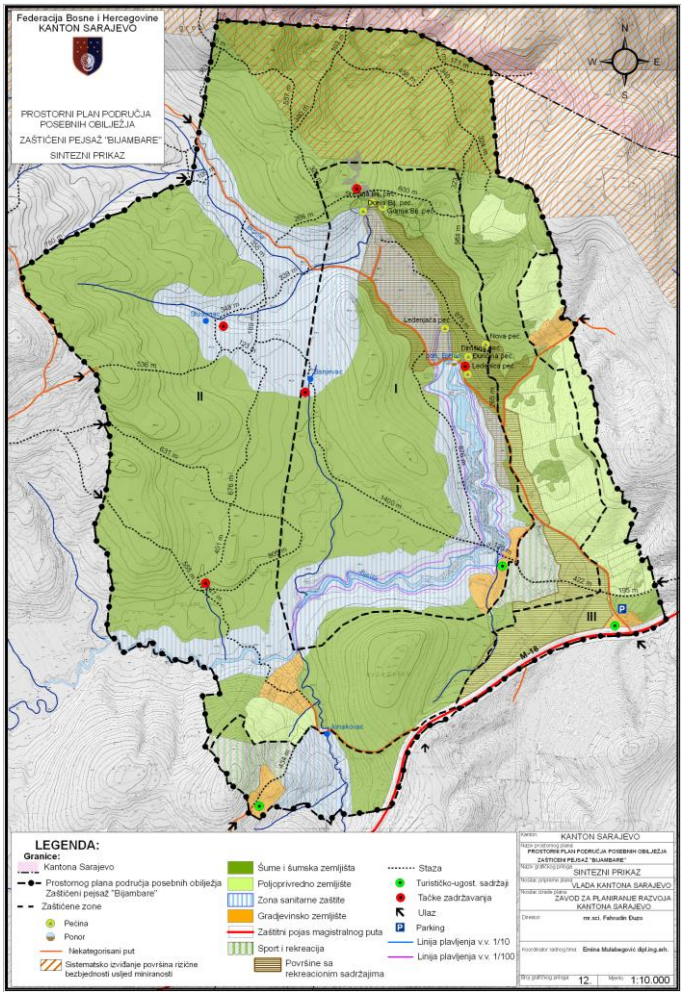
- Zone I- A (nucleus of PL): 133,83 ha
- Zone II- B (buffer zone of PL): 141,04 ha
- Zone III- C (transitional zone of PL): 92,49 ha (Map 1).

Zone I-A: it include the caves as the karst objects with the highest value. There were identified 8 speleological objects: Central/ Main Cave of Biambare, Ledenjaca/ Freezing Cave, Donja/ Down Cave, Djurichina Cave, Gornja/ Upper Cave, Dimshina Cave, Ledenica/ Ice Cave and Nova/ The New Cave (Mulaomerovic, Milanolo, 2011).

Zone II-B: it include well preserved area that is used for conservation of its eccosystems as well as eccosystems in the nucleus. Therefore, it allows different activities: researching, education and recreation. Geological features of this zone are: sinkholes, corrosive forms e.g. karren and sinking streams, while hydrological component is composed by streams of Bjelila and Brodic, as well as springs of Studenac and Junakovac. Floristic composition is made of 133 different life associations and 128 endemic species, while 39 floristic units is identified as vulnerable. There is huge number of medicinal and honey plants which are very useful for the locals, as well as for the protected area itself. Typical representatives of medicinal plants are: Rosa canina, Digitalis, Teucrium montanum, while the honey plants would be: Eranthis hyemalis, Lamium, Tussilago farfara, Taraxacum. Besides, there are various type od willows

and fruit-trees that bloom in the April or May e.g. Salix fragilis, Salix alba, Prunus avium, Prunus cerasus, Aesculus hippocastanum, etc. (Dalmatin, Dreskovic, Djug, 2008).

Zone III-C: it include panonics, sinkholes and channels with hydrological and floristic value. This zone is used for activities in the field of forestry, agronomy, tourism and hospitality, all of it based on the principles of sustainable development (Djug, Dreskovic, Hamzic, 2008).



Map 1: Spatial Plan of Area of Special Characteristics
»Protected Landscape of Biambare«
(Development Planning Institute of the Sarajevo Canton)

Natural-geographical Features of PL Biambare

PL Biambare is the part of Central Dinarids in Bosnia&Herzegovina. The area is composed by werfen slates of the lawer trias, jurassic marl and sandpit, triassic carbonate and alluvium. Biambare Caves genesis relates with their position between persistant rocks and massive carbonates (mid-trias-anisian). Relief diversity is influenced by different petrographic

composition of this rocks. The area of PL Biambare is depressed below surrounding mountains with its elevations range from 915 to 1044 metres (Akcer grave). The depression is 60 metres lawer then the saddles Black River and Cevljanovici, while its mild slope failures toward the Biambare Caves. This area, including the Black River, present karst with its drainage system of Black river. The wider area of the caves is presented by smaller depression formated in the basin of Ljubina, Misoca, Krivaja and the stream of Bjelila. The lateral corrosion at the edge of depression developed the margin caves at different high-levels which is indicator of polyphase cave genesis. The caves were formated during the corrosive processes of carbonate massive and several succesive stages of water horizons (Dreskovic&Associates, 2015). Karst terrain resulted in a limited surface water. The main river is Bjelila that collect water from hole area. There is huge number of perennial and temporary streams, especially in the wider area of Kopitovac. Climate distribution shows the Cfb climate located at the lower levels (up to 1000 m), while above this height is Dfb (Djug, Dreskovic, Hamzic, 2008). *Picea abies* is native to this area; at the same time, the spruce is indicator of D climate as well as for the thermal inversion during the winter season. There is normal distribution of precipitation, but the rainy monthes are May, June and November. The most developed are automorphic soils, while the wetlands present the significant part of the area (Dreskovic&Associates, 2015). There are 133 different associations with over 800 species of vascular plants. There is also huge number of representatives from most faunal groups- mammals, birds, reptiles, amphibians, molluscs, insects. There are also many lower plants of flora with high biological value. The accumulation of sphagnum with water represent the genus of many species (Djug, Dreskovic, Hamzic, 2008).

Content and Activities/ Tourist Attractions at PL Biambare

PL Biambare is attractive to visitors who are interested in speleology, walking in nature, bicycling, riding, hiking, alpinism, fishing, hunting, skiing, collecting medicinal herbs and mushrooms. The protected area is recognized by the rare and unique natural resources with its high scientific and tourism value. PL Biambare has the mountain mobiliar for staying in nature, as well as the playing yard for the kids *("Ancient City")*. Bijambare offers visitors access to walking and biking trails, bike rentals, views of incredible natural beauty while riding in the tourist train, as well as a chance to rest and have some refreshments in a cozy mountain cabin… The greatest attraction, however, is Bijambare Cave, which is full of striking cave formations (stalactites, stalagmites, curtains, basins, pillars…) and about 400 meters of the cave are open to the public. Besides, there is a necropolis „Mramorje“, which is protected historical site that it witnessing continuity of Bosnia&Herzegovina. There is also educational&informative centre („Students Centre“ Sarajevo) and the restaurant with the rich gastronomy offer. There is acces to a licensed tour guide thrue the Biambare Cave, where the visitors can enjoy an impressive touch of the nature and walking the different trails, e.g. *an educational trail* cca 1000 m with the "wood pano" (billboards) that present some of the most valuable natural attractions; the *forest trail* cca 2000 m with the benches for a break, orientation marks and educational billboards as well as the woody bridges and stairs; the *trim trail* for recreation, etc. The kids yard fitting to playing or teaching program *"flexi-learning at open school"* (Ministry of Spatial Planning, Construction and the Environment of Canton Sarajevo, Sarajevo).

METHODOLOGY

Valorisation of the Biambare Caves- PL Biambare was based on the model of Pereira et al. (2007), Pralong (2005) and Reynard (2007) for the assessment of natural, geomorphological and tourist site. There was implemented the three-step assessment process: *a) identification of the caves, b) collecting data (including photo-documentation), c) quantitative evaluation and ranking.* Criteria of identification: *morphogenesis, spatial (location) and tourist accessibility (access, trails and tourist interest)*. Valorisation criteria divided into 2 groups- primarily indicators: *geomorphological* and *management value (max 10 points for each of them)*. Secondary indicators for measuring the morphological value: "scientific" and "additional", while for the management value: "economic" and "environmental" (protection). Indicators of scientific value (max 5.5 points): *rarity (1), preservation (1), representativity (1), paleogeographic importance (1), geo-heritage (0.5), acknowledgement on geomorphological features (0.5) and diversity (0.5).* Indicators of the additional value (max 4.5 point): *ecological (1.5), esthetic (1.5)- panorama (0.5), relief energy (0.5), a visual landscape (0.5) and cultural (1.5).* Indicators of economic value (max 7.0): *accessibility (1.5), visibility (1.5), exploitation/ utilization (1), exploitation of other natural and cultural attractions (1), conservation (1), accomodation & services (1).* Indicators of environemntal value (max 3.0): *preservation (1)* and *vulnerability (2)*. The fieldwork was carried out from October to December 2017 (observations, visiting the referal institutions, survey and the interview). Participants in the assessment process of Biambare Caves- PL Biambare were 5 experts from referal institutions in the field of spatial planning and environmental protection (Municipality of Ilijas, Canton Sarajevo and Cantonal Institution For Protected Areas). Consensus method of interpersonal communication (authors and participants) resulted in a quantitative assessment of Biambare Caves. Cartographic method and application of ArcGis v10.1 enabled spatial visualisation of data with the graphic extension of the concept/ Plan of PL Biambare with its 3 zones (A, B, C) and the following content.

RESULTS AND DISCUSSIONS

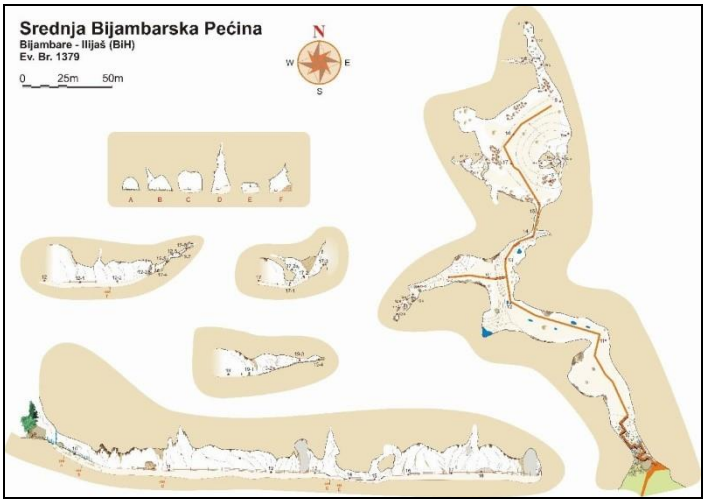
Identification of Biambare Caves

Table 2: Cave objects in the protected area- PL Biambare , Sarajevo

Name	***Length (m)***	***Depth (m)***	***Height (m)***
1. Central/Main Cave	533	-24	959
2. Ledenjaca/ Freezing Cave	323	-51	935
3. Donja/ Down Cave	148	+6/-11	930
4. Djuricina Cave	142	-28	950
5. Gornja/ Upper Cave	112	+10	980
6. Dimshina Cave	108	-30	935
7. Ledenica/ Ice Cave	41	-18	940
8. The New Cave	28	-12	980

(Milanolo, Mulaomerovic, 2007-2008. Edited by Authors)

- ***Central (Main) Biambare Cave:*** It is the most popular cave in the protected area- PL Biambare. It is over 400 m long with a passageway which branches into four chambers ornamented with stalactites hanging from the cave roof extending into spectacular curtains and stalagmites which form the cave floor. The forth chamber is the largest and it is called the *"Music Chamber"* due to its acoustic effects. The Central Bijambare Cave is home to bats and crickets and some other species. There are numerous findings from the Ice Age (animal skeletons) and Paleolite (cave men). A hundred meters from the Central Cave, you will come across the Lower Bijambare Cave, where the Brodic Crook sinks (Tourism Association of Sarajevo Canton). The Central Cave is the longest and its touristically adapted for visitors (trails and electrification). More then a half of this cave is out of the border of PL Biambare which could be threat to its complete preservation. Three of four chambers are the part of the same channel which is oriented to the northwest while the other branch comes from the west. The length of chambers range from 30 to 80 and its width 18-30 meters. Loam covers the bottom of the cave and there is various stalactites and stalagmites and the caves tuff. Significant feature is the flowstone cave formations of various colour from the snow-white to the grey and black (manganese oxide) as well as reddish-brown (iron oxide). The flowstones are found on the cave walls and even on its ground. There is also the cave pearls and the very rich stalactites (Dreskovic&Associates, 2015).



Map 2: Plan of the Central Biambare Cave, Ilijas, Sarajevo, Bosnia&Herzegovina (Milanolo & Mulaomerovic, 2007-2008)



Figure 1: The Central Biambare Cave
(Author: Žunić, L.)

- ***Ledenjaca/ The Freezing Cave:*** This cave was firstly found in 1984 year by the Speleological Society "Bosnia&Herzegovina Karst". The length of the cave was estimated to cca 70 meters. Experts from Italy did research of total cave during the two year period (2002-2003). The cave is located at the edge of small depression which is actualy the old basin of the stream Bjelila. This cave is mostly dry but it takes a function of the temporary abyss cave during the rainy season. There are 3 sections of the cave: *Upper passage*- it has a rounded/ curved shape and it links 3 entrances of the cave. There is also connection with the lower passage and the main pavement cave-ins. *The Main Entrance of the Cave*- it presents temporary abyss. *Lower passage*- it is located few meters under the entrance and it's hydrologically active during the long rainy seasons.
- ***Upper Cave:*** This cave is a true archeological site. There is a wide entrance from the southwest and therefore the first chamber is very lightened, so it was used as an ancient shelter. The ground of the cave is covered with sediments so there is no typical cave formations.
- ***Down Cave:*** This cave is an active abyss of the stream Bjelila. Besides the entrance chamber the rest of the cave is very narrow. There are remains of the stone wall that was used like the dam. During the winter the cave is rich in ice stalactite and stalagmites.
- ***Ice Cave:*** This cave is a cove with the snow during the most of the year. There is the stream in the end of the downfall passage of the cave that is actually linked to the abyss in the lake that was formated by the stream Bjelila. The rest of the narrow passage is a limitation for the further research. This cave is also rich in ice stalactite and stalagmites.
- ***Dimshina Cave:*** This cave is active abyys of the stream Bjelila. However, the entrance of the cave is a few meters above the water level and it's mostly dry. The fieldwork results based on the study of the air circulation in the cave showed the connection between

Djurichina and Dimshina cave as one linking cave system. That's why the cold air from Djurichina cave streams down to Dimshina cave.

- ***Djurichina Cave:*** The research results from 2001-2003 year based on the available documentation of Ržehak (1958) showed the error identification of the cave location. The real Djurichina cave is actually located 60 m further to the northeast and it's not the part of the marked tourist trail. The first section of the cave is covered by grass and shrubs, while the lower one is erosional with the collapsed block stones. The abyss is at the same time the main entrance of the cave. The shorter passage of the cave leads to the fracture oriented from northwest to southeast. The rest of the cave is found after this fracture and it is presented by a large chamber with the roof cave window. There's a small passage (channel) from the main chamber linked to the entrance of the cave on the southwest. This channel could be linked to Dimshina Cave. This cave has been assigned as a natural monument since the fifties of the 20th century.
- ***The New Cave:*** This cave is located above Djurichina cave and it's very simple. It has a descending passage with the small chamber (Drešković i saradnici, 2015).

The biggest attractions are The Central Cave, Upper Cave and Djurichina Cave. Other caves because of their active hydrological function (abysses) could be the complementary component of the tourism offer (the educational role in protected area).

Valorisation of Geomorphological Value of Biambare Caves

The evaluation results for geomorphological (scientific and additional) value of the Biambare Caves showed 8.33 points from the total of 10 points.

Table 3: Scientific Value of the Biambare Caves

SCIENTIFIC VALUE OF THE BIAMBARE CAVES (max 5.5)		
Parameter	***Value***	***Description***
Rarity	1	Unique
Preservation	0.75	Slightely damaged, but with well kept native geomorphological features
Representativity	1	Good example of processes and/ or good pedagogic resource
Paleogeographic importance	0.75	High importance
Geological formations as a geo-heritage and/or with the impact on a relief	0.33	Geological formations with the impact on a relief
Acknowledgement on geomorphological features	0.25	Medium: National level, tourism articles, brochures
Number of relevant (significant) geomorphological forms and /or features-diversity	0.5	More then three (>3)
Total=4.58		

(Adaptive assessment based on the models: Pereira et al. (2007), Pralong (2005), Reynard (2007). Employee Assessment Surveys-Experts, 2017. Authors)

Scientific value of the Biambare Caves was assessed to 4.58 from the total points- max 5.5. This caves were recognized as a geomorphological monument of nature as they are very representative at processes related to its genesis and karst phenomenology of Bosnia and Herzegovina. That's why the highest value was found at 3 parameters: rarity, representativity and diversity. However, the moderate acknowledge of geomorphological features indicates the national importance. Therefore, it is necessary to build the scientific image of Biambare thrue the promotion tools particularly at the scientific conferences and the base isi (international scientific information- indexing).

Table 4: An Additional Value of the Biambare Caves

AN ADDITIONAL VALUE OF THE BIAMBARE CAVES (max 4.5)		
Parameter	***Value***	***Description***
Ecological value	1.5	Geomorphological forms are crucial for ecosystem
Esthetic		
Panorama	0.5	>6
Contrast & Relief energy	0.25	Moderate
Chromatic contrast- a visual landscape	0.25	Different colours
Cultural value	1.25	Important material cultural objects connected with the relief forms
Total=3.75		

(Adaptive assessment based on the models: Pereira et al. (2007), Pralong (2005), Reynard (2007). Employee Assessment Surveys-Experts, 2017. Authors)

An additional value of the Biambare Caves was assessed to 3.75 from the total points- max 4.5. The highest value was found at ecological side as this area is recognized by its huge biodiversity. Particularly significant is a living cave world (e.g. *Barbastella barbastellus,* etc.).

Valorisation of Management Value of Biambare Caves

The evaluation results for management (economical and conservation) value of the Biambare Caves showed 6.22 points from the total of 10 points.

Table 5: Economical Value of the Biambare Caves

ECONOMICAL VALUE OF THE BIAMBARE CAVES (max 7.0)		
Parameter	***Value***	***Description***
Accessibility	0.86	Osobnim autom, asfaltiranom i /ili makadamskom cestom i >200 m pješačkom stazom
Visibility	1.2	Dobra vidljivost za sve važne geomorfološke karakteristike
Exploitation/ utilization of geomorfological attractions	1.0	Promoviran i/ili korišten kao geolokalitet
Exploitation of other natural and cultural attractions	0.33	S drugim znamenitostima, ali bez promocije i korištenja

Conservation	0.33	Zaštita s ograničenim korištenjem
Accomodation & services	0.25	Smještaj i prateće usluge udaljene 10-15 km
Total=3.97		

(Adaptive assessment based on the models: Pereira et al. (2007), Pralong (2005), Reynard (2007). Employee Assessment Surveys-Experts, 2017. Authors)

Economical value of the Biambare Caves was assessed to 3.97 from the total points- max 7. The highest value was found at recent exploitation of geomorfological attractions as the caves are the part of protected area- PL Biambare. Therefore there are incentives for the area promotions and the tourism offer improvement. However, there's a weak exploitation of other natural and cultural attractions in this area because of lack of acknowledgement and very modest receptive infrastructure. That's why the lowest value was found at sector of accomodation&services as this area doesn't offer an overnight stay (there's only a day visit concept). This is one of the key problems for the tourism development of municipality Ilijas where the PL Biambare is located. The good thing is that there's a very positive trend of tourist interest for this area. That's why there should be invested in a projects with the aim to enable building a tourism infrastructure- accomodation objects and other contents & services for tourists. There's also a relatively lower value at accessibility of objects because of the mountain topography and the local macadam roads that might be asphalting at some points on condition their previous research.

Table 6: Conservational Value of the Biambare Caves

CONSERVATIONAL VALUE OF THE BIAMBARE CAVES (max 3.0)		
Parameter	***Value***	***Description***
Preservation	0.75	Slightely damaged, but with well kept native geomorphological features
Vulnerability as the results of utilization	1.5	The damage can appear only at the accessible structures
Total=2.25		

(Adaptive assessment based on the models: Pereira et al. (2007), Pralong (2005), Reynard (2007). Employee Assessment Surveys-Experts, 2017. Authors)

Conservational value of the Biambare Caves was assessed to 2.25 from the total of 3 points. The Biambare Caves are the part of I zone of the protected area (nucleus) with its highest values that must be integratively preserved. Conservation of this caves flows thrue the check-in system with the maximum capacity of 30 visitors at one sightseeing so there hasn't been found any physical damage of the cave formations neither the noise pollution that might interferes with normal activities and disrupts quality of animal life (Ministry of Spatial Planning, Construction and the Environment of Canton Sarajevo, Sarajevo).

CONCLUSIONS

The Biambare Caves have a high geomorphological value because they are rare and representative karst&speleological phenomen. From the tourism, spatial and scientific point of

view, this caves own recognized national importance that should be improved with their promotion at the global tourism market and with its participation in the international scientific events (conferences, projects and ISI). Toward the management value of the Biamabre Caves there's a little bit lower result particulary at its economical value. The caves are used as the part of protected area- PL Biambare but there's a limited capacity of their exploatation because some are still missing the tourist adaptation. Besides the caves, there's a huge potential of other natural and cultural attractions in this area which haven't been explored yet or there's no adequate tourism content & programs. PL Biambare represent extremely precious natural, geographical, geomorphological, biological and ecological, as well as tourism and recreative heritage. This area, beside the environmental protection, should participate more in the tourism economy and science&education of Canton Sarajevo and the whole country. Therefore it is nessessary to improve the tourism offer and hospitality (accomodation&services). The spatial plan of PL Biambare allows the economical activities in the third zone (III), as well as out of the area border where should exist the staying reception nearby. Staying concept in/ or nearbye protected areas has a positive trend worldwide with a complexive benefits especially for the locals. The main goals of the ecotourism development in the PL Biambare would be: conservation of biodiversity, benefitions for locals, education, responsible tourism & positive impacts, interest of steckholders particulary the small corporations, minimal exploatation of a nonrenewable resources, participation of locals, property rights and the entrepreneurial opportunities especially for the rural residents. It's also important to affect the ecological thinking at visitors and locals via educational (brochures, billboards) and audio-visual materials (video clips and internet presentations). IUCN guide for protected areas emphasize the role of informations for the visitors (from the simple facts of area e.g. location, visit duration, the ticket price, etc. up to a very complexive interpretations of natural heritage). Informative program should result in increasing interest of tourists for the protected area as well as their deeper impressions. PL Biambare is very good foundament for the tourism development that could be improved with an adequate infrastructure and professional stuff. This is confirmed by the facts (2015) that the area had 51.682 visitors, while 79% of them experienced the eco-train tour and 36% visitied the Central Cave (Cantonal Institution For Protected Areas, 2016). PL Biambare is getting more tourist interest lately because of its positive image (recommendations) that is highly influenced with the recent structure of visitors- mostly Arabs that are actualy seeking/ or longing for this type of *"green motives"* (Žunić, 2017). The authorities should prepare a qualitative documentation, strategies and the plans to regulate the tourism activities with the aim to create a sustainable tourism and financial benefits. There should be focused to tourism diversity and available packages as different type of tourist activites results in a bigger material benefits. The process of tourism development should be followed by locals & local community, tourism association, steckholders, science institutions, etc. The authorities at all levels should recognize the priority of investing in a qualitative projects with the potential European fund support that would stimulate tourism of PL Biambare and the Ilijas municipality.

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