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HNV farming in the area of the Radan mountain and the role of agri-environment payments

Abstract: EU CAP reform after 2013 envisages strengthening of agri-environment measures of support, tailored to local specificities, in particular HNV areas and Natura 2000 sites. Additional support would be directed to the development of local markets, promotion of quality local products (including organic) and regional development initiatives.

Concept of high nature value farming (HNV farming) is interesting for Serbian agriculture, having in mind the vast areas of mountain pastures and meadows and numerous protected areas as well as the opportunity of using IPARD funds to pilot HNV farming support measures.

The analysis of agricultural resources and biodiversity in the area of the Radan Mountain points out significant potentials for HNV farming, but also severe socio-economic and infrastructural constraints that lead to land abandonment and degradation of valuable natural resources.

Agri-environment payments, in parallel with infrastructure and rural diversification support measures will contribute to economic viability of HNV farms and rural communities.

Keywords: High Nature Value farming, agri-environment payments, sustainable rural development.

EU Biodiversity strategy 2020 puts sustainability of agriculture, together with forestry and fishery, among six key tasks on whose achievement will depend the “stopping of fast biodiversity loss and ecosystem services degradation in EU to 2020, and their restoration, to the extent possible, as a contribution to prevention of biodiversity loss at global level” (2020 EU headline target). **Candidate countries are invited to give active contribution to the implementation of the Strategy, by adapting and developing national support policies.** Stronger cooperation among researchers and other stakeholders in spatial planning and land management activities is encouraged to provide coherency with the goals of the Territorial Agenda of the EU (EC, 2011).

CAP response to this complex task implies “greener, fairer, more efficient and more effective politics”, which can efficiently use the advantages of different production structures and production systems across the Union, in a way which is going to strengthen its territorial and social cohesion. EU CAP reform after 2013 envisages strengthening of support to environmental protection, mitigation and adaptation to climate change and innovation in these areas. Investments would obligatory include ecological performance. Agri-environment measures would respect locally specific needs, especially of High Nature Value (HNV) areas and Natura 2000 sites. Additional support for development of local market is proposed together with promotion of quality local products (incl. organic) and regional development initiatives (IP/10/1527).

Nearly one third of agricultural area in EU has HNV characteristics (Paracchini et al., 2008). Agricultural habitat types represent 17 % of the terrestrial part of Natura 2000 sites and depend on implementation of low intensity production practices and maintenance of ecological infrastructure in agriculture (EEA, 2006).

These areas give key contribution to protection of climate, natural resources, biodiversity and landscapes, but today widely across the Europe they are under large pressure of intensive agricultural production, infrastructure development and mass tourism, on one side, and under abandonment of production in less accessible marginal parts of these areas, on the other side (EEA, 2010).

Active support to their protection and sustainable development is of crucial importance for permanent ecosystem service providing. Agri-environment measures, adjusted to HNV farming characteristics represent one of the most important instruments for the realization of that support.

The High Nature Value farming concept was established in the early 1990s and describes those types of **farmland** and **farming activity** that, because of their characteristics, can be expected to support high levels of biodiversity or species and habitats of conservation concern (Baldock et al., 1993; Beaufoy et al., 1994; Bignal and McCracken, 2000).

HNV farmland refers to farmland characterised by the presence of particular land cover types and patterns (especially semi-natural vegetation and low-intensity crop mosaics) which indicate that this farmland is valuable for nature conservation.

According to Andersen et al. (2003), three types of HNV farmland have been defined:

- Type 1 – Farmland with a high proportion of semi-natural vegetation,
- Type 2 – Farmland with a mosaic of low-intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc (modified Paracchini et al., 2006),
- Type 3 – Farmland supporting rare species or a high proportion of European or World populations.

The definition of three types of HNV farmland is a useful tool for understanding the concept and for identifying HNV farmland on the ground in different situations. However, there is no concrete line dividing the three types. Rather, there are significant overlaps between them, and many areas of HNV farmland will combine elements of 2 or 3 HNV types (Paracchini et al., 2006).

HNV farming system refers to both the land cover (farmland) and the way it is managed for production by a particular farming system and practices. High nature value results when certain patterns of land cover (those with a high proportion of semi-natural vegetation and a diversity of types) are managed for production in a particular way (under low intensity systems and with particular farming practices). The term **HNV farming** (and HNV forestry) is used as an umbrella term to refer to the overall concepts without distinguishing land from management system (Lukesch, Schuh, eds., 2010).

HNV farming is usually associated with **traditional agricultural landscapes**, which are characteristic for areas of “family, dominantly natural agriculture, where traditional or locally specific production methods shape esthetical values of the space, supporting at the same time its ecological integrity” (IIEP, 2007).

Besides the presence of agro-ecosystem and landscape characteristics, low intensity farming practices need to follow a number of **socio-economic drivers** which shape the HNV farm structure. These drivers are being observed in the context of sustainable development of rural economy and entire local community and they represent the basis for establishment/correction of agri-environmental schemes and other measures of support to rural development in the area observed (Jean-Baptiste, Romain, 2010; Astrain et al., 2010; Beaufoy, 2010).

Agri-environmental payments, in combination with the support to processing and marketing of high quality agricultural products and development of other rural non-farm activities, **primarily tourism based on nature**, contribute to sustainable development of HNV areas, in accordance with the above mentioned EU priorities.

The HNV farming concept is interesting for Serbian agriculture, having in mind the biodiversity of rich vast mountain pasture areas as well as the large number of protected areas. Also, small holdings with traditional presence of low intensity livestock and crop production are responsible for the mosaic land structure in Central Serbia.

Serbian Rural Development Program 2011-2013, within Axis 2, is planning budgetary support to organic production and preservation of rare and endangered breeds of domestic animals. Application of other agri-environment payments, including those related to biodiversity and landscape diversity conservation¹ until 2014 will be conducted through IPARD pilot projects² (Official Gazette of the Republic of Serbia, No. 15/2011).

HNV farming identification and mapping in Serbia was developed within the IUCN SEE project "Support to agri-environmental politics and programs in Serbia" (2008-2010). Using relevant CORINE 2006 land cover classes and IPA, PA, IBA, PBA or Habitats layers data, the area of 11,872 km² has been determined (19% of agricultural area or 13% of the territory of Serbia). This area consists mainly of HNV farmland Type 1, where there is a history of, or current practices of traditional low intensity livestock farming systems. Based on this work, the draft of **National Agri-environment Program** (NAEP) has been designed and includes a range of agri-environment payments within five schemes of support for: organic farming, traditional breeds, HNV farming, landscape features and soil and water protection (Cooper, Pezold, eds., 2010).

First experiences with HNV agri-environment payments are noted in the pilot area of Stara Planina, within WB GEF STAR project in Serbia.³ Grassland management scheme included more than 400 grazing livestock units, of which 270 were autochthonous breeds. One of the necessary preconditions for efficient implementation of the project was organized stakeholder cooperation⁴ (EFNCP, 2011).

South-East Europe HNV farming network member countries have also shown interest for HNV farming and development of relevant support politics in the region through exchange of experiences and best practices (Kazakova, Stefanova, 2010).

Data sources and used methodology

Research was based on the quantitative and qualitative analysis of agricultural resources in the area of the Radan Mountain, conducted by one of the authors of this paper in the period 2010-2011, during the elaboration of the Spatial

1 Art. 39. and 40. Reg. (EC) 1698/2005. and Reg (EC) 74/2009, Annex II.

2 Reg (EC) 718/2007, Art. 177.

3 http://siteresources.worldbank.org/INTSERBIA/Resources/STAR_ProjectBrief.pdf.

4 Associations of producers, clusters and local action groups have the key role in local development strategies programming and implementation as well as local authorities that coordinate these activities (Popović et al., 2007, Tomić et al., 2009, Nikolić, Popović, 2010).

Plan for Special-Purpose Area of the Radan Mountain (Popović, 2011). The study of the Institute for Nature Conservation of Serbia (INCS) on putting under protection the Landscape of outstanding features “Radan” was a precious source of information about natural resources and biodiversity of the area observed. Also, the data of The Statistical Office of the Republic of Serbia (SORS) and The Republic Geodetic Authority (RGA) were used. A number of scientific papers, project results and official documents of European institutions, networks and organizations, relevant for HNV farming and support politics, were analysed and quoted. The authors also consulted national legislation, documents of national and local administrations and the site of the native association “Pusta River”.

On-desk research was combined with field research and sample surveys. Results were processed using standard statistical methods. EU methodology for identifying HNV farming⁵ was used (Beaufoy, Cooper, 2009; Lukesch, Schuh, eds., 2010), to the extent that the availability of data allowed this. Analytical procedures applied in the “Stara Planina” case study has also been taken into account (Cooper, Pezold, eds., 2010). During the discussion and formulation of conclusions and suggestions, the analytical-sintetical method has been used.

Research results and discussion

Introduction to the Case Study Area

The area of the Radan Mountain is located in southern Serbia, between upper streams of the Kosanica River, the Pusta River and the Jablanica River. Heterogeneous hilly and mountainous relief, with numerous peaks, slopes and valleys in the area of about 469 km² lies at an altitude of 280 – 1408 m (RAPP, 2011).

The wider Radan area has semiarid temperate continental (subcontinental) climate, with total annual precipitation of 620 - 760 mm. Mountains Pasjača, Viđojevića, Rgajska and Sokolovića protect this area from cold, wet winds from the north and west, while to the east and south it opens to Leskovac Valley, exposed to the influence of sub-Mediterranean climate, that penetrates from Aegean Sea through South Morava Valley.

The area is rich with watercourses and has the largest complexes of well-preserved beech and oak forests in Serbia, important for prevention of dry winds penetration from the south to the north of the country.

The **soil cover** was formed on andesites of Lece andesite massif, one of the largest volcanic complexes of Serbia. Arable land (I-IV Land capability classes - LCC) is present in smaller extent on the fringes of the area, where

⁵ In order to establish the baseline situation against which the changes in HNV farming will be measured in the context of Common Monitoring and Evaluation Framework evaluating the effects of RD support.

they alternate with arable land of V LCC. This land has serious production limitations and is therefore recommended for grassing and afforestation. Poorly productive land of VI-VIII LCC is mainly located in the central mountain zone and is predisposed for pastures and forests (INCS, 2002).

The Radan Mountain Area is characterized by significant degree of **species and ecosystems diversity and landscapes and geological heritage phenomena of exceptional value**.

Wild plant and animal life consists of: 960 taxa (species and subspecies) of higher (vascular) plants, categorized in 370 genera and 100 families; fungi, moss and lichens with total 190 identified species so far; 100 bird species of which 94 are nesting species and 57 are nesting-resident species; 29 mammal species, without completely explored bat fauna which counts at least 12 species; 17 representatives of herpetofauna (8 reptile species and 9 amphibian species), 12 fish species and 295 identified insect species so far.

There are 3 plant species, 3 insect species and 1 bird species on the global IUCN Red List of Endangered Plant and Animal Species, and 3 plant species and 6 insect species on the European list. Among numerous ornitofauna, 35 bird species are of international importance (categories SPEC 1-3) and there are also 90 migratory species.

Of *strictly protected wild species*, determined by the Rulebook on Designation and Protection of Strictly Protected and Protected Wild Flora, Fauna and Fungi (Official Gazette of the Republic of Serbia, No. 5/2010), the area has around 20 plant species (including fungi, lichens and moss) and around 95 animal species – mostly birds (around 50 species), and of *protected wild species*, it has around 80 plant species and over 100 animal species – mostly birds, insects and mammals (RAPP, 2011).

There are 28 **plant communities** at forests, meadows, pastures, and rocky habitats. The most widespread herbaceous vegetation is that of **hilly meadows and pastures, class *Festuco-Brometea***, and there are also valley meadows and fragments of marshy meadows.

Around 11 **landscape types** are detected at the area of the Radan Mountain and among them, the geomorphological formation Devil's Town is unique.

Radan is on the List of ecologically important areas (Official Gazette of the Republic of Serbia, No. 102/2010), potential EMERALD areas and prime butterfly areas (PBA) in Serbia (MESP, 2011).

According to the Proposal of the Institute for Nature Conservation of Serbia (2002)⁶, **protected area** category II is predicted for Landscapes of outstanding fea-

⁶ According to the Draft of Spatial Plan of the Radan Mountain Special - Purpose Area, Spatial plan covers the protected areas of: 1) the Radan Mountain (Nature monument Devil's Town and protected area

tures “*Radan*” which corresponds to IUCN category IV (Habitat/Species Management Areas: protected area managed mainly for conservation through management intervention) (INCS, 2002).

For protected areas of category IV, it is necessary to provide continuous intervention of man regarding maintenance of rare and endangered plant and animal species and their habitats, by active application of traditional management methods of natural and semi-natural ecosystems. That, in addition to contribution to the main goal, also contributes to successful implementation of landscape protection strategies and public awareness development regarding the importance of habitats and species, and openness for visitors enables establishment of contact with nature for urban population (Dudley, 2008).

Socio-economic situation is characterized by depopulation and land abandonment processes that seriously threaten biodiversity and the survival of rural communities⁷.

According to the 2002 Census, among 4,847 residents in this sparsely populated and traditionally emigrational area with poor infrastructure, 28.3% is engaged in agriculture. Besides that, the labor/arable land ratio is still unfavorable – 1 farmer maintains in average 15ha (in 8 cadastral municipalities (CM) this number is reached, and in two CM it by far exceeds 100 ha). Semi-subsistence agricultural production takes place on small family farms with average size of 2.03ha of arable land.

Holding population accounts 3869 inhabitants, of which 70.4% was older than 50 years of age and 76.9% had only elementary school education – incomplete or complete. Out of 39 settlements, in 18 there were no children younger than 14 years of age at holdings.

Nearly one fifth of holdings obtain income exclusively from agriculture, 58% from non-agricultural sources, predominantly pensions, 18.5% from agricultural and non-agricultural sources (predominantly combination of income from agriculture and pensions), and 3.5% outside of holding (SORS, Census, 2002).

Identification of HNV farming in the area of the Radan Mountain

A combination of indicators relating to **land cover data**, **farming characteristics and practices** and **species data** will be used to provide an estimate of the extent of HNV farming. RGA land cover data are given at the cadastral

“Radan”), at provisional area of 237 km² and, in the rest of the area of about 232 km², the protected areas of 2) the accumulation “Brestovac” basin of about 42 km² and cultural heritage of outstanding value “Empress’s Town” (Iustiniana Prima – UNESCO WH Tentative List, 2010, <http://whc.unesco.org/en/tentativelists/5539>), with a protective area of about 6 km², (RAPP, 2011).

⁷ These trends are obvious in a number of settlements in the east of the area that are considered to be more viable than those in the rest of the area, <http://www.pustareka.org.rs/naselja.htm>.

municipality level (farm + off-farm level) and then aggregated at the level of agricultural zones⁸ and the level of the total area observed. Livestock data originate from The SORS 2002 Census and species and habitats data from the Study of the Institute for Nature Conservation of Serbia (2002).

Low-Intensity Livestock

The most widespread type of HNV farming consists of semi-natural vegetation under low-intensity livestock grazing.

Semi-natural pastures and hay-meadow

Out of 46,918ha of the total area, utilized agricultural area (UAA) makes up 22,927ha (49%) while forests cover 22,069ha (47%). The share of agricultural land in total is highest in the hilly zone – 75%, in the sub-mountain zone it is at the level of 49 % and it is lowest in the mountain zone – 36%.

In the structure of utilized agricultural land the largest part is made up from hay-meadows (31 %) and pastures (29 %). Meadows and pastures are the most important, but underused agricultural resources of the area. They spread over 13,776ha (7,208ha of meadows and 6,569ha of pastures) and form the basis for the development of livestock grazing and production of high quality beef, sheep and goat meat and milk.

Most of the meadows and pastures is located in the sub-mountain (42%) and mountain zones (40%) and have the largest share of the UAA in mountain CM: Djake (87%), Vlasa (85%), Mehane (84%) and Gajtan (83%).

Except in the hilly area, where there are more meadows than pastures, meadows participation increases with altitude, but the pastures are of generally better cadastral structure – 65% of pastures and 28% of meadows in the area are 1-5 cadastral class.

Meadows are almost entirely (97%) in private ownership (family holdings), but more than half of the pastures (56%) is in other forms of ownership and represents common grazing areas (RGA, 2010).

According to the research of the Institute for Nature Protection of Serbia (2002), most of these areas are semi-natural meadows and pastures, with significant biodiversity and biomass potential, but they have for a long time been affected by natural succession due to lack of regular grazing or mowing.

⁸ Respecting the altitude, slope, land use by crops and land quality, the Radan Mountain agricultural area is divided in the following agricultural zones: the hills - 9322 ha at an altitude of 350 - 600 m, sub-mountain zone - 18420 ha (600-800 m) and mountain zone - 19176 ha at an altitude above 800 m.

The practices of resowing and intensive fertilizers application are recorded only on very limited areas of valley meadows and pastures.

The most significant association of hilly meadows, by its presence and biomass yield, is *Inulo-Danthonietum calycinae* K. and it exists at the south and south-west slopes of Sokolovica, at 400-700m of altitude and the lower part on Sokolov Vis and Radan. The most present association of hilly pastures is *Astragalo-Calaminthetum alpinae*, in the forest zone at 400-500m of altitude (INCS, 2002).

In addition to semi-natural grasslands, large areas under shrubs and bushes, which are formed of elm, oak, beech, hazelnut, etc. and cover over 2,100ha can also be used for grazing.

Stocking density

Livestock is poorly developed, particularly given the available fund of meadows and pastures - 0.1 livestock units per hectare of utilized agriculture areas (0.1 LU/ha of UAA)⁹. It is most intense in the hilly zone (0.2 LU/ha) where forage is dependent on the grain to a great extent, given the larger share of arable land in the structure of the agricultural area. In the sub-mountain and mountain zones, this ratio is 0.1 LU/ha.

At the level of cadastral municipalities (CM) there are significant differences – stocking density is greatest in hilly CM: Svinjarica (0.5 LU/ha), Prekopčelica (0.4 LU/ha), Štulac (0.3 LU/ha) and Bačevina (0.3 LU/ha). In the sub-mountain zone only Petrovac CM has 0.3 LU/ha, while in the mountain zone, this ratio is the highest in CM Prolom and reaches 0.2 LU/ha.

For the preservation of semi-natural grassland in mountain and sub-mountain zones, the number of grazing animals (cattle, sheeps, goats and horses) per hectar of meadows and pastures is more important. Only in one out of 27 cadastral municipalities this ratio is higher than 0.2 LU/ha of grazing area and reaches the level of 0.4 LU/ha whereas in 4 mountain and sub-mountain CM it is lower than 0.1 LU/ha.

This situation in livestock breeding to a large extent endangers the survival of semi-natural grassland. It seems hard to maintain semi-natural meadows and pastures in mountain and sub-mountain zones in good agro-ecological conditions with 0.1 LU/ha of UAA, i.e. with the same ratio level of grazing animals per hectar of grazing area¹⁰.

⁹ For the calculation of this indicator the Census 2002 data of livestock (SORS) and cadastral data of total utilised agricultural area, performed at the cadastral municipality level (RGA, 2010) were used.

¹⁰ Having in mind the requirement contained in agri-environment measure: Restoration and maintenance of undergrazed HNV grasslands of min 0.3 – 1.0 grazing LU/ha of grazing area, as envisaged in NAEP draft (Cooper, Pezold, eds., 2010).

Land cover

Arable land includes 34.5% of the total UAA in the area observed (in the hilly zone this percent reaches 56%, in the sub-mountain 31% and in the mountain zone only 17%). The hilly zone contains one half out of 7,906ha of total arable land and 78% of this land is 1-5 cad. class, appropriate for cultivation. Arable land in the sub-mountain and mountain zones has low production potential. Less than 20% of mountain arable land has 6 cad. class and more than 70% 7-8 cad.class, but their maintenance in forest surrounding is necessary for preservation of biodiversity and mosaic landscape.

Grains are dominant – wheat, maize and to a lesser extent oats. Forage crops (clover, lucerne) are found on unreasonably small areas. Low-yield production of wheat and maize on poorly productive land in the sub-mountain and mountain zones should be largely replaced by the production of rare species of grain (oats, rye, barley, millet, buckwheat, etc.), forage crops and orchards containing indigenous varieties of fruit.

Vegetables are grown primarily in river valleys of Toplica and Kosanica (pepper, tomato, cabbage) and potato on higher altitude terrains. Several dozen species of wild edible vegetable plants are particularly important for biodiversity conservation, and some species of the genus *Allium* have a market potential (INCS, 2002).

Considerable areas of arable land are not being sown. In 2010 in the Lebane municipality, 88% of arable land was sown, in Prokuplje 80%, in Kuršumljija 78%, in Bojnik 77% and in the Medvedja municipality only 61%. At national level this percent was 93% (SORS, 2011).

Orchards and vineyards, for which there are very good soil conditions and centuries-old tradition, especially in the hilly zone (41% orchards and 83% vineyards), at the margins of the Leskovac basin and in the sub-mountain zone (38% orchards and 15% vineyards), are not sufficiently present – only 5.4% of UAA (1,244ha), of which orchards have 4.9% (plums, apples, pears, apricots, cherries and sour cherries).

A small number of most intense fruit plantations is located on the east fringes of the area, that gravitate towards the Leskovac valley. It is necessary to use the favorable soil and microclimate conditions in the area for growing new plantations of fruit and berries (raspberries, blackberries, blueberries), but producers should be directed towards the application of integrated protection and plant nutrition production methods.

However, most of the existing orchards, particularly in the sub-mountain and mountain zones, are traditional, with large old trees of autochthonous varieties (such as wild pears) and a semi-natural understorey, usually mowed¹¹ or grazed by livestock.

Together with rich fund of forest berries, aromatic and medicinal herbs (89 registered species under the controlled use and trade) they make significant source of geno-potential (INCS, 2002).

Traditional orchards contribute to erosion control, stabilization of microclimate and protection of rural landscape and serve as habitats for endangered and rare species of plants and animals and for these reasons is their preservation very important.

Low-intensity use of inputs

Unfortunately, there are no available statistical data about **fertilisers and pesticides use** per hectare in agriculture at the holding level. However, informations gathered on the field and by simple surveys during the elaboration of the Spatial Plan for Special-Purpose Area of the Radan Mountain confirm that the use of modern machinery, fertilizers, pesticides and highly productive varieties and hybrids is minimal and that larger part of arable land is not being cultivated or that cultivation is not adequate, due to depopulation processes and aging of the farmers¹². Indirectly, this should be confirmed by the average yields of arable crops, fruit and grapes (*Table 1*).

Table 1. Yields of arable crops, fruit and grapes (average 2008-2010)

	Wheat, kg/ha	Maize, kg/ha	Beans, kg/ha	Potatoes, kg/ha	Clover, kg/ha	Lucerne, kg/ha	Apples, kg/tree	Plums, kg/tree	Grapes, kg/vine
<i>Bojnik</i>	3,335	4,448	2,799	14,352	5,175	5,409	20.0	24.3	2.1
<i>Lebane</i>	2,979	3,697	1,803	5,160	3,472	6,818	17.3	14.5	1.0
<i>Medvedja</i>	3,283	4,561	932	6,612	3,849	3,822	33.6	14.1	1.2
<i>Kuršumlja</i>	1,782	2,062	950	3,196	2,251	3,203	15.6	7.1	0.5
<i>Prokuplje</i>	3,242	3,895	1,094	6,600	5,286	6,029	15.9	14.9	0.9
Republic of Serbia	3,558	5,167	1,163	11,152	4,429	5,742	16.2	13.6	1.3

Source: SORS. Municipalities in Serbia, 2009; 2010; Municipalities and Regions in the Republic of Serbia, 2011.

These data are, however, only available at the level of municipalities, which only with a small, poorly productive, mountainous part of its territory belong to the observed area¹³, which must be taken into account in the yield analysis.

¹¹ This practice is also confirmed by statistics with the remark on inclusion of the „yields of hay from fallows, uncultivable arable fields and orchards into the yield of meadows“ (SORS, 2011).

¹² <http://www.pustareka.org.rs/naselja.htm>.

¹³ Bojnik municipality participates in the area observed with 30.6% of the territory, Kuršumlja with 17.8%, Lebane with 16.2%, Prokuplje with 13.9% and Medvedja with 11.3% (SORS, 2011, RGA, 2010).

About 50% of entire arable land, 41% of orchards and 83% of areas under grape vine is located in the **hilly zone**, in the east of the area¹⁴. **Submountainous zone** spreads widely around the central mountain massive Radan and includes 36% of entire arable land, 38% of orchards, 15% of vineyards, 43% of meadows, 41% of pastures and 39% of forests. **The mountain zone** contains about 15% of entire arable land, 21% of orchards, 43% of meadows, 37% of pastures and 53% of forests.

The mosaic landscape of small low-intensity used arable land parcels with different crops, fallow land and traditional orchards alternate with semi-natural meadows and pastures, beech and oak forests.

This landscape is widely present in the whole area, especially in the submountain and hilly areas, with a greater share of arable land and permanent crops in the total land area. In addition to field surveys, that fact also, indirectly, indicates the **average size of arable land per farm** and the **number of land used parcels per holding**¹⁵. These data originate from the Census 2002 (SORS) and are given at municipality level.

Farms in the municipalities, that belong with the respective part of its territory to the area observed, used an average of 1.59ha of cultivated land (Municipalities Kuršumlija) to 1.97ha (Medvedja municipalities), which was significantly lower than the national average of 2.46ha. The number of parcels of land used per holding in the municipality of Kuršumlija is the lowest – 4, which is the national average, while holdings in municipalities Prokuplje and Medvedja consist of five, in the municipality of Bojnik of six, and in the municipality Lebane of even seven parcels. The average size of these land parcels ranged from 0.5ha (Lebane, Bojnik, Prokuplje) to 1.5ha (Medvedja).

Crop rotation is a traditionally used production practice in this area in the absence /limited use of fertilizers and pesticides and it results in significant **crop diversity** on the sown area. **Fallows** are also very common as well as uncultivable arable fields. These categories, together with nurseries, areas under willow groves and poplars on arable fields, and areas under flowers and decorative bushes made between 12% (Lebane municipality) and 39% (Medvedja municipality) of arable land in 2010 (SORS, 2011).

Traditional, extensive agricultural production which is preserved in these areas, due to limited accessibility and intensive emigration, and which is firmly incorporated in the cultural-historical heritage is entirely harmonized with intention of biodiversity protection by providing limited human activities in the area.

¹⁴ Except CM Visoka in the north-west of the area.

¹⁵ The arable area includes the following categories of land: arable fields and gardens, orchards, vineyards and meadows. The total area used includes the following categories of land: arable fields and gardens, orchards, vineyards, meadows, pastures, marshes and ponds, forests, shrubs and infertile land.

Habitats and Species

In the absence of reliable statistics on the extent of **semi-natural features**, a number of *habitats relevant for HNV farming* from the **List of habitats**, identified on the area according to the CORINE classification, could be helpful:

- **Land principally occupied by agriculture with significant areas of natural vegetation** – arable land parcels, orchards, vineyards and, to a lesser extent in the east of the area, re-seeded and fertilized meadows, bordered by semi-natural features, like groups of trees, tree lines, hedgerows, patches and groves, that are of special interest for indication of HNV farmland;
- **Water bodies** – natural and artificial lakes, including accumulations, bogs, swamps and ponds (Brestovac lake and five smaller periodic lakes in the vicinity of Prolom Spa, a number of ponds for rainbow trout breeding);
- **Watercourses** – include river basins of Toplica, Pusta River and Jablanica;
- **Shrubs, bushes, juniper and heathland** – widespread in the area, as already mentioned, only shrubs and bushes spread over 2,100ha;
- **Mesophilic natural grassland** are represented by *hilly meadows and pastures vegetation class Festuco-Brometea* and by *vegetation class Epilobatea-angustifolii*. Most associations of this group are located at Sokolov Vis, Ivanjske livade, Gornji Gajtan, Sokolovica, etc.
- **Humid meadows and fragments of marshy and peatland vegetation** (vegetation class *Phragmitetea, Molinio-Arrhenatheretea* along streams and rivers in the hilly-mountain zone and *Phragmatetea* around rivers and lakes in the valleys);
- **Dry herbaceous vegetation on andesite rocky blocks** – widespread on the Radan and Sokolovica mountain with endemic species *Sedum Stefco* and associations *Scilla autumnale-Sedetum Stefco* and *Jovibarba heuffelii-Sempervivum zeleborii*;
- **Sparsely vegetated and instable areas of stones, cliffs, rock outcrops and boulder on steep slopes** – have been developed in the area of Gornji Gajtan, Sokolov Vis and Kosanica river gorge.

The presence of HNV features is of particular importance for intensive landscapes, as they provide feeding, nesting and breeding sites for a range of farmland species. However, by themselves, these features do not qualify intensively managed farmland as HNV. In parallel with its identification and quantification of its key characteristics (such as their size, density, connectivity, degree of naturalness or management, that are, unfortunately, unavailable in this case) it is necessary for identifying the species of conservation concern that are associated with them. These are, primarily, bird and butterfly species, defined as indicators of HNV farmland in the relevant EEA/JRC lists of European farmland bird and butterfly species (*Beaufoy, Cooper, 2009b*).

Out of 100 **bird species** that are recorded in the area of the Radan Mountain, 34 of them are on the above-mentioned *List of farming species of European conservation concern*. These species are also on the national list of *strictly protected* (30) and *protected species* (4) (Official Gazette of the Republic of Serbia, No. 5/2010) and are related to the following types of habitats, indicated in the area observed:

- **Open habitats:**
 - **Mountain meadows and pastures** – Eurasian Skylark (*Alauda arvensis*), Wood Lark (*Lullula arborea*), Grey Partridge (*Perdix perdix*), Common Quail (*Coturnix coturnix*);
 - **Mountain humid and marshy meadows** – Red-backed Shrike (*Lanius collurio*), Corncrake (*Crex crex*);
 - **Hilly dry meadows** – Woodchat Shrike (*Lanius senator*), Red-backed Shrike (*Lanius collurio*), Cirl Bunting (*Emberiza cirlus*), Eurasian Hoopoe (*Upupa epops*), Crested Lark (*Galerida cristata*);
 - **Valley meadows, arable land parcels and gardens** – Yellowhammer (*Emberiza citrinella*), Ortolan Bunting (*Emberiza hortulana*), Eurasian Skylark (*Alauda arvensis*), Eurasian Tree Sparrow (*Passer montanus*), European Turtle-dove (*Streptopelia turtur*), Common Kestrel (*Falco tinnunculus*);
- **Semi-open habitats:**
 - **Scattered hilly forest, including shrubs and bushes** - European Turtle-dove (*Streptopelia turtur*), Eurasian Green Woodpecker (*Picus viridis*);
- **Forest habitats:**
 - **Foothill deciduous forest belt** - Lesser Spotted Eagle (*Aquila pomarina*), Eurasian Hoopoe (*Upupa epops*);
 - **Mountain deciduous forest belt** – Booted Eagle (*Hieraaetus pennatus*), Lesser Spotted Eagle (*Aquila pomarina*);
- **Rocky habitats:**
 - **Sparsely vegetated and instable areas of stones and boulder on steep slopes** - Red-backed Shrike (*Lanius collurio*), Cirl Bunting (*Emberiza cirlus*), Common Whitethroat (*Sylvia communis*), Eurasian Hoopoe (*Upupa epops*);
- **Human settlements:**
 - **Permanent valley settlements** – Little Owl (*Athene noctua*), Barn Swallow (*Hirundo rustica*), Eurasian Tree Sparrow (*Passer montanus*), Syrian Woodpecker (*Dendrocopos syriacus*);
 - **Permanent hilly settlements** - Eurasian Green Woodpecker (*Picus viridis*), Barn Swallow (*Hirundo rustica*), Eurasian Hoopoe (*Upupa epops*), Eurasian Tree Sparrow (*Passer montanus*).

The butterfly fauna of the area was surveyed by Jakšić et al. (2006). With 91 registered **butterfly species** (of which 9 are target species), the level of fauna knowledge is satisfactory. **PBA Radan** hosts nationally important populations of the following target species: *Zerynthia polyxena*, *Melitaea aurelia* and *Erebia medusa*. The dominant habitat types are mature broadleaved woodland (*Fagetum montanum*, *Quercetum petraeae*) and dry semi-/unimproved acid grassland.

According to research of the potential threats for butterfly habitats in the area of PBA Radan “agriculture and grazing are moderate and localised” and do not threaten butterfly colonies¹⁶.

¹⁶ <http://www.habiprot.org.rs/areas.htm>, accessed 20. 03. 2012.

However, attention must be paid to the fact that, due to inadequate maintenance of semi-natural grassland, bushes and shrubs reduce and fragment grass habitat, thus preventing the butterflies to re-populate the earlier habitat. Also, particularly harmful is (illegal) practice of burning stubble after harvest, when massive destruction of butterflies in the stage of eggs and larvae occurs¹⁷.

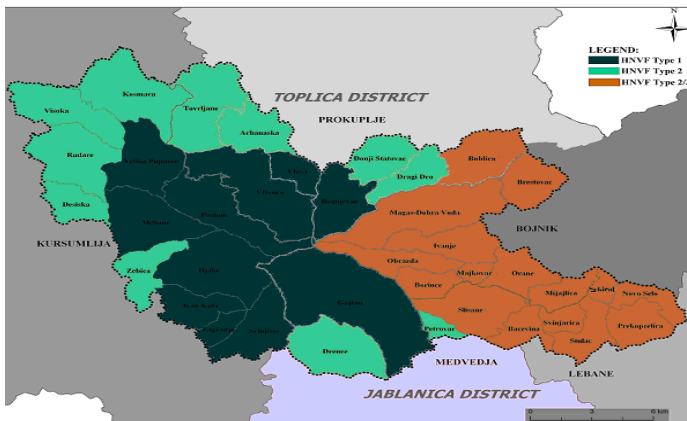
The high nature value agricultural area of the Radan Mountain has a high percentage of semi-natural vegetation and a mosaic of agricultural areas with low intensity production and structural elements of semi-natural origin.

At margins of the area, in contact with fertile Leskovačka basin, sporadically there are areas with intensive crop production and livestock breeding at smaller farms as well as more intensive growing of fruit and grapes on plantations. In these areas, as is mentioned above, “agriculture and grazing are moderate and localised” and still protect species of European/national concern.

Typology of HNV farming in the area of the Radan Mountain

The analysis, presented above, would allow the identification of broad, approximate zones with a high concentration of HNV farming and the characterisation of systems within each zone. Although precise delineation of such zones and measurement of their extent is not recommended as a reliable indication of the baseline extent of HNV farming for monitoring purposes (Lukesch, Schuh, eds., 2010), an approximate zoning may provide a useful base for multi-disciplinary analysis of the key types of HNV farming and rural development potentials in the region.

In accordance with various natural resources base, agri-environmental characteristics and HNV farming systems practiced in the area, the following HNV farming type zones could be defined (Picture 1):



Picture 1. HNV farming types in the area of the Radan Mountain

Source: Our elaboration based on agricultural production zoning (Popović, 2011).

¹⁷ http://www.habiprot.org.rs/S_Endanger.htm, accessed 20. 03. 2012.

- 1) **TYPE 1 – Farmland with a high proportion of semi-natural vegetation engaged in low-intensity livestock grazing production systems** – located in the mountain zone of the area and includes CMs: *Gajtan, Svinjište, Zagrađe, Ivan Kula, Đake, Mehane, Prolom, Veliko Pupavce, Vlasovo, Vlasa* and *Bogujevac*.
- 2) **TYPE 2 – Mosaic of arable land and orchards in the system of low-intensive traditional agriculture and landscape structural elements of semi-natural origin** - covers the submountainous area of CMs: *Petrovac, Drence, Dežiška, Zebica, Kosmača, Rudare, Arbanaška, Tovrljane, Donji Statovac* and *Dragi Deo*, and the hilly settlement *Visoka*, with a higher percentage of permanent grasslands.
- 3) **TYPE 2/3 – Continuum of HNV farming of type 2 and HNV farming of type 3 Farmland supporting rare bird species or a high proportion of European/national butterfly populations** – covers cadastral municipalities of the hilly (*Brestovac, Publica, Majkovac, Orane, Bačevina, Svinjarica, Sekicol, Mijajlica, Novo Selo, Prekopčelica, Štulac*), sub-mountain (*Dobra Voda - Magaš, Ivanje, Obražda, Slišane*) and the mountain area (*Borince*) and includes small areas of more intensive agriculture, located out of the protected areas “Empress’s Town” and the accumulation “Brestovac” basin, in CMs which gravitate towards the *Leskovac* valley.

Support to HNV farming in the area of the Radan Mountain

Current agricultural pressures on biodiversity are the following:

- degradation of meadow and pasture plant communities and traditional orchards by natural succession processes, due to lack of regular grazing and mowing, land abandonment and uncontrolled gathering of medicinal herbs;
- pollution of soil and water, endangerment of habitats and poisoning of small mammals, birds and insects by inappropriate use of agrochemicals and manure management, land fragmentation and early mowing and
- erosion processes at the area observed as a consequence of existing relief, hydrological and soil characteristics and inappropriate ploughing methods use at sloped terrains.

The main cause, common for the most activities which endanger biodiversity, is **land abandonment**. The reasons for this long-term trend which is especially intensive in transitional period, mainly have socio-economic character. Low profitability of traditional agriculture, small holdings, poor infrastructure and lack of basic services for the rural population are the main obstacles for return of younger, educated unemployed population from surrounding cities. Available agricultural resources, protected area status and possibility to use IPARD funds for RD support measures represent good potentials for low intensity grazing livestock system revival and production of fruit, vine, medicinal and aromatic herbs and beekeeping in the systems of traditional, integral and organic production.

Revival and development of **HNV farming** would protect biodiversity and capacities of the area for providing ecosystem services, while processing traditional local products with high biological value and regional brands in small plants at multifunctional holdings would strengthen the base of sustainable tourism and contribute to promotion of protected area, entrepreneurship and employment and regional development (Popović et al., 2009).

In accordance with the existing types of HNV farming in the Radan Mountain area and having in mind the proposed NAEP agri-environment schemes and instructions for its definition and application¹⁸, agri-environment payments scheme for the Radan Mountain pilot area could contain the following support measures:

- **Restoration and management of undergrazed HNV grasslands** – removing of unwanted vegetation and application of low-intensity production methods – use of fertilizers adjusted to organic systems, without ploughing and drainage, postponed mowing using ecologically accepted methods and grazing after the last mowing, except in combined meadow-forest systems; stocking density should be determined in accordance with actual vegetation status at defined localities/status of the protected area;
- **Conservation of autochthonous livestock breeds** - in controlled grazing system and with application of measures stipulated by breeding program for genetic potential conservation and health and livestock welfare improvement, in paralel with sustainable management of traditional semi-natural grazing system;
- **Maintenance of traditional orchards** – preservation and sustainable use of old orchards with traditional local varieties and planting practices, maintenance of low intensity production practices, including uderstorey maintenance by mowing or grazing;
- **Organic farming support** – for organic production of fruits and grapes, vegetables and medicinal herbs, organic livestock breeding and beekeeping with limited use of fertilizers, pesticides and growth regulators, soil conservation techniques, optimal stocking density on grasslands, more adequate manure management and respect of other measures stipulated by the Law on Organic Production (Official Gazzette of the Republic of Serbia, No. 30/2010);
- **Maintenance of habitats of protected bird and butterfly species** – maintenace of semi-natural features outside the arable land, delayed harvest and restrictive use of pesticides and mineral fertilizers in arable areas, to ensure welfare of butterfly colonies of PBA Radan and bird species of conservation interest;
- **Control of soil erosion** – building plant protective belts and ditches for water runoff; grassing and afforestation of marginal farmland and taking appropriate anti-erosion land practices in arable fields and perennials affected by erosion processes.

¹⁸ Small number of measures, which deal with certain ecological problems and in some cases can be applied in combination at the same parcel, respecting predicted limits of total AE-payments per hectare, are adjusted to local specificities and are complementary to other rural development support measures; are clear and easily applied, with contributions which are attractive for beneficiaries, but which are not too high (Cooper, Pezold, 2010).

In agri-environment schemes design and implementation, a wide circle of stakeholders must be engaged starting from administration, research organizations, farmers and their associations and local environmental organizations.

It is particularly important to introduce farmers to the activities and benefits that are expected for them on the basis of participation in the support schemes. Research of the Institute for Nature Conservation of Serbia on readiness of the population to participate in protection and development of future protected area "Radan" showed that 58% of respondents is willing to be engaged in that direction, where that readiness is logically more expressed in younger, employed and educated persons. About 80% of this group of population is interested in establishing contacts with experts as well as in educative lectures. The older farmers see their contribution primarily in production of high quality food and homecraft (INCS, 2002).

Permanent, obligatory training of **agri-environment scheme participants** and diffusion of information and good practice are necessary, and extension service plays a very important role in these activities.

The amount of agri-environmental payments that, in accordance with EU practice, would not exceed 600Eur/ha for annual crops, 900Eur/ha for perennial crops, 450Eur/ha for other types of land use and 200Eur/LU for breeding of endangered autochthonous livestock, would surely contribute to improvement of holdings' income situation, especially of older semi-subsistence farmers. This category of producers, however, can not provide sustainability of HNV farming, necessary for continual providing of agri-environmental services. In order to create critical mass of market oriented farms, that will be able to ensure viability of rural economy and rural communities, it is necessary to combine agri-environment measures with investment support measures directed toward:

- **modernization of agricultural production and holdings** (livestock facilities, facilities and equipment for manure handling, feed storing and preparing, milking preservation and cooling, storing and packaging of fruit and vegetables etc.);
- **strengthening of producer associations and cooperatives** and
- **diversification of economic activities** (facilities and equipment for storing, processing and packaging of high quality agricultural products and development of rural tourism and crafts), with parallel investments in **local infrastructure** and provision of **basic services** for rural residents.

The measures specified above are listed in the National Program for Rural Development and co-financed from budgetary sources under favorable conditions for marginal areas but significant financial support is also expected from the IPARD fund in the future.

Conclusion

Natural resources and low intensity farming practices provide HNV farming status of the Radan Mountain area. The socio-economic situation however indicates the difficulties in providing sustainability of this status in the future. The area is under a depopulation process and land abandonment, caused by poor infrastructure and low profitability of traditional agriculture and rural economy.

Agri-environment payments, dedicated to: restoration and management of undergrazed HNV grasslands, maintenance of traditional orchards, conservation of autochthonous livestock breeds, organic farming support, maintenance of habitats of protected bird and butterfly species and land and water protection by application of anti-erosion measures, combined with support to processing and marketing of high quality agricultural products and development of rural tourism can support maintenance of HNV farming and ensure viability of rural economy and rural communities in the area of the Radan Mountain.

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