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EFFECT OF CLIMATE CHANGES ON AGRICULTURE OF THE WESTERN BALKAN COUNTRIES AND ADAPTATION POLICIES

SUMMARY

Agriculture is both a cause and a victim of climate change. Most of the emissions of methane and nitrogen suboxide in the Western Balkans comes from agriculture. Increased temperature, reduced total precipitation, increased number of summer days, extended period between the last spring and first autumn frost, increased sum of active air temperature above 10°C, are just some of the effects of climate change in the area of the Western Balkan countries. Climate changes will have a positive effect on yield and quality of winter crops. Areas of fruit and vine growing will expand. Spring crops will be threatened by high temperatures and water shortages during the summer months. There will also be a reduction in yield and quality of pasture, fodder; pastures will get depleted due to heavy rains and winds; and, propagation of various pathogenic microorganisms and parasites harmful for animals will accelerate. Accelerated processes of soil erosion caused by change of land use, increased rainfall intensity and extended drought periods, may also be expected. There is a substantial number of short-term adaptation measures whose implementation does not require large investments and can be easily applied in various agro-environmental regions. Such measures include: change of timing of field operations and planting density; biological protection methods; change of land cultivation method; prudent use of fertilizers-taking into account the changed efficiency of fertilizers due to modified climatic conditions; etc. Majority of the medium-term adaptation measures are related to the improvement of soil fertility, while the long-tem ones, which are the most expensive but also most effective, include change of crop rotation in accordance with changed growing conditions, selection of new varieties and hybrids resistant to drought and able to efficiently use the available moisture, setting of shelterbelts, changes in use of agricultural land, reconstruction and improvement of irrigation systems, installation of hail nets and frost protection systems. All three countries have proposed a detailed list of potential adaptation measures by sectors in their Initial National Reports, in accordance with the United Nations Framework Convention on Climate Change. Establishment of relevant policies

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and measures is essential for the countries of Western Balkans. Institution and capacity building in these countries is crucial.

Key words: agriculture, climate changes, adaptation policies, Western Balkan

INTRODUCTION

Unlike any other human activities, agriculture is a cause as much as victims of climate change. 14% of glass house emission or 6.8 Gt CO_2-eq/yr come from agriculture (FAO, 2009). On annual basis, agriculture releases into the atmosphere about one quarter of carbon dioxide, half of methane and three quarters of nitrogen suboxide (Rosenzweig and Tubelio, 2007). Additionally, an increase to 8.3 Gt CO_2-eq/yr is expected in 2030 (Smith *et al.*, 2007). Most of the methane and nitrogen suboxide in the Western Balkan countries comes from agriculture. For example, 75% methane and 97% nitrogen suboxide emission in Montenegro come from agriculture. According to the UNDP BiH report (2009), agriculture of Bosnia and Herzegovina (BiH) participates in CO_2 emission with 12%, while most part of N_2O and methane emission comes directly from agriculture. At the same time, agriculture is the sector that will suffer most from the climate change effects. Extreme weather events such as: drought, flood, extremely high or low temperatures, hail, windstorm etc., cause significant damage to the sector of agriculture thus reducing its production potential. Impact of climate change on agriculture is particularly huge in underdeveloped and developing countries, due to difficult economic situation and small investments in improving production. Therefore, agriculture is faced with the process of reducing its harmful effects on climate change (mitigation), as well as the process of adapting to changed climate conditions (adaptation). Currently, there is almost no country in the world that doesn't take certain action regarding climate, regardless of whether these actions are a result of the citizens' interest or numerous international agreements, standards, laws, etc.

CLIMATE CHANGE IN THE WESTERN BALKAN COUNTRIES

For the assessment of climate change in the territory of the Western Balkans countries, different climatic scenarios were used, some of which will be presented in his section for the three countries in the region: BiH, Montenegro and Serbia.

By using EH5OM global model, it was projected that temperature in BiH will increase from 0.7 to 1.6°C, namely between 1 and 2°C along the coast, and between 2 and 3°C in the interior part of the country. The highest increases will occur in summer and in inland areas (UNDP BiH, 2009). When it comes to precipitation, the result will be a drier climate during the summer (June-August). A reduction by 50-100 mm (up to 10 percent) is expected. From the seasonal point of view, maximum effects are expected in the fall, where the level of precipitation will significantly decrease-up to 25%. Changes in precipitation regime will also be reflected in the timing, frequency and intensity of extreme

phenomena-floods and droughts. This means an increased evapotranspiration and more pronounced extreme minimums in the watercourses regime. On the other hand, the increasingly frequent precipitation of extremely high intensity will cause rapid runoff, often in the form of flooding. All of this will lead to an even more pronounced unevenness in water runoff in BiH. On the one hand, the availability of water resources during the vegetation season, when the requirements are the largest, will generally decrease, while, one the other hand, the risk of flooding will become higher. BiH is highly vulnerable to climate change and will be considerably exposed as it is extremely sensitive to such threats due to the fact that economic role of the „climate-sensitive" sectors such as agriculture and forestry, has a significant secondary effect.

Pavićević (2012) states that an increase of average annual temperature; more frequent dry periods during the summer; and, intense rainfall with potential flooding in the winter, are to be expected in Montenegro. According to the projections, a significant reduction of precipitation, up to-50% in the southern parts of Montenegro in the summer, and a slight increase of precipitation, up to 5%, also during the summer, in the central parts, and in the north-western part (border with BiH) in the spring season, are expected. The largest temperature increase is expected in the northern part of Montenegro in the summer, with the occurrence of warm and cold waves, drought, desertification of land, avalanches and hurricanes. Extreme weather events will most affect the poor population (especially in the north), whose livelihood largely depends on agriculture.

According to the WWW report (2012), in the past 50 years in almost entire territory of Serbia there was an increase of mean annual temperature up to 0.04° C per year, whereas in some areas in the east and southeast of the country, a negative trend was recorded, up to -0.05°C per year. The highest increase of temperature occurs in autumn period. At the same time, there is a positive trend in precipitation in most parts of the territory, while in the eastern and southeastern part of Serbia precipitation was reduced. According to the projections for A1B1 temperature increase scenario, a relatively uniform increase is expected throughout the country, with somewhat more pronounced positive trend in the eastern parts, along the Danube, and in the southwest. Situation with precipitation is alike, where a slight negative trend is expected in the north of Vojvodina and in some areas in the east and southeast. According to Lalić *et al*. (2011), in the area of Vojvodina, the increase of mean annual air temperature from 1.1°C to 1.5°C can be expected. A reduction of the number of frost days and an increase of summer and tropical days are also expected. Substantial extension of the period between the last spring and the first autumn frost, should be an important characteristic of thermal regime in Vojvodina in the coming decades, which could ultimately have a significant effect on the sowing date and the dynamics of work in the field. When it comes to the vegetation dynamics, all the models indicate a significant increase of the sum of active air temperatures above 10°C, which will considerably accelerate vegetation of not only all grown crops, but also weeds and pests. As for the precipitation, a reduction of quantity

is expected, though it will not be uniform, as the increase of dry days in the summer and autumn and reduction in the spring are expected.

For the whole region it can generally be stated that the duration of dry periods, the frequency of torrential flooding and soil erosion intensity are expected to increase over the next century. Additionally, an increase in the occurrence of hail, windstorms, thunderstorms and maximum wind speed is projected, which can pose a serious threat to all forms of human activity, and certainly the agriculture.

STATUS OF AGRICULTURAL SECTOR IN THE WESTERN BALKAN COUNTRIES

Total area of BiH, Serbia and Montenegro amounts to 153,302 km^2. According to the official statistical data, the total population in these countries amounts to 11,647,155, most of whom live in rural areas. In terms of landscape, this is a very diverse area encompassing a whole range of forms, to include very fertile lowlands and high mountain massifs.

Although since 2000, the countries of the Western Balkans have recorded some progress in terms of economic development (IAMO, 2010), GDP per capita in these countries is still considerably lower in comparison with the EU countries. The largest GDP in the amount of 31,000 million EUR was achieved in Serbia, and the smallest, amounting to 3,234 million EUR in Montenegro. However, when it comes to GDP per capita, it is the largest in Montenegro, amounting to 5,211 EUR, and smallest in BiH, amounting to 3,392 EUR.

Table 1 Basic statistical indicators (2011)

	Bosnia and Herzegovina	Montenegro	Serbia
Total area (km^2)	51,129	13,812	88,361
Population	3,839,737	620,556	7,186,862
GDP (million EUR)	13,025	3,234	31,000
GDP per capita (EUR)	3,392	5,211	4,280
Nominal GDP growth (%)	3.62%	4.2%	3%
Unemployment rate (%)	27.6	19.7	23

Source: BHAS, MONSTAT, RZS Serbia

Agricultural sector plays a very important role in the overall development of these countries, and therefore in the employment of the population, especially in rural areas. In 2011, the share of agriculture, forestry and fishery sectors in the structure of total GDP amounted to 6.92% in BiH, 7.9% in Montenegro and 8.5% in Serbia. According to data from the Labor Force Survey for 2011, the largest number of people employed in agricultural activity was recorded in Serbia-490,004 or 21.5%, followed by BiH with 160,000 or 19.6%, and Montenegro with 10,900 or 5.5%.

During the transition period, the agricultural sector in the Western Balkans experienced an enormous decrease, where instead of accomplishing its business objectives, it was forced to perform a social function. This resulted in a large number of small family farms oriented to subsistence farming and barely capable of surviving (Vittuari, 2011).

Agricultural sector is characterized by small agricultural holdings, subsistence farming and irregular functioning of local market. Another aspect causing poor results is the lack of high level mechanization and lack of modern agricultural systems and technologies. In addition, limited access to advisory services, nonconformity of market chains (due to poor information and knowledge), lack of infrastructure, low level of food security and quality standards, as well as limited financing options are the problems the countries in the region are faced with at different levels, and which have a negative impact on the improvement of competitiveness of the value-added products (Adria Food Quality Project, 2007).

Structure of farms is shown in Table 2. Average farm size ranges between 3.2 and 3.7 ha, distributed on several land parcels.

Table 2. Structure of farms

	Bosnia and Herzegovina	Montenegro	Serbia
Number of farms	515,000	43,208	779,000
Average farm size (ha)	3.3	3.2	3.7
Share of farms up to 2 ha (%)	50	66	46
Share of farms over 10 ha (%)	4	5	6

Source: IAMO

Thanks to the climatic and soil conditions, the Western Balkans area has a great potential for agricultural production.

Out of the total BiH's land area, agricultural land takes up about 42%. In 2011, the arable land areas by the way of use amounted to 1,009,000 ha, of which 527,000 ha of sown area, 478,000 ha of fallow and uncultivated arable land, and 4,000 ha of nurseries and other arable land related forms. About 49% of the total agricultural areas are pastures and meadows, while permanent plantations account for around 4.7%. On average, BiH has approximately 0.56 hectares of agricultural land per capita.

In Montenegro, agricultural land takes up 37.5% of the total land area. In 2011, the arable land areas by the way of use amounted to 45,748 ha, of which 32,149 ha were sown areas, 13,576 ha fallow and uncultivated arable land and gardens, and 2 ha nurseries. Share of pastures and meadows is 63% and 25%, respectively. Permanent plantations take up 3.1% of the total agricultural land. Per capita, Montenegro has 0.83 hectares of agricultural land.

Agricultural land in Serbia covers 67% of the total area. In 2011, the arable land areas by the way of use amounted to 3.29 million hectares, of which 3.06

million hectares were sown areas, 224,000 hectares fallows and uncultivated arable land and gardens, and 1 hectare nurseries. In the overall structure of agricultural land, share of pastures is 16.7%, meadows 12.3%, and permanent plantations 5.85%. On average, Serbia has approximately 0.69 hectares of agricultural land per capita.

However, in the Western Balkan countries there is an evident occurrence of abandoned agricultural land. According to statistical estimates, about 47% of arable land in BiH is not being cultivated, in Montenegro around 30%, while the smallest percentage of uncultivated land is in Serbia, amounting to 7%.

When it comes to the way of use of arable land, there are noticeable differences between these countries. Total area sown with grains in 2011 amounted to 2,219,174 ha (61.20%), fodder 437,125 ha (12.05%), vegetables 368,872 ha (10.17%) and industrial crops 600,978 ha (16.57%).

When analyzed by countries, grains are predominant in Serbia and BiH and their share in the sowing structure is 62.31% and 57.50% respectively, while in Montenegro this percentage amounts to 16.09%. Industrial crops are mostly grown in Serbia and their share is 13.99%, followed by BiH with 1.52%, while in Montenegro, the representation of industrial crops is below 1%. Predominant in the sowing structure in Montenegro are vegetables with 58.70%. Share of vegetables in BiH is considerably smaller and amounts to 14.80%, whereas in Serbia its share amounts to just 8.87%. Share of fodder ranges from 14.84% to 26.19%.

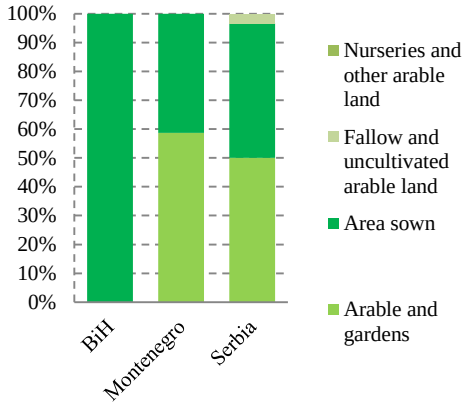

Figure 1. Arable land by type of cultivation (2011)

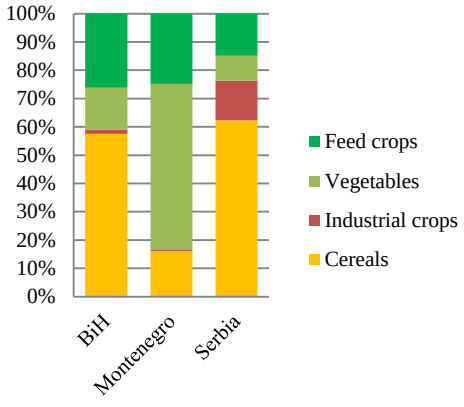

Figure 2. Area sown (2011)

When it comes to fruit production, the most represented fruit species include apple, plum, pear, sour cherry, cherry, peach, walnut, etc. Total production of apple was 348,482 t, pear 96,347 t and plum 751,523 t. approximately 70% of this production was realized in Serbia. Total production of grapes amounted to 379,335 t, where most of it was realized in Serbia (85.65%). Importance of livestock production in the region is increasing thanks to the high

representation of pastures and meadows. Serbia leads in the production of cattle, pigs and poultry.

EFFECTS OF CLIMATE CHANGE ON AGRICULTURE

In its second, third and fourth report, the MZOPUG (Ministry of Environmental Protection, Physical Planning and Construction) (2006) states that in general, it could be said that the climate change in the studied region will have positive effects on the yield and quality of winter crops thanks to extended vegetation period. Areas of fruit and grape production will expand thanks to disappearance of extremely cold winters and late spring frosts. However, the spring crops will be affected by high temperatures and water shortages during the summer months. Conditions unfavorable for development of pests will result in a reduced application of plant protection chemicals, while warmer and drier climate will reduce mycosis infestation which depends on frequent precipitation and high air humidity. There will be a decrease of yield and quality of pasture, fodder (especially spring crops), depletion of pastures due to heavy rains and high winds, as well as an accelerated reproduction of various pathogenic microorganisms and parasites harmful to livestock. Similarly, an accelerated process of soil erosion, influenced by area's climate with the increased rainfall intensity and extended dry periods, along with specificity of relief, geological substrate and pedological composition, as well as the condition of the vegetation cover and change in way of land use (Spalevic, 2011, 2012, 2013; Dengiz and Akgul, 2005), can also be expected.

In Europe, according to the majority of models, the climate changes will cause a slight increase in productivity, thanks to the application of highly developed technology in the countries of Western Europe, while in the Mediterranean and South-East Europe countries there will be a decrease in grain yields (IPCC, 2007). According to the UNDP (2008) report, the losses in yield in Southern Europe will range from 10 to 30%.

Philipe (2010) states that the northern BiH is likely to have a noticeable reduction in corn yield, ranging from 10 to 25%. In the south, where fruits and vegetables are the most common crops, projections indicate that without irrigation, crops could suffer even larger negative effects. Though the projections show potential for a significant increase of yield in the central part of the country, it needs to be stated that topography was not taken into account, as most of the central BiH would not be suitable for any large scale production of grains because of mountainous terrains and pronounced relief features.

Although the sector of agriculture is rather small in Montenegro, it does not mean that the effects of climate change are not relevant for the economy of the entire country. A large part of domestic production is consumed by local markets. Reduced crop yields and livestock production that occur because of climate changes, can probably be balanced by expanding the sowing areas, however, the expenses related to expansion of arable land areas, along with reduced yields and livestock production, will result in an increased cost of new

land cultivation. As an effect of economic development, it could happen that the major part of lost production were substituted by imported agricultural products, which would generate a higher rate of migration of rural population. Estimated effects of climate change on maize production in Montenegro range from -270 to -719 MT/year for 2050, and -719 to -1348 MT/year for 2100. These are minor effects, as production of maize does not occupy any large land areas. And yet, damages could significantly increase if the current and future efforts of the country caused a more substantial increase of livestock feeding on maize (and wheat), so that eventual losses in maize production could amount to thousands, even dozens of thousands of tons. Loss in gross revenues of a farm range from -16,177 to -79,089 € for 2050 and -43,140 to -148,292 € for 2100. These projections could be even higher if there were structural shifts in agricultural sector, as suggested (UNDP Montenegro, 2010).

In Serbia, a decrease of yield is expected in almost all field crops, and the only increase, though a very slight one, is expected in maize yields, provided that an extensive irrigation is ensured. Particularly affected will be the area of Vojvodina, where the yields of spring crops will be considerably reduced, whereas some positive effects could be expected in winter crops thanks to extended period of vegetation. The effects will be differently reflected in different regions of Serbia, but, it must be pointed out that the most significant farming regions of Serbia are located in Vojvodina and in major river valleys, exactly where drier climate conditions are expected. Due to the increase of winter and early spring temperatures, it is possible to see an increase in disease incidence and insect infestation, which have already been the case in grains and fruit in the past several years. On the other hand, it is expected that some insect populations, primarily those depending on soil humidity, will get reduced in both frequency and number, because of extended dry periods. Erosion is another unfavorable occurrence that could be aggravated by climate change. The expected increase of flooding and high water levels will certainly have impact on the intensity of water erosion, while wind erosion, a significant part of Vojvodina is exposed to, could be amplified due to extended drought periods and high temperatures (WWW, 2012).

ADAPTATION AND MITIGATION IN AGRICULTURAL SECTOR

Adaptation to climate change implies some changes in agricultural practice as a response to changed climate conditions. These are the measures of adaptation that are implemented for the purpose of prevention or control of losses, or even conversion of climate changes into an advantage (IPCC, 2001). The objective of adaptation measures should be to increase capacity of the system to survive extreme phenomena and changes. Projected approval of strategy for adapting to drought, at farm level, is important in terms of provision of information that can be used to formulate a policy that will improve the adaptation measures. Primary measures of adaptation include: changes in sowing structure, modification of crop rotation, involvement of agriculture in water

management programs, building accumulations and canals for irrigation, use of drop-by drop irrigation system. Secondary measures are related to educating the farmers and decision makers about new soil cultivation technologies (conservation tillage), improving the application of organic and mineral fertilizers (GLOBAL GAP, nitrates directive), using biomass for the production of biogas, measures to reduce methane emissions through new practices for livestock breeding and feeding, training in protection of livestock from extreme heat, assisting farmers to cover the cost caused by weather disasters.

These measures have not yet been introduced in the agricultural sector in BiH, since the strategies for agriculture at state, entity and local levels have not yet been developed, and even less so for the adaptation of this sector to climate change. While planning animal husbandry in BiH, one should take into account the new temperature zones, as keeping animals in general would be made more difficult, while in some areas it would be possible only with ultimate care (shelters, wettening of animals with water, etc.).

Adaptation of Montenegrin agriculture to climate change is related to all of the above stated measures (irrigation, drainage, crop rotation, reduced tillage, mulching, change of sowing dates, introduction of new crops, etc.), while additional engagement is required for mapping the most vulnerable areas, examining what regions are suitable for certain breeds and types of animals, improving breed structure, building technical and administrative capacities, using new technologies in livestock feeding, investing in rural areas for the purpose of reviving cottage industry, promoting new varieties that are more resistant to drought or require less fertilizers, etc.

For the area of Serbia, Lalić *et al.* (2011) state that there is a substantial number of short-term adaptation measures whose implementation does not require large investments, that do not endanger environment and that can easily be applied in various agro-environmental regions. Such measures include change of dates for filed activities and sowing density, biological protection methods and change of soil tillage methods. Reasonable application of fertilizers, which takes into account the changed effectiveness of fertilizers caused by climate change, represents another short-term measures of adaptation.

Majority of medium-term adaptation measures are related to the improvement of soil fertility, while the long-term ones, which are the most expensive but also most effective, include changed crop rotation that is in line with changed growing conditions, selection of new varieties and hybrids resistant to drought and able to more efficiently use the available moisture, setting of shelterbelts, change of use of agricultural land, reconstruction and improvement of irrigation system, installation of hail nets and frost protection systems.

Crop production in Serbia is a large source of waste (biomass), which remains largely unused. It is estimated that the total energy potential of the biomass residue in Republic of Serbia amounts to nearly 1,56 million toe, and if it was used to produce energy, a reduction of emission of approximately 4.8 million tons of CO_2e would be achieved. Realistically possible use of 20% of

biomass residues from small scale farms and over 50% of residues from large farms for energy production purposes, can contribute to reducing the emissions by at least one million tCO_2e.

Adaptation of livestock production to climate change is related to the examination of suitability of certain regions for specific breeds and types of animals, the necessity of introducing the breeds resistant to thermal stress and tropical diseases, work on improving the existing breed structures and use of new technologies, especially in the area of animal feeding.

Generally it could be stated that all these measures could be considered for the studied region, while their implementation is conditioned by social development, adoption of strategies and other documents that support and encourage the application of these measures. The activities directly or indirectly related to the adaptation of agriculture to the new situation take place through various projects at both national and regional levels, but at a very slow rate.

Education of producers in the application of new technical adaptations, action focused on raising awareness of the negative effects of climate change, provision of material support to both short- and long-term research programs, are the conditions we need to pay close attention to if we want to make progress in these measures.

One of the region's weaknesses with regard to the introduction of measures for adaptation to climate change in the area of agriculture is related to inadequate social and human resources available in the region. There is still not enough social pressure for introducing the measures for adaptation to climate change. Key groups (politicians, farmers, scientists, advisors, consumers, etc.) still don't take the climate change seriously enough, especially measures related to agriculture. For this reason, it is necessary to begin, as soon as possible, with proper educational, informative, research and advisory programs for farmers, agronomists and consumers. Particular attention should be given to educating and supporting young farmers.

ORGANIC AGRICULTURE

Organic agriculture contributes to the reduction of use of fossil fuels, reduces emissions of CO_2, CH_4 and N_2O, reduces the risk of erosion and contributes to the increase of soil organic matter, where longtime experiments show the accumulation of 12-300 percent more carbon than conventional agriculture (Niggli, *et al.*, 2007). According to Ching (2011), developing countries should redirect their agriculture towards organic, which is essential to adaptation and does not contribute to future climate changes.

Areas under organic agriculture in BiH occupy 681 ha which is only 0.03% of the total agricultural area. This area is cultivated by 92 farmers, where each one of them has 7.40 ha on average. Major crops are grains (246 ha), industrial plants, apple, plum, raspberry, vegetable crops, while medicinal plants are harvested on approximately 356,000 ha (GIZ, 2012).

In Montenegro, organic production is organized on approximately 3,561 ha which is 0.07% of the total agricultural area. Around 3,000 ha is used as pastures, while the remaining area is used to grow field and vegetable crops, and a very small area for fruits and vines. Number of farmers using these areas is around 100, and average farm size is 3.5 ha (GIZ, 2012).

In Serbia, 10,999 ha are under organic production, which is 0.22% of the total agricultural area. This area is cultivated by 317 farmers, with the average of 35 ha per farmer. Major crops include grains (739 ha), sunflower, soybeans, forage crops, fruits on 1,132 ha, potato, tomato, paprika, carrot, medicinal and aromatic herbs (GIZ, 2012).

IRRIGATION

There are no official data on irrigated areas in BiH, however, it can be stated with high certainty that this is a rather symbolic percentage which, prior to 1992 amounted to only 0.4%. A number of projects related to water management and improvement of water infrastructure are currently ongoing in BiH. Yet, opportunities, requirements and chances are much, much bigger. Encouraging irrigations, especially in case of smaller agricultural areas and orchards, rational construction of micro-hydro-accumulations and small hydro-power plants, provide significant opportunities, however, these processes are very slow (UNCDS, 2012).

In Montenegro, 2,650 ha are regularly irrigated in the lowland area near Podgorica, including 2,000 ha of vineyard owned by AD Plantaže (Marković, 2010).

Share of irrigated arable land in Serbia is low and amounts to about 1.5% (Bogdanov and Božić, 2010).

ADAPTATION POLICY

United Nations Framework Convention on Climate Change (UNFCCC) took effect in 1994. The main purpose of the Convention is to ensure stabilization of the greenhouse gases emission (CO_2, N_2O, CH_4, HFCs, PFCs and SF_6) in the atmosphere at the levels which will prevent dangerous anthropogenic impact on climate. The Convention has been ratified by 186 countries and the European Union (EU) as an economic community (First National Report of BiH in accordance with UNFCCC, 2009).

In terms of the obligations toward UNFCCC, the Convention parties' responsibilities are as follows:

1. Developed countries -Annex I of the Convention: have the obligation to regulate greenhouse gases emission on their territory,
2. Developed countries -Annex II of the Convention: have the obligation to cover the cost of adaptation to climate change for the economy of developing countries,

3. Developing countries: have the obligation to report on their national levels of greenhouse gases emission, as well as vulnerability of their natural resources and economy to climate change.

Countries that are not members of Annex I should research the impact of climate change on their territory and its vulnerability to climate change, as well as identify measures of adaptation to climate change and request appropriate assistance from developed countries by using appropriate mechanisms. These countries should certainly be able to establish a comprehensive system for dealing with climate change which would, again, have to be supported by developed countries. Types of measures available to them involve actions in all economic sectors affected by climate change, as well as actions aimed at reducing the global emission of greenhouse gases. Namely, the capacity to address climate change has to be a national capacity with sufficient funding for both mitigation and adaptation activities.

BiH has become a member of the Convention in 2000, Serbia in 2001, and Montenegro in 2006. Kyoto Protocol was ratified in Montenegro in 2006, and in BiH and Serbia in 2007. All three countries have proposed a detailed list of potential measures for adaptation by sectors in their First National Reports in accordance with the United Nations Framework Convention on Climate Change.

The priority measures, in terms of the achievement of the set objectives, have not yet been directly defined for BiH by the Convention. For the purpose of meeting its obligations, BiH has established the state-level Climate Change Committee consisting of 32 members, as well as the Climate Change Sub-Committee (UNDP, 2011). BiH has no strategy, policy or action plan that specifically address the climate change issues at the state or entity levels, though some sectoral strategies recognize the problems induced by climate change. Preparation of specific strategies, programs and action plans, with special focus on legislative regulations, among other things, and establishment and strengthening of institutional framework, are the high priorities in this country (Marković, 2012).

In Montenegro, although there is no special national policy when it comes to climate change, they prepared numerous strategies and plans as a basis for this policy. For example, the National Strategy for Sustainable Development (2007) has set the general goals and guidelines for action in the area of climate change, while this issue, being a global priority, received a lot of attention in the national Environmental Policy (Knežević, 2012).

Adaptation to climate change is a relatively new topic in Serbia that can indirectly be recognized in the strategic documents and legislation of Serbia: Strategy of Sustainable Development, National Strategy for the Protection of Environment, National Strategy for the Protection of Biodiversity (Manojlović, 2012). Implementation of the multidisciplinary project dubbed „Examination of climate changes and their effects on environment, monitoring of impacts, adaptation and mitigation“. The Working Group for the process of negotiation within the UNFCCC was established in 2009.

It is crucial for the countries of the Western Balkans to set up appropriate policies and measures, as well as to have the existing policies harmonized. Given that these countries are on the path to the European Union, which entails the obligation to comply with the EU standards and acquis communautaire, any kind of assistance, be it financial or technological, is essential. Institution and capacity building in these countries is crucial.

REFERENCES

Ching, L.L. (2011): Mitigating and Adapting to Climate Change through Ecological Agriculture, Third world network, www.twnside.org.sg.

Dengiz, O., Akgul, S. (2005): Soil Erosion Risk Assessment of the Golbasi Environmental Protection Area and its vicinity using the CORINE Model. Turkish J. of Agriculture and Forestry. Volume 29, Issue 6, p.439-448.

FAO. (2009): Climate Change and Bioenergy Challenges for Food and Agriculture, High Level Expert Forum – How to Feed the World in 2050, FAO, Rome.

GIZ. (2012): Study on the organic potential in Sout East Europe. Initial national communication of the Republic of Serbia under the United Nations Framework Convention on climate change, Belgrade, 2010.

IPCC. (2001): Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Knežević, M. (2012): Overview of the current situation in Montenegro in terms of adaptation to climate change, Agricultural adaptation to climate change – networking, education, research and extension in the West Balkan, workshop, Sarajevo, 2012.

Lalić, B., Mihailović, D.T. & Podraščanin, Z. (2011): Buduće stanje klime u Vojvodini i očekivani uticaj na ratarsku proizvodnju. *Ratar. Povrt.* 48, 403-418.

Manojlović, M. (2012): Overview of the current situation in Serbia in terms of adaptation to climate change, Agricultural adaptation to climate change – networking, education, research and extension in the West Balkan, workshop, Sarajevo, 2012.

Marković, M. (2012): UNCCD - activities in Bosnia and Herzegovina, Agricultural adaptation to climate change – networking, education, research and extension in the West Balkan, workshop, Sarajevo, 2012.

MZOPUG. (2006): Second, Third and Fourth National Communication of the Republic of Croatia under the United Nations Framework Convention on Climate Change (UNFCCC).

UNDP. (2008): Izvješće o društvenom razvoju – Hrvatska.

Niggli, U., Earley, J. & Ogorzalek, K. (2007): Organic Agriculture and Environmental Stability of the Food Supply. International Conference on Organic Agriculture and Food Security, Rome, FAO.

Pavićević, S. (2012): Studija o ugroženosti od klimatskih promjena: Crna Gora, SEEFCCA.

Philippe, H., Houerou, L., Armitrage, J., Mantovanelli, M., Funck, B. & Nikšić, O. (2010): Studija o politici poljoprivrednog sektora u Bosni i Hercegovini

Studija o politikama trgovine i integracije, Jedinica za siromaštvo i ekonomsko upravljanje Region Evrope i centralne Azije, Izvještaj br. 57919-BA

Predstudija o izvedivosti poljoprivredno-prehrambenih inovacijskih centara u zemljama Zapadnog Balkana", Adria-Food Quality Project-promocija jedinstvenog jadranskog prostora za proizvodnju kvalitetnog voća, povrća i proizvoda životinjskog podrijetla, 2007.

Prvi nacionalni izvještaj Crne Gore o klimatskim promjenama prema Okvirnoj konvenciji Ujedinjenih nacija o klimatskim promjenama (UNFCCC), Podgorica, 2010.

Rosenzweig, C. & Tubelio, F.N. (2007): Adaptation and mitigation strategies in agriculture: an analysis of potential synergies. Mitig Adapt Strat Glob Change 12:855–873

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, D., Ogle, S., O'Mara, F., Rice, C., Scholes, B. & Sirotenko, O. (2007): Agriculture, in Metz, B, Davidson, OR, Bosch, PR, Dave, R and Meyer, LA (eds), Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, NY, USA.

Spalevic, V., Djurovic, N., Mijovic, S., Vukelic-Sutoska, M. and Curovic, M. (2013): Soil erosion intensity and Runoff on the Djuricka river basin (North of Montenegro). Malaysian Journal of Soil Science, Vol. 17, 7-22. Malaysian Society of Soil Science ISSN: 1394-7990

Spalevic, V., Curovic, M., Borota B., and Fustic, B (2012): Soil erosion in the River Basin Zeljeznica, area of Bar, Montenegro. Agriculture & Forestry, Vol. 54. 1-4: 5-24, 2012, Podgorica.

Spalevic, V. (2011): Impact of land use on runoff and soil erosion in Polimlje. Doctoral thesis. Faculty of Agriculture of the University of Belgrade, Serbia.

UNCDS. (2012): Bosna i Hercegovina u procesu RIO +20, Izvještaj Bosne i Hercegovine za UN Konferenciju o održivom razvoju.

UNDP. (2008): Izvješće o društvenom razvoju – Hrvatska.

UNDP BiH. (2009): Prvi nacionalni izvještaj Bosne i Hercegovine u skladu sa Okvirnom konvencijom Ujedinjenih nacija o klimatskim promjenama, Banjaluka.

UNDP Crna Gora. (2010): Ekonomski uticaji klimatskih promjena u Crnoj Gori.

UNDP. (2011): Assessment of capacities for low-carbon and climate resilient development, Bratislava.

Vittuari, M. (2011): Agriculture and rural areas in the Western Balkans: status update.

Volk, T. (2010): Agriculture in the Western Balkan countries, Studies on the agricultural and food sector in Central and Eastern Europe, edited by Leibniz Institute of Agricultural Development in Central and Eastern Europe.

WWW. (2012): Procena ranjivosti na klimatske promene–Srbija, Izdavači: WWF (Svetski fond za prirodu), Centar za unapređenje životne sredine.

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UTICAJ KLIMATSKIH PROMJENA NA POLJOPRIVREDU ZEMALJA ZAPADNOG BALKANA I POLITIKE PRILAGOĐAVANJA

SAŽETAK

Poljoprivreda je istovremeno i uzročnik i žrtva klimatskih promjena. Najveći dio emisije metana i azotsuboksida u zemljama Zapadnog Balkana potiče iz poljoprivrede. Povećanje temperature, smanjenje ukupne količine oborina, povećanje broja ljetnjih dana, produženje perioda između posljednjeg proljetnog i prvog jesenjeg mraza, porast suma aktivnih temperatura vazduha iznad 10°C su neki od efekata klimatskih promjena na području zemalja Zapadnog Balkana. Klimatske promjene će imati pozitivan učinak na prinose i kvalitet ozimih usjeva. Područja uzgoja voća i vinove loze će se proširiti. Jari usjevi će biti ugroženi zbog visokih temperatura i nestašice vode tokom ljetnih mjeseci. Doći će i do smanjenja prinosa i kvaliteta ispaše, krme, osiromašenja pašnjaka zbog jakih kiša i vjetrova, a također će se ubrzati razmnožavanje različitih patogenih mikroorganizama i parazita opasnih za stoku. Mogu se očekivati ubrzani procesi erozije zemljišta zbog promjena u načinu korištenja zemljišta, povećanog intenziteta kiše i dužih sušnih perioda. Postoji značajan broj kratkoročnih mjera adaptacije čija implementacija ne zahtijeva velika ulaganja i može nesmetano da se primijeni u različitim agroekološkim regionima. U takve mjere se ubrajaju promjena termina operacija u polju i gustine sjetve, biološke metode zaštite, promjena načina obrade zemljišta, pažljiva upotreba đubriva uz uzimanje u obzir izmijenjene efikasnosti đubriva usljed izmjenjenih klimatskih prilika itd. Većina srednjoročnih mjera adaptacije se vezuje za unapređenje plodnosti zemljišta, dok dugoročne, najskuplje, ali i najefikasnije mjere obuhvataju izmjene plodoreda u skladu sa izmijenjenim uslovima gajenja, selekciju novih sorti i hibrida otpornih na sušu i sposobnih da efikasnije koriste raspoloživu vlagu, postavljanje poljozaštitnih pojaseva, izmjene u korištenju poljoprivrednog zemljišta, rekonstrukciju i unapređenje sistema za navodnjavanje, instalaciju protivgradnih mreža i sistema za zaštitu od mraza. Sve tri zemlje su predložile detaljnu listu potencijalnih mjera adaptacije po sektorima u svojim Prvim nacionalnim izvještajima u skladu sa Okvirnom konvencijom Ujedinjenih nacija o klimatskim promjenama. Za zemlje Zapadnog Balkana od ključnog značaja je upostaviti odgovarajuće politike i mjere. Izgradnja institucija i jačanje kapaciteta u ovim zemljama je od ključnog značaja.

Ključne riječi: poljoprivreda, klimatske promjene, politike prilagođavanja, Zapadni Balkan