IMPORTANCE OF BIODIVERSITY PRESERVATION FOR SUSTAINABLE RURAL DEVELOPMENT IN BOSNIA AND HERZEGOVINA

ABSTRACT

Biodiversity plays a critical role in the sustainable development and is essential for the human well-being, livelihoods and cultural heritage of people. A number of autochthonous cultivars and landraces of many crops, grasses, legumes are still grown in the Bosnia and Herzegovina, despite the dominance of improved cultivars and hybrids. Autochthonous cultivars and genotypes are important in order to ensuring genetic variability, which is essential for the food production in the future. The most important commercial and agronomic traits within the groups of autochthonous genotypes should be evaluated and put in the information database, which will also serve as a source of valuable data for the future breeding programs. This paper shows the present situation regarding the preservation of agricultural biodiversity in Bosnia and Herzegovina and the possibilities for the sustainable food production and rural development.

Key words: biodiversity, landraces, autochthonous cultivars, genotype, sustainability.

1 MAIB – Mediterranean Agronomic Institute of Bari (Trainee), Via Ceglie, 9 - 70010 Valenzano (Bari), Italy, e-mail: jsmn_simic@yahoo.com
2 University of Aarhus, Faculty of Sciences and Technology, Department of Food Science, Kirstinebjergvej 10, 5792, Aarslev, Denmark, e-mail: Natasa.Cerekovic@agrsci.dk
3 Agricultural Institute of Republic of Srpska, Knjaza Miloša 17, 78 000 Banja Luka, Bosnia and Herzegovina, dragana.vukojevic@poljinstrs.org
1. INTRODUCTION

FAO estimates that 75 percent of the crop diversity was lost between 1900 and 2000. It was estimated in the State of the World’s Plant Genetic Resources for Food and Agriculture that as much as 22 percent of the wild relatives of important food crops would disappear by 2055 due to the climate change (FAO, 2010). About 7,000 plant species have been cultivated or collected for food in the past, but today fewer than 150 species are under commercial cultivation and only 30 species provide 95 percent of human food energy needs (Mouillé et al., 2010). Wheat, rice and maize alone provide over 50 percent of the global human protein and dietary energy supply. Thousands of species are marginalized by both agricultural and dietary researchers, yet some of these minor crops may be more nutritious than the major crops. A diversity of crops is the foundation of a balanced, nutritious diet. A broader and better use of genetic resources and biodiversity in food crops would stimulate their conservation. There are thousands of crop wild relatives worldwide that should be collected, preserved and evaluated because they represent valuable genetic resources for drought resistance, tolerance to salinity, pests and disease resistance.

Unfortunately due to neglecting of biological resources many of these genes have been lost. Important issue is that preserving biodiversity is important coping strategy for climate change adaptation. Losing genetic biodiversity and variability is affecting our health and dietary diversity. Current global food system is becoming homogenized and disconnected from our cultural food traditions. The global diet relies on a shrinking number of species. Minor plant species play crucial roles in poor people’s livelihoods but are otherwise underutilized which represents serious environmental and biodiversity problem. Rural development strategy of Bosnia and Herzegovina could aim to promote local heritage in biodiversity of plants and food products through local branding and preserving these knowledge resources. These aims could be in accordance with modern food consumption trends that recognize environmental dimension of Food Pyramid which shows that those foods with higher recommended consumption levels are also those with lower environmental impact (Barilla Center, 2010).

According to estimates by the Food and Agriculture Organization (FAO), during the 20th century, three quarters of the genetic diversity of agricultural crops were already lost. A great genetic diversity of major crops is collected in gene banks. However, many other landraces and neglected species are not equally collected and preserved. Due to many environmental problems as well as land use changes likelihood of genetic erosion has increased (FAO, 2010). The genetic
diversity in farming systems is consisted from varieties, either “local” (meaning traditional) or improved (the result of modern breeding programs). Farmers and local breeders often have expert knowledge about their local varieties and their characteristics. This knowledge is often not disseminated. The name used locally for a certain variety may differ from one place to another and the varieties themselves are often dynamic and changing with respect to their genetic constitution and traits. This makes it difficult to assess the loss of a particular variety or to determine its characteristics and significance for nutrition, breeding programs (UNEP, 2005), but also for possible regional rural development programs by protecting and branding these varieties, food products or unique recipes.

Bosnia and Herzegovina ranks among the territories with the highest level of biological diversity in Europe (WSSD, 2002) mostly due to different environmental conditions, varying from cold and wet continental to dry and hot Mediterranean climate. Therefore, diversity of plant genetic resources in Bosnia and Herzegovina is considered a significant gene pool, based on information concerning the rich variety of vegetables, fruits and cereals in the area.

2. AUTOCHTHONOU FRUIT VARIETIES

Fruit biodiversity in Bosnia and Herzegovina is reflected in many autochthonous varieties of cherries (Prunus avium local names: šlame, hašlamuše, alice, rušt, hrušćovi, crnice, bjelice); plums (Prunus domestica local names: bijele, prskulje, mrkulje, savke); pears (Pyrus sp. local names: ječmenke, krivočke, mednače, takoše, bijeli karamut, crni karamut, krunjača, jeribasme); apples (Malus sp.: petrovače, golubače, šarenike, zelenike, senabije, šahmanuše, krompiruše, crvenike etc.), as well as sour cherries, apricots, peaches, almonds, raspberries, blackberries, strawberries and currants (NBSAP BiH). Although this particular area of former Yugoslavia or the newly created states could be considered as a great biodiversity source for many fruit species this is not recognized in literature due to the lack of systematic studies in the earlier period (Đurić et al., 2008). Paunović et al. (1997) presented results of earlier researches within the area of Yugoslavia and according to that there are 124 registered wild fruit species and their relatives. In Vavilov’s research of some wild species and their relatives’ distribution (1926) only name Balkan is mentioned related to the Yugoslavia or newly created countries. Paunović et al. (1997) stated that the area of Bosnia and Herzegovina could be considered as a gene centre for wild fruit species and their relatives from great number of genera: Malus, Pyrus, Chaenomeles, Sorbus, Crategus, Mespilus, Eriobotrya, Prunus, Amygdalus, Juglans, Corylus, Castanea, Cornus, Morus, Sambucus, Fragaria, Ribes, Rubus, Rosa,
Ficus, Punica, Zizyphus, and Citrus. Recent studies have been conducted on autochthonous apple and pear varieties from Bosnia and Herzegovina (Beširević, 2009; Tomić et al. 2011, Đurić, 2009, Miletić et al., 1997).

Collecting wild berry fruits and non timber forest products (medicinal herbs, their drying and processing as well as production of essential oils) could play an important role in supplementing other food as well as generating additional income for the rural households. The cultural diversity and traditional knowledge about the use of the so – called non timber forest products and organic agriculture in Bosnia and Herzegovina is good possibility for development of rural areas. Forest blueberries are important income for rural households because their high market prices and because of the suitable environment for organic production. Coniferous and deciduous forests of Balkan Peninsula are rich with forest blueberries (Vaccinium myrtillus L.) (Petrović et al., 2007). According to the most recent theory, partially corresponding to that of Vavilov, the area of origin of medlar (Mespilus germanica L.), family Rosaceae, is native to Balkan Peninsula (Bellini et Giordani, 2000). Nowadays, in most parts of the world medlar is considered as endemic medicine shrub. Myrobalan is one of the oldest fruit species at the Balkan Peninsula (Božović, 2002). In recent years collecting wild berry fruits and non timber forest products is only being performed in the area of municipality Trebinje and Šipovo (Mirjanić et al. 2011).

Due to war-triggered population migration and the migration toward urban areas that have both led to rapid deterioration of the rural environment and losing of the knowledge and traditional practices used. Good example of preservation of our food identity was given by the Slow Food Foundation for Biodiversity that recognized Bosnian traditional product called Požegača Plum Sweet. It is made of autochthonous plum variety with excellent processing properties of the fruit. This product was only prepared for domestic consumption and the tradition is disappearing along with the local plum variety, požegača (http://www.slowfood-foundation.org).

3. CEREALS

Cereals play an important role in world agriculture, and they contribute significantly to food and nutrition security. Wheat, rice and maize are of prime importance – these three crops alone provide over 50 percent of the global human protein and dietary energy supply (FAOSTAT 2003, 2004). Certain number of old wheat cultivars are conserved in Plant Gene Bank of the Republic of Srpska and some of them are in the process of the multiplication at the Agricultural Institute of Republic of Srpska.
Local cereal population can be found within farmers that had not migrated during the war and mainly live in mountain regions (Đurić et al., 2008).

Spelt wheat is an ancient cereal that was extensively cultivated in the mountain regions in Europe. This cultivar is again receiving the importance for growing for its dietary characteristics, resistance to pests and its ability to grow on soils with limited fertility in wet and cold climates where it is better adapted than bread wheat (Marconi et al., 2002). Recently spelt wheat appears to attract consumers' attention due to its nutritional value. Consumption of spelt wheat-based products could assure increased intake of minerals, vitamins and fiber what could play an important role by decreasing of glycemic index of final products containing spelt (Lacko-Bartošová et al., 2010). The expansion of the cultivation of spelt largely depends on the possibility of using it in the production of other products such as pasta, flakes, etc., with good sensorial and nutritional properties (Cubadda et Marconi, 1996; D’Antuono et Bravi 1996; Abdel-Aal et al., 1998). Many of old wheat cultivars have been replaced with new high yielding cultivars. In Bosnia and Herzegovina traditional cultivars are very rare and are grown mainly in isolated mountain regions. In the 2005 in the area of village Korićani at the altitude of 1000 m (municipality Kneževo) almost extinct spelt wheat (Triticum spelta) has been found by the experts from the Agricultural Institute of Republic of Srpska, Banja Luka (personal communication: Miloš Nožinić et Dragan Mandić). The local names of the wheat are krupnik and pir. Spelt wheat, although almost extinct, had been registrated in Statistical Bulletin of the Institute for Statistics of Republic of Srpska by 2005.

Domestic populations and cultivars of rye, barley and oat can be found among local farmers that had not migrated and mainly live in the mountain regions. The most of these old cereal genotypes were lost during the war period because of the migrations of people.

Domestic populations of buckwheat are more and more spreading in recent time. It is a positive example of returning of old genotypes due to increased ecological and dietary awareness of consumers. From environmental point of view this cereal is quite important as a bee pasture for its long flowering period.

4. LOSS OF FLAX AND HEMP BIODIVERSITY

Currently, integrated or organic flax production is possible in the unpolluted mountain regions. Generally, pests and diseases appear rarely in such conditions for higher altitude, permanent air circulation, colder winters and extensive plant production. Besides, weeds spectrum is poorer than in lowlands where flax cannot cope with aggressive weeds like Ambrosia artemisiifolia (Nožinić et al.,
Despite these favorable environmental conditions, almost all domestic flax genotypes have been lost. Kondić et Nožinić (2001) turned the attention to the importance of returning of flax and hemp in the production in Bosnia and Herzegovina emphasizing rich tradition of growing and processing in the past. Several old flax cultivars and populations from the former Yugoslavia have been preserved in foreign Genebanks (Dehmer et Frese, 2001, Strajeru, 2001, Fouilloux et al., 2001). Because of complicated legislation concerning the hemp cultivation (*Cannabis sativa* L.) for industrial purposes, almost all local varieties have been lost. Climate changes were emphasized in the Millennium Ecosystem Assessment as one of the strongest drivers for changes in biodiversity and its loss in general.

### 5. THE CONTRIBUTION OF PLANT GENETIC RESOURCES TO HEALTH AND DIETARY DIVERSITY

Awareness that the degree of human impact on the environment threatens human existence and the survival of many other species has also led increasingly to calls for more sustainable human-environment relationships (i.e., those that conserve resources for future generations) and more discussion and research about what “sustainability” means in a given situation (e.g., UNCED 1993). The Johannesburg Plan of Implementation of the World Summit on Sustainable Development in 2002 calls upon taking action to change unsustainable consumption and production patterns. Consumption is a primary driving force of environmental degradation. Food systems and diets are major player in biodiversity erosion, natural resources and ecosystem degradation, climate change etc. (Capone et al., 2011). Promoting agro biodiversity would include the domestication of nutritionally rich wild plants and decrease the environmental degradation. There is growing evidence on the impact of diet on health (Reddy et al., 2009). However sustainability of food systems and food consumption is both health concern and environmental problem. A diversity of crops is the base of a nutritious and balanced diet. Traditional crops, varieties and food recipes contain considerable wealth of micronutrients according to Kuhnlein (2003). Dietary diversity and nutrition uptake depends not only on diversity of crops but also of diversity within crops (Kuhnlein, 2003; Rodriguez-Amaya et al., 2008). It is generally thought that macronutrients vary only insignificantly within the same species (Greenfield et Southgate, 2003). However, Burlingame et al. (2009) show data that this is not always the case and that the compositional differences among varieties or cultivars can be very significant for macronutrients, micronutrients and bioactive non-nutrient. These differences in nutrients among cultivars have a major
impact on nutrient intake estimations. The wet gluten content of spelt can vary a great deal between cultivars (Kohajdová et Karovicová, 2008). But still more effort and resources are needed to analyze and disseminate data on the nutrient composition of wild, underutilized species and varieties, and under-appreciated food biodiversity.

Such information is needed both to enhance use of more nutritious cultivars in diets and to make them available for use in breeding programs aimed at increasing the nutrient content of more commonly used varieties of the same species, eliminating the need for transgenic modifications. Plant foods derived from genetically modified plants could represent new allergen sources (Hoffmann-Sommergruber, 2002). The availability of the data on nutrient composition could assist countries and regions to promote local species and varieties as well as brand their traditional food product and recipes and through these actions value and maintain the ecosystems that produce them.

6. CONCLUSION

Large-scale monoculture crop production, have a negative impact on biodiversity. The Food and Agricultural Organization of the United Nations, referring to the scale of the loss as “extensive,” found that some 75 percent of plant genetic diversity has been lost since 1900 as farmers turn to genetically uniform, mass-produced crop varieties. Since genetically modified crops reinforce genetic homogeneity and promote large scale monocultures, they contribute to the decline in biodiversity and increase vulnerability of crops to climate change, pests and diseases.

In order to prevent biodiversity loss and to provide possibility to use these resources for implementing rural development projects in Bosnia and Herzegovina action should be taken to establish effective conservation strategies (ex situ, in situ and on-farm). Management of germplasm including breeding and selection in the hands of the farmers has to be ensured. It is necessary to establish a seed multiplication system to encourage local farmers to use and sow local landraces, varieties and cultivars.

Recent research has provided data to confirm the micronutrients superiority of some lesser-known cultivars and varieties over more extensively utilized cultivars. Therefore, the availability of genetic diversity is an outstanding resource for the production of healthy and high-quality foods that could possibly be locally branded and therefore market as unique products from our area.
7. BYBLOGRAPHY


lection of papers from Ad hoc meeting, 7–8 December, Prague. International Plant Genetic Resources Institute, Rome, 2001.


