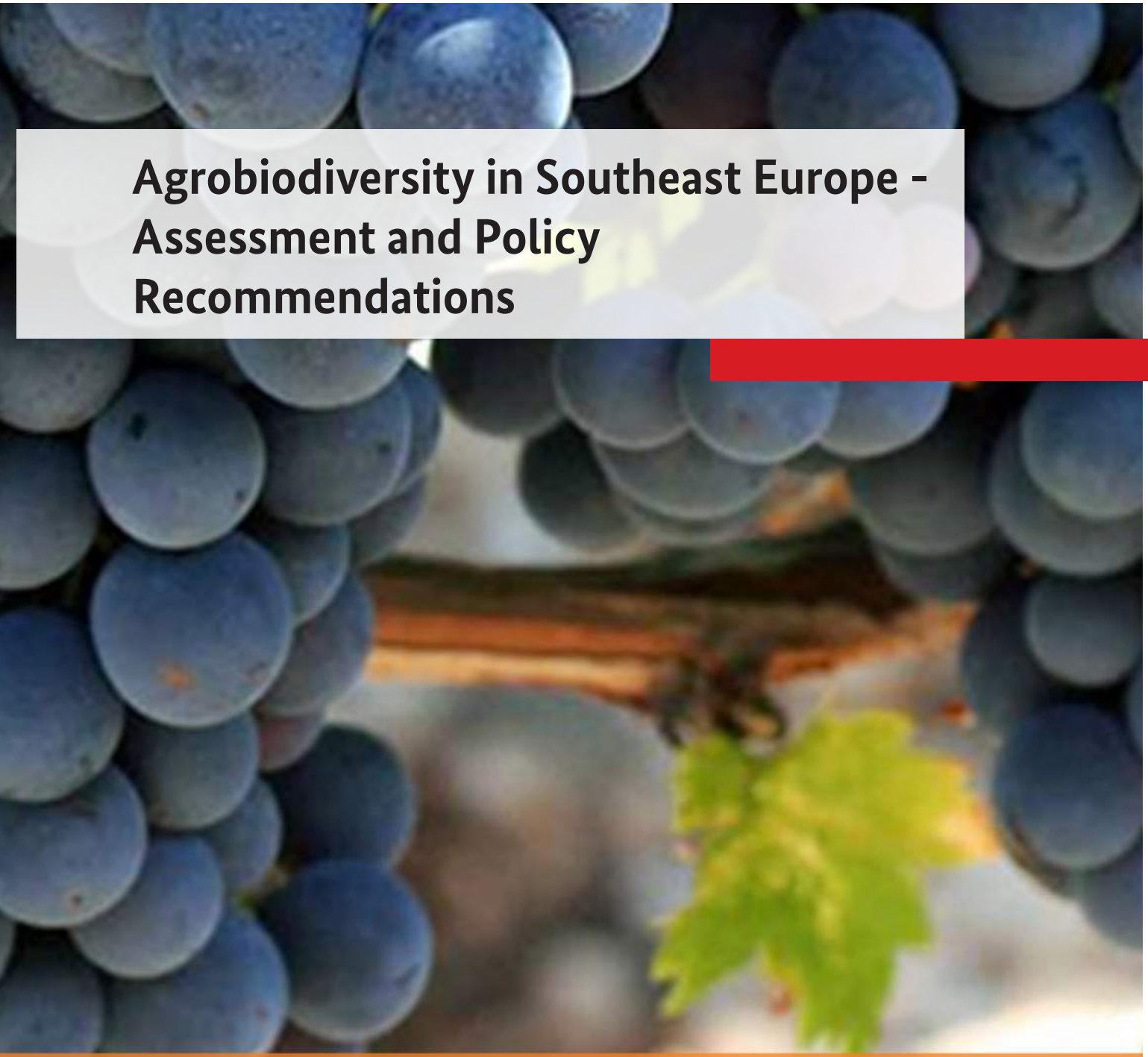

Agrobiodiversity in Southeast Europe - Assessment and Policy Recommendations

REPORT - ENTITY FEDERATION OF BOSNIA AND HERZEGOVINA

South Eastern Europe SWG RRD Regional Rural Development Standing Working Group

german cooperation DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH,
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The analyses, conclusions and recommendations in this paper represent the opinion of the authors and are not necessarily representative of the position of the Regional Rural Development Standing Working Group in SEE (SWG) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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LIST OF ABBREVIATIONS

AEGIS	European Genebank Integrated System
BD	Brcko District of Bosnia and Herzegovina
BiH	Bosnia and Herzegovina
CBD	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
CEFTA	Central European Free Trade Agreement
DUS-VCU	Distinctness, Uniformity and Stability (DUS) and Value for cultivation and use (VCU)
EAAP	European Association for Animal Production
ECPGR	The European Cooperative Programme for Plant Genetic Resources
EPPO	European and Mediterranean Plant Protection Organization
EU	European Union
FAFS	Faculty of Agriculture and Food Sciences
FAO	Food and Agriculture Organization
FBiH	Federation of Bosnia and Herzegovina
GR	Genetic Resources
HERD	Higher Education, Research and Development
INGEB	Institute for Genetic Engineering and Biotechnology
IPA	Instrument for Pre Accession Assistance
IPARD	Instrument for Pre Accession Assistance for Rural Development
IPPS	International Plant Propagators` Society
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MAP	Medicinal and Aromatic Plants
MoFTER	Ministry of Foreign Trade and Economic Relations
NBSAP	National Biodiversity Strategy and Action Plan
OPPGR	Operative Program for Plant Genetic Resources in Agriculture
PHPO	Administration Office for Plant Health Protection
PGR	Plant Genetic Resources
RS	Republic of Srpska
SAVE	Saveguard for Agricultural Varietes in Europe
SEEDNet	South East European Development Network on Plant Genetic Resources
SSR	Simple Sequences Repeats
ULO	Ultra Low Oxygen

UNDP	United National Development Programme
UPOV	Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
WG	Working Groups
WTO	Word Trade Organization

FOREWORD
AND ACKNOWLEDGMENTS

The three-year project "Rural Development through Integrated Forest and Water Resource Management in Southeast Europe (LEIWW)" is jointly implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Standing Working Group for Regional Rural Development (SWG RRD).

The project aims to improve the regional capacities for sustainable management of natural resources for the development of rural areas of Southeast European countries: Albania, Bosnia and Herzegovina, Kosovo*, Macedonia, Montenegro and Serbia.

As part of the EU (pre-) accession process, the countries of Southeast Europe (SEE) are committed to the harmonisation of their strategies, policies and legislation with the acquis communautaire of the EU and to build the conditions and capacities for their implementation.

Therefore, one of the main objectives of the LEIWW project is to create preconditions for evidence-based, EU-compliant policy formulation regarding the conservation and sustainable use of genetic resources in agriculture (agrobiodiversity). Agrobiodiversity is essential for the sustainable development of agricultural production, nature conservation and adaptation to climate change, as well as for the welfare of the people living in rural areas.

In line with this objective, evidence-based policy assessments and gap analysis related to agrobiodiversity were performed in a regional process involving leading experts and institutions of all SEE countries and entities aiming to identify priorities and to formulate recommendations for mainstreaming agrobiodiversity in agriculture and rural development policies, strategic plans, programmes and relevant legislations.

On this occasion, SWG and GIZ would like to express our appreciation to the Ministries of Agriculture and Rural Development from the SEE region for their dedication and active contribution to the process.

The appreciation particularly includes the regional coordinators Prof. Sonja Ivanovska and Prof. Sreten Andonov from the Faculty of Agricultural Sciences and Food, St. Cyril and Methodius Universityof Skopje, all participating experts and institutions, as well as the team of international experts from the Environment Agency Austria (Umweltbundesamt, GmbH).

The coordination of the process by Ms. Irena Djimrevska, GIZ and Ms. Katerina Spasovska, SWG, as well as the technical assistance of Ms. Jana Vasilevska, GIZ and Mr. Oliver Pop Arsov, SWG is highly acknowledged.

We would like to thank you all for having contributed to this major work!

On behalf of the SWG Secretariat
Mr. Boban Ilic
Secretary General

On behalf of GIZ LEIWW
Mr. Benjamin Mohr
Team Leader

INTRODUCTION

Southeast European (SEE) countries are rich in agrobiodiversity. Farming systems are built on a broad range of divergent local and autochthonous plant varieties and animal breeds of international importance. In times of ecological and economic pressure the treasure of diversity is at risk, distinction is irreversible and hinders today's and tomorrow's welfare, resilience and adaptive capacity. Strong links between agrobiodiversity, traditional knowledge, cultural diversity and local innovations are evident in the region and are part of its unique and rich character. In contrast to the developed countries, often less rich in agrobiodiversity, but equipped with strong policies for supporting preservation, sustainable use and promotion of genetic resources, Southeast European countries still struggle to establish an adequate framework for conservation and sustainable use of plant and animal genetic resources.

Moreover, the public, political and scientific awareness on the essential role of agrobiodiversity is on very different, mostly low levels, followed by (in-)different legislative, low institutional and financial support. Finally, all countries of SEE are facing two strong factors leading to inevitable loss of the still existing valuable genetic resources in agriculture: aging and migration of the rural population.

Conservation and sustainable use of genetic resources in agriculture are essential for the sustainable development of agricultural production, food security, adaptation to climate change, as well as for the socio-economic development and welfare of rural areas. Strong international governance structures, such as the Convention for Biodiversity (CBD) are in place, while the EU countries developed support mechanisms for safe-guarding agrobiodiversity. The SEE region, however, is lagging behind in defining and implementing support policies for conservation and sustainable use of its -still rich- agrobiodiversity.

National and regional policy assessments and gap analysis have been conducted in a process in ownership of the SEE countries (Albania, Bosnia and Herzegovina, Kosovo*, Macedonia, Montenegro and Serbia) in order to provide recommendations for EU compliant policy development relevant for the conservation and sustainable use of agrobiodiversity.

The assessment focuses on an analysis of the current national legislative and institutional status, trends of agrobiodiversity and its protection in the SEE countries. They also focus on identification of gaps, highlighting the necessary changes, reforms and harmonization of the legal base in respect to the Common Agricultural Policy (CAP), NATURA 2000, EU Biodiversity Strategy and Biodiversity Action Plan for Agriculture, Global Plan of Action for Plant Genetic Resources, Global Plan of Action for Animal Genetic Resources and Convention for Biodiversity (CBD).

Key problems and challenges requiring policy interventions are identified, and policy recommendations that will assist the EU integration process of the candidate and potential candidate countries are formulated and disseminated.

The work has raised awareness regarding the importance of agrobiodiversity in the SEE countries, in particular regarding the incentives for conservation and adding value to agrobiodiversity in order to enhance the rural welfare thus maintaining traditions, passing on the local knowledge and ensuring food security.

The assessments, gap analysis and policy recommendations were prepared by academic experts (one for animal genetic resources and one for plant genetic resources from each of the SEE

countries/entities), in cooperation with representatives of the respective Ministries of Agriculture and Rural Development, and coordinated by a team of experts from the Faculty of Agricultural Sciences and Food at the St. Cyril and Methodius University in Skopje.

Considering that the agrobiodiversity heritage of the SEE countries is without boundaries, shared, or mutually owned, while the EU accession process represents a common framework for the whole region, the issue of agrobiodiversity affects not only the national levels of each SEE country, but also touches upon the aspects of regional coordination and cooperation. Key challenges and reform priorities at regional level are presented in the Regional Synthesis Report prepared by the Environment Agency Austria, in their position as international backstopping institution.

The assessments were performed in the period between June 2017 and April 2018, through a process of research, consultations, peer learning and networking, both on national and regional level. During this period of time, four coordinative regional working meetings of the experts and Ministries were held.

All the information presented here are as of December 2017.

**This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence*

1. SOCIO-ECONOMIC, INSTITUTIONAL AND LEGISLATIVE CONTEXT

1.1. GEOGRAPHICAL AND POLITICAL CONTEXT

Bosnia and Herzegovina (BiH) is a south-eastern European country occupying a central position on the Balkan Peninsula, bordering Croatia to its north and west, Serbia to the east, and Montenegro to the southeast, as well as bordering the Adriatic Sea to the south - with a coastline of about 20 km in length. The distance from the northernmost to the southernmost point of Bosnia and Herzegovina is 314 km. Sarajevo is the capital and largest city in BiH.

Bosnia and Herzegovina has a decentralized political and administrative structure with several levels of governance:

1. State level (country Bosnia and Herzegovina - BiH);
2. Level of entities and districts:
   - The Federation of Bosnia and Herzegovina (FBiH) – entity;
   - Republika Srpska (RS) – entity;
   - Brcko District of Bosnia and Herzegovina (BD) – district;
3. Level of cantons (only one entity - the Federation of Bosnia and Herzegovina (FBiH) has the cantons, of which there are ten: Una-Sana, Posavina, Tuzla, Zenica-Doboj, Bosnian-Podrinje, Central Bosnia, Herzegovina-Neretva, West Herzegovina, Sarajevo ,and Canton 10);
4. Level of the municipalities (79 municipalities in FBiH).

The Federation of Bosnia and Herzegovina (FBiH), one of the two entities that make Bosnia and Herzegovina (BiH), is almost entirely located on the Dinarides, except the Posavina part of the Federation that is part of the Pannonian Basin. The highest point of the FBiH is the peak of Cvrsnica (2,222 m) located in northern Herzegovina, while the other major mountains are Vranica, Prenj, Treskavica, and Vran. The largest lakes of the Federation BiH are Jablanicko jezero (70.0 km^2) and Busko jezero (55.8 km^2). The FBiH is hilly and largely wooded, but the northern part of FBiH (Posavina) is a flatland containing very fertile agricultural land suitable for plant production. The FBiH has a predominantly moderate continental climate with warm summers and cold and snowy winters, except for southern Herzegovina, which has a Mediterranean climate with mild winters and hot summers.

According to the 2013 census, the FBiH has a population of 2,219,220 people of which 961,617 live in urban areas and 1,257,603 in rural areas. The total gross domestic product was € 9,559,624 for the FBiH in 2015 (Agency for Statistics of Bosnia and Herzegovina, 2016), while gross domestic product per capita amounted to € 4,061 in 2015. In 2016, FBiH exports from the agricultural sector amounted to € 43,509,000.

There is no Ministry of Agriculture on the state level. However, the Federal Ministry of Agriculture, Water-Management and Forestry is in charge of supporting the agriculture and rural development in FBiH as a part of its activities. The Ministry has commissioned the preparation of the mid-term development strategy of the agricultural sector in the FBiH for the period 2015 - 2019. In terms of supporting producers in agriculture, measures are planned in categories such as market support

measures for producers, direct payments, agricultural equipment and machinery investments, investments in multi-year plantations, and the construction of protected areas.

When it comes to EU integration, Bosnia and Herzegovina is on its way to gaining candidate status. The Stabilization and Association Agreement was signed on September 20th, 2016. The Council of the European Union invited the European Commission to prepare an opinion on the application of Bosnia and Herzegovina for EU membership. The European Commission's questionnaire was delivered to the authorities of Bosnia and Herzegovina on December 9th 2016. Bosnia and Herzegovina ratified the Agreement on Amendment of and Accession to the Central European Free Trade Agreement (CEFTA 2006), which entered into force in November 2007. Of the total amount of IPA I funds allocated to Bosnia and Herzegovina from the IPA 2007-2013 state programs (513.246 million €), on March 10th, 2011, a total of 92% or 473.854 million € was contracted (Direction for European Integration; DEI).

The total amount of IPA II state programs funds allocated to Bosnia and Herzegovina (2014-2016), on December 15th 2014, it was contracted a total of only 20%, i.e. € 31.878 million in total (Report on the International Assistance for the Agriculture, Food, and Rural Development Sector 2015 in Bosnia and Herzegovina).

Bosnia and Herzegovina has not yet acceded to the use of IPARD funds, because it has not established IPARD structure.

1.2. AGRICULTURAL PRODUCTION

During the war, BiH suffered and experienced enormous damage to its economy and infrastructure. According to World Bank estimates, agricultural production was reduced to one-third of the pre-war production level; systems for food processing, distribution and trade channels, the stock of agricultural machinery (losses are estimated at 80%), livestock assets, irrigation systems, barns, warehouses and other farm facilities – all were almost completely destroyed or significantly damaged. This destruction and migration also reflected on agricultural genetic resources as the most sensitive element of agriculture.

According to the document “Annual Report in the Sector of Agriculture, Food and Rural Development of Bosnia and Herzegovina for 2016”, the share of Agriculture was 4.6% of the total GDP of the Federation BiH in 2015. The share of the agricultural sector in the total gross value added (GVA) of FBiH was 5.53% for the same year. Contribution by the agricultural sector to the total GVA of FBiH was around € 420 million for the period 2013-2015.

The basic indicators of agriculture in FBiH were reported in “The Environment Report of Bosnia and Herzegovina” issued by the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina in 2012. According to this report, there is about 0.56 ha of agricultural land per capita in the FBiH, but when fertile land and gardens are taken into account, this figure drops to 0.23 ha per capita. Furthermore, the land fragmentation hampers productivity and investment in irrigation and equipment, so fragmented land ownership can be considered as a disadvantage for the farmers in FBiH. In general, small land farms are limited in regard to quantities of products, and also have difficulties in accessing profitable markets and participation in the chain supplies. According to data from the Register of Agricultural Holdings (2015) of FBiH, 65% of agricultural holdings use less than 1 ha of land. Compared to the total number of agricultural holdings, 64.6% are up to 1 ha in size, 24.2% 1 – 3 ha, 6.2% 3 - 5 ha, 3.6% 5 - 10 ha, 1.3% 10 - 50 ha and 0.1% over 50 ha. The situation is further complicated by an incomplete land registry, and rigid land transaction processes, making land registration and land transactions costly and time consuming. In the FBiH, the agricultural sector employs around 53,000 people, of which 36,000 are men and 17,000 are women. The share of agricultural activity is about 11% of total of the employment in the FBiH.

The government of FBiH established the program of subsidies in agriculture to the amount of € 33,592,000 in 2017. Of this amount, € 5,317,436 subsidizes plant production, € 26,689,436 goes toward animal production, € 1,175,971 on the capital investment model, and € 153,387 is planned for other types of activities. € 1.2 million was adopted for the Veterinary Support Program. In this program, there are no subsidies provided for the agrobiodiversity conservation activities. There is only one agricultural advisor available for 8,000 - 10,000 farmers in FBiH, compared to 550 in Austria or 189 in Slovenia. The public advisory services are actually burdened with administrative duties (payment of subsidies) and have no practice in the field, and as such show no presence in the fields.

From the standpoint of natural resources and the number of citizens (farmers) engaged in animal production, it is of the greatest importance for the agriculture and agricultural development in the FBiH. The dominant share of meadows and pastures (269,000 ha and 432,000 ha respectively; 2015) in agricultural areas represents a resource on which it is possible to base further development.

The number of almost all types of domestic animals in the Federation of Bosnia and Herzegovina has varied over the last five years (Federation in Figures, 2016). Cattle breeding records show a slight increase (from 213,466 in 2011 to 216,205 in 2015) and the number of sheep also shows a slight increase (from 519,671 in 2011 to 524,608 in 2015). In the above-mentioned period, the number of goats varied from 41,000 to 42,000 while the number of horses is extremely low and it tends to decline (from 6,491 in 2011 to 5,623 in 2015). The number of pigs is relatively stable in the period of 2011-2015 (87,000 - 89,000). Related to the number of poultry, there is evidently a significant increase (from 8,788,000 in 2011 to 9,818,000 in 2015). The statistics on the number and production by species of domestic animals are shown in Annex I.

According to the Federation in Figures (2017), the most important products of animal industry in the FBiH are the dairy products, meat and meat products. Milk production grew slightly from 330,387 L in 2013 to 357,138 L in 2016. This increase in production is attributed to improved productivity and breed composition.

Production of meat in registered slaughterhouses in the period 2011-2015 increased from 58,023 tons to 60,240 tons. According to the Statistical Yearbook (2016), the structure of meat production in 2015 is as follows:

- Beef meat 20,079 tons;
- Pork meat 1,697 tons;
- Poultry meat 37,292 tons;
- Sheep meat 1,172 tons.

Progress in the breeding of animals, genetics, and disease control has enabled massive and intensive production of poultry meat worldwide, as well as in the FBiH. Of the total quantity of meat produced in 2015, the proportion of poultry meat was 62%, whereas of sheep meat the figure was only 2%.

In the FBiH (Federation in Figure, 2016), in 197,139 ha of total sown ploughed field surfaces, the share of cereals was 88,307 ha (58 %). The leading crops in the structure of land surfaces sown with cereals are maize with 139,000 ha and wheat with 66,000 ha, followed by fodder plants (clover, alfalfa, and grass-clover mixtures). Average yields per hectare of all cereal crops are still far behind those achieved in EU countries. The main reasons for this, besides the already mentioned limited agro-climate conditions, are small and split farm land, insufficient use of certified seed and very low levels of applied agro-technical measures, first of all use of fertilizers, herbicides, and irrigation. Fodder plants cover 63,000 ha, vegetables around 43,000 ha, and industrial plants 3,000 ha. The fruit and vegetable sector is the one of the most significant sectors for agricultural

production in Bosnia and Herzegovina. Vegetable production was 311,608 tons in 2015. Potato production is the largest, followed by cabbage, tomato and onion. In 2015, the number of fruit trees was 24.51 million, with the production of 121,711 tons of fruits. The greatest production was achieved by plum, followed by apple, and pear. But, in the last 10 years, raspberry production has seen an expansion (9,055 tons).

The most efficient current production is achieved by production of fresh plums, frozen and fresh raspberries, forest fruits, cherries, gherkins, tomatoes and potatoes. Most of the producers in this sector follow the latest trends, as well as technologies which are required from the Global GAP standard. A very positive and encouraging situation during the last couple of years has been the fact that there has been an introduction of new species and varieties in primary production such as the primocane raspberry, chokeberry, new strawberry varieties, etc.

Commercial agricultural production, acquisition of seed and testing of the suitability of imported cultivars for local conditions are regulated by the BiH Law on Seeds and Planting Material of Agricultural Plants, the Law on Protection of Novel Cultivars of BiH, as well as by the entity laws. Before planting, there is now the obligatory testing of new or introduced cultivars, as well as the obligation for registration of cultivars in the list of varieties. These are the frame laws, and there are entity laws as real implementing laws in both entities. Neither of the entities is restricting access to the PGR regarding the issue of access and benefit sharing. Regarding this, there is a plan to develop a good system for material transfer agreements, as well as for seed and plant material quantity and quality.

Over the next decades, climate change will have an increasingly intense impact on agriculture in FBiH, but the current institutional set-up is not prepared to support the sector in adapting to these changes. The effects of climate change have been characterized as extreme drought during vegetation period that led to the decreased agricultural production and in lower quality of the yield; however, 2014, there were extreme floods.

Organic Production

According to the State of the Environment Report in BiH (MoFTER, 2012), the production of organic food began in 2000. In 2007, there were about 600 manufacturers recorded involved in organic production, while 14 farms were registered for the production of organic dairy and meat products in BiH. Also, in BiH there is a production and a range of other products, such as buckwheat, corn, wheat, barley, rye, oats, potatoes, carrots, lettuce, onions, beets, peppers, cucumbers, strawberries, raspberries, cherries, grapes, figs, and apricots. However, it is not known the exact number of manufacturers and companies that are today involved in organic production. In 2009, the area used for organic production was 262 ha, which covers 0.02 % of arable land. The average size of the farms in BiH was 1.2 ha of farmland. Although the organic sector is very small, organic production recorded a sharp rise in the period 2003-2007 (State of the Environment Report in BiH, 2012). There is no new official data about organic production in FBiH.

1.3. INSTITUTIONAL AND ADMINISTRATIVE ORGANISATION

On the level of the state, i.e. Bosnia and Herzegovina, the most important governmental institutions related to the agricultural genetic resources are as follows:

Ministry of Foreign Trade and Economic Relations of BiH (MoFTER) - Sector for Natural resources, Energy and Environment Protection; Sector for Agriculture, Food, Forestry and Rural Development; Veterinary Office. This Ministry is in the charge of contracts, agreements and other documents in the field of economic relations and trade with other countries, both bilateral and multilateral agreements. Within the MoFTER, the Sector for Energy, Natural Resources and Environmental Protection, with its six departments, has 34 employees, and within the Department

of Environmental Protection there are nine employees. The MoFTER should have one Sector which would deal with issues of collecting and reporting data related to agrobiodiversity. Currently this does not exist.

Administration Office of BiH for Plant Health Protection (PHPO): The PHPO is the central authority for plant health protection in BiH and for exchange of information with the official international authorities. The PHPO performs administrative and related technical tasks in line with the Law on Plant Health Protection and other substantive regulations that make up the legal framework. The PHPO cooperates, informs and exchanges information with the official international plant protection authorities and organizations (EU, EPPO, WTO, FAO, IPPC, UPOV, etc.).

Ministry of Foreign Trade has the **State Veterinary Office**, but this governmental office still does not perform all activities stipulated by the law. The reason for this, as well as for the lack of field enforcement of veterinary law, is in the inadequate regulations and sub laws within this law.

On the level of FBiH, the most important governmental institutions related to plant genetic resources are as follows:

Federal Ministry of Agriculture, Water Management and Forestry: Under other obligations in the agricultural sector this Ministry manages the genetic and biological resources in FBiH. The Ministry of Agriculture of the FBiH is highly decentralized. It consists of departments for agriculture, veterinary services, water resources and forestry. Besides this Ministry, there are seven cantonal ministries of agriculture. For the other three cantons, agriculture is under the jurisdiction of the Ministry of Economy. On the municipality level, there are 200 agricultural administrators. Currently, most of the activities of the Ministry of Agriculture of FBiH are directed towards the reconstruction of the agricultural production, preparation of the strategy for agricultural development and the establishment of an institutional infrastructure for agriculture in market economy conditions. This Ministry has been involved in establishing the Gen Bank for PGR in FBiH. Also, this Ministry adopted the Operative Program for Plant Genetic Resources in Agriculture in the Federation of Bosnia and Herzegovina (2014); however, there are no other activities related to agrobiodiversity in FBiH. The establishment of a livestock breeding service in FBiH is under consideration, pending major policy orientation to be approved within the strategy for agricultural development.

The number of employees at this Ministry is 98. There is a dearth of employed expert staff who are involved in conservation of agrobiodiversity, which complicates the process of the implementation of activities that need to respond to world trends in this area.

Federal Ministry of Environment and Tourism has been appointed as the operational focal point on behalf of BiH for the implementation of the Convention of Biodiversity. Accordingly, the Ministry is responsible for communication with international institutions, initiating activities in line with the Convention and for coordination with other relevant authorities and stakeholders in the Federation of Bosnia and Herzegovina.

Cantonal Ministries of Agriculture: The total number of employees in all of the cantonal ministries is 107; however, the exact number of employees within public enterprises is not known. Advisory services are organized on the cantonal level in FBiH.

Federation of Bosnia and Herzegovina Environmental Protection Fund: The duty of this fund is to collect and distribute financial resources for environment protection in the territory of the FBiH. There are currently 48 employees at this fund. There are no planned budget funds for conducting activities on agrobiodiversity protection.

Public professional institutions and agencies in FBiH that deal with agrobiodiversity data collection are as follows:

Faculty of Agriculture and Food Sciences (FAFS) in Sarajevo. FAFS performs inventory, collection, characterization, morpho-pomological and molecular characterization, evaluation, documenting and storing of GR (plant and animal genetic resources), research projects for use of GR and education via a course programs on GR. The Gene Bank of FBiH is part of the Faculty and contains over 500 accessions of various plants. Still, the position of the Gene bank is undefined (without employees and financial support). The Faculty has 105 employees, out of which 50 hold Ph.D.'s. (The Faculty also have trial field, various laboratories for phenotypic, agronomic and qualitative GR analysis, laboratory for molecular genetic analysis and inventory collection of seed samples.

Institute for Genetic Engineering and Biotechnology (INGEB) in Sarajevo. INGEB is a public scientific institution, and is part of the University of Sarajevo University. The Laboratory for Molecular Genetics of Natural Resources is a part of INGEB, which collaborates with other educational and scientific Institutions in the field of molecular genetics of GR in FBiH.

Other research and educational institutions are as follows: Faculties of Agriculture and Food Technology of the Mostar University; Agromediterranean Faculty of the Dzemal Bijedic University in Mostar; Biotechnical Faculty of the University in Bihac; Technological Faculty of the University of Tuzla; Faculty of Forestry of the University of Sarajevo; Faculties of Natural Sciences and Mathematics of Universities in Sarajevo, Mostar and Tuzla. They provide educational and research activities related to specific issues of GR.

Federal Institute for Agriculture in Sarajevo and Federal Agromediterranean Institute in Mostar: These institutes carry out professional and other tasks within the jurisdiction of the FBiH related to organization of reporting - forecasting services in plant protection; breeding-selection work in livestock; certification of seed and planting material of agricultural plants and advisory service and land management as a basic natural resource in the continental/Mediterranean climate regions, as well as other activities related to agricultural production.

Cantonal Institute for Agriculture in Tuzla and Bihac: This institute carries out professional and other tasks within the jurisdiction of the cantons related to the agricultural services regarding plant production and livestock.

National Museum, Sarajevo: Has a total of five employees (one ornithologist, 1 entomologist, 2 botanists, and 1 horticulturist). The Botanic Garden and Collections, which contains specimens of domestic animals and plants, is a part of the National Museum.

The problems regarding the institutional set-up are:

- The absence of clearly defined competencies and institutions responsible for GR.
- The fragmentation of the institutional structure.
- The Gene Bank established at the Faculty of Agriculture and Food Sciences in Sarajevo has not been legally confirmed as a Centre for Plant Genetic Resources of FBiH and it should be legally founded by the Federal Ministry of Agriculture, Water Management, and Forestry. The Gene Bank does not have any full time employees, nor does it receive financial support.
- There is not any central institution in charge of livestock breeding and animal performance recording in the Federation of Bosnia and Herzegovina.
- The responsible institutions lack adequate capacity (human and technical).
- There are no activities regarding the establishment of a Genetic Bank of Animal Genetic Resources.

The needs for future strengthening are as follows:

- In order to provide harmonization and improve the framework for the preservation and sustainable use of agricultural PGR, it is necessary to establish a coordinating body at the state level, as well as at the federal level for inter-entity/cantonal and international cooperation. In this body must be included representatives from research institutions.
- Establishment of transfer offices at all public institutions which deal with GR.
- Prioritization of agrobiodiversity issues through establishment of new and strengthening of existing human resources in professional and scientific institutions.
- Securing funding for strengthening the capacities (human, institutional, legal and technological).
- Strengthening of scientific/professional research in the domain of agrobiodiversity protection by priority issues and formation of databases.

1.4. NON-GOVERNMENTAL ORGANISATION

On the state level, the Environment Report of Bosnia and Herzegovina (2012) reported that environmental expert associations perform numerous activities. They have a legal status in terms of having opportunities to raise awareness about the environment, including education. Their joint participation in the formulation and implementation of environmental policy with governmental working groups is at a low level. They do not participate in the meetings of the Inter-entity Steering Committee for the Environment or on the Supervisory Boards of environmental funds at the entity level. NGOs have access to financial support from the entity environmental authorities. In BiH, around 20 NGOs regularly participate in environmental impact assessments in the country. According to the Directory of Environmental NGOs from 2006, there were 87 registered and 1 unregistered non-profit organizations in the field of environment, with 54,628 members in total in BiH, of which 222 members are full or part-time employees. The Directory of Environmental NGOs has not been updated since 2006. However, the environmental NGO movement is still at a relatively early stage of development, and therefore external support and assistance is of great importance. The majority of NGOs are still in need of basic support such as training on proposal writing, project and financial management, as well as support in terms of office and technical equipment. It was not possible to find any data about the activities of NGOs in the field of agrobiodiversity protection in FBiH. But, there are several good examples of some farmers' organizations, private farms and companies, as well as associations. The NGO Odraz supported financial rebuilding of the Gene Bank of FBiH. These NGOs do not have any other role regarding PGR conservation, nor seed storage. More about these examples is elaborated upon in the following chapters related to genetic resources and case studies.

1.5. LEGAL FRAMEWORK FOR PROTECTION OF AGROBIODIVERSITY

In FBiH, it is noticeable that there are good examples of biodiversity integration into agricultural practice, but also there are examples of uncoordinated policies. It is necessary to continue with activities on harmonization of the existing policies at all levels, as well as on better coordination, cross-sectorial collaboration, implementation and monitoring. Biodiversity should be fully incorporated into all relevant sectorial policies and strategies, budgets and planning.

The legal regulations of FBiH do not directly address the issue of the usage, development and conservation of animal genetic resources. Although a number of legal acts dealing with agricultural production and livestock production have been made during the period 1996 - 2017, there is no clear emphasis on the goals and methodologies for the protection, development and use of animal genetic resources in the FBiH. One article on animal husbandry (Article 13) defines the original breeds and how to deal with them, but this article, along with its other views, is still not operational.

Currently there is a setup for about ten laws and regulations related to plant genetic resources. The list of national laws (including sanitary/phyto-sanitary/veterinary/origin of product/protection of product regulation) is as follows:

Law on Protection of New Varieties of Plants in BiH: regulates the procedure for the protection of new varieties of plants, the conditions, allocation, methods and procedures for the protection and duration of breeding rights.

Law on Genetically Modified Organisms in BiH: regulates the procedure and conditions for the limited use, cross-border transfer, intentional introduction into the environment and placing on the market of genetically modified organisms and products containing or originating from genetically modified organisms, provides the definitions of genetic material, genetic resources and genetically modified organisms.

Law on Agriculture, Food and Rural Development in BiH: sets out the objectives, principles and mechanisms of development policies in the sectors of agriculture, food and rural development, the structure and competencies at all levels of government, the structure and institutional support services, their roles and relationships, mechanisms for monitoring and evaluation, provides the definitions of traditional manufacturing and traditional products based on plant and animal components, and provides the definitions of indigenous species and breeds of animals.

Law on Plant Health Protection in BiH: regulates the issue of plant health, the measures and responsibilities to prevent the occurrence, introduction and spread of organisms harmful to plants, plant products and other regulated objects/subjects and their eradication, the biological protection of plants, the collection and exchange of data and information systems, and public services in the area of plant health.

Law on Seeds and Planting Material of Agricultural Plants in BiH: defines the conditions for the production, transport and import of seeds and planting material of agricultural plants, regulates the registration of plant varieties in the list of varieties, the maintenance of registered varieties, provides the definitions of seeds and planting material of agricultural plants, the reproduction plant material and varieties.

Regulation on Recognition of Varieties of Agricultural Plant Species in BiH: regulates the procedure and manner of recognizing varieties of agricultural plants which must be registered in the List of Varieties of BiH, the manner of preparation of seeds and the required seed quantities, the experimental field and the duration of testing; the manner of testing varieties and determining the value of varieties.

Regulation on Registration of Varieties in the Variety List of BiH: prescribes the process of registration of varieties in the List of Varieties of Agricultural Plants in BiH for plant species which must be registered, the contents of the List and cultivar files, the conditions and procedure for renewal of registration of varieties in the List, the conditions for accepting and determining the name of the variety, supervision over the maintenance of the variety, the content and manner of keeping records of variety maintenance, and provides the definition of domestic varieties.

Law on Nature Protection: regulates the conditions and manner of restoration, protection, conservation and sustainable development of landscape, natural areas, plants, animals and their habitats, minerals and fossils and other components of nature, the jurisdiction of authorities in carrying out tasks related to environmental protection, nature conservation planning, the general and special measures for nature protection, information system, supervision, and financing of nature conservation, provides the definitions of biodiversity, natural resources, habitat, living organisms, species, sustainable development and sustainable use.

Law on Seeds and Planting Material of Forest and Horticultural Species of Trees and Shrubs: regulates all issues related to forest and horticultural seeds and planting material, as well as the process of registration and the manner of keeping registers.

Law about veterinary drugs (from 1998) treats and deals with the definition, description and regulates distribution and use of veterinary drugs.

L**aw about improving animal production treats**: deals with the definition, description and regulation of animal production, trade and quality of animals and animal products, and animal welfare. This law has a lot of disadvantages, as it does not define clear categories of animals and how they are rated or classified. In this law there is a term of animal breeding selection service whose existence is questionable. The articles within this law do not deal with agrobiodiversity.

Veterinary law of Federation of Bosnia and Herzegovina: (from 2000) treats and deals with the definition, description and regulation of veterinary services and veterinary services providers.

Agricultural Law: (from 2007) This Law regulates goals and measures of agricultural policy and users rights in the FBiH. It also defines agricultural economy, determines the concept of farmers, institutional support, reporting in agriculture and the keeping of registers, administrative and inspection supervision, penal provisions as well as others issues of importance to agriculture. Neither this law, nor one of its articles, treats agrobiodiversity as a serious issue.

Law on subsidies in agriculture and rural development: (from 2010) treats and deals with the measures of financial support in agriculture and rural development, models of financial support, sources, priority selection and amount of funds, beneficiaries of financial support for the realization of financial support, supervision of the implementation of this law, penal provisions, transitional and final provisions as well as other issues regarding cash grants. Although this law among other things mentions autochthonous breeds, it does not sufficiently define the way and the possibility of affirming it.

Animal Husbandry Law: (from 2013) This Law regulates the production and breeding of domestic animals, insemination and licensing of domestic animals, trade in quality animals and genetic material, zoological technical measures, sanitary conditions for breeding and exploitation of domestic animals, carrying out breeding of breeding-valued animals. The provisions of this Law encompasses the breeding of: cattle, pigs, goats, sheep, horses, donkeys, rabbits, poultry, bees and other species of domestic animals that have an economic purpose. As with the aforementioned laws, this law does not, to a great extent, treat the issue of defining agrobiodiversity or its preservation.

Law on agricultural organic production: (from 2016) This Law lays down the objectives and principles of organic production, the production rules for organic agricultural production, the labeling of organic products, the system of controls in organic production, the register of entities in organic production, administrative and inspection supervision, import, export and placing on the market organic products, issues of importance for organic production. This law does not mention in its text agrobiodiversity, nor issues related to it.

The Decree on the Founding of the Federal Council for Agriculture and Rural Areas: (from 2012) This Regulation establishes the Federal Council for Agriculture and Rural Areas as a Professional and Advisory Body of the Government of the Federation of Bosnia and Herzegovina. The task of the Agriculture Council is to; follow the development and implementation of the agricultural strategy, monitor and review the Green Report on the state of agriculture, monitor the development and implementation of the rural development strategy and protect the interests of rural economists Community in the FBiH, give an opinion on the proposals of state and federal regulations and international agreements in the field of agriculture. The council formed by this decree is not yet operative.

The list of national strategic and program documents is as follows:

1. **Medium-term strategy for Advisory Services FBiH** (2017-2021) elaborated by the Ministry of Agriculture, Water Management and Forestry of FBiH.
2. **The strategy of providing advisory services in the FBiH** and **the Strategy for the development of the Federation of Bosnia and Herzegovina** 2010–2020, elaborated by the Ministry of Agriculture, Water Management and Forestry of FBiH.
3. **Medium-term development strategy of the agricultural sector in FBiH** for the period 2015-2019, elaborated by the Ministry of Agriculture, Water Management and Forestry of FBiH.
4. **Operative Program for Plant Genetic Resources in Agriculture in the FBiH (OPPGR FBiIH)**, adopted by the Ministry of Agriculture Water management and Forestry of FBiH in 2014. This programme was made by an expert team (led by the Faculty of Agricultural and Food Sciences in Sarajevo) from the Faculties of Agriculture and other stakeholders, which have been involved in SeedNet project. In this programme it was defined that the Gen Bank at the Faculty of Agriculture and Food Sciences should be the implementing body for the programme. The position of the Gene bank is still undefined (it is without employees and financial support).
5. The FBiH has adopted the **Strategy of Integrated Environmental Protection**, comprising: the Federal Nature Protection Strategy, the Federal Air Protection Strategy and the Federal Waste Management Strategy with Action Plan.
6. **National Biodiversity Strategy** and **Action Plan** (NBSAP BiH 2008-2015)
7. **National Biodiversity Reports**: First, Second, Third and Fourth were developed over the course of the period 2005-2010.

The above-mentioned strategies refer to the general biodiversity without emphasis on biodiversity in agriculture and do not offer concrete solutions and activities related to this issue.

For agrobiodiversity issues on the territory of the FBiH, no action plans have been taken in the past and none are in process. There are no special budget allocations for agrobiodiversity. The subsidies are prescribed by law generally for animal husbandry and are not especially focused on or interested in the conservation of agrobiodiversity.

According to the available data from the Ministry of Justice of BiH, there are no international conventions on agrobiodiversity signed by BiH. When it comes to agrobiodiversity in the animal domain and the preservation of genetic resources, neither BiH, nor the FBiH, is a member of the European Association for Animal Production (EAAP).

The laws that have been put in place to address the issues in agriculture are not sufficiently implemented. The bodies whose existence is envisaged by these laws often do not exist so that it is very difficult to address issues from different areas, including from the field of agrobiodiversity and conservation of animal genetic resources.

In order to improve the legal framework to address this issue within the existing laws and system of institutions, it is necessary to appeal to the legislative bodies and to acquaint them with the importance of this issue for the country and its follow up in the contemporary world. A series of sub-legal acts related to the problems of agrobiodiversity and conservation of animal genetic resources need to be introduced. In order to carry out such activities, it is necessary to animate the bodies whose legislation is already envisaged.

List of international agreements/conventions:

- Convention on Biological Diversity (CBD - Rio de Janeiro, 1992), ratified in 2002.
- FAO (Food and Agriculture Organization):

A. Constitution of the United Nations Food and Agriculture Organization, signed 16.10.1945 (General Director of FAO), published in the "Official Gazette of BiH", no. 25/93, and came into force on July 12, 1993; ratified on 15.12.1993 (unlimited validity).

B. Annex II - Food and Agriculture Organization of the UN - Convention on the Privileges and Immunities of Specialized Agencies, signed on 29.11.1948 (UN Secretary-General); Came into force 01.09.1993; ratification has not been carried out (unlimited validity).

- Bosnia and Herzegovina became an ECPGR member in 2008.
- Bosnia and Herzegovina is not a member of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).
- By deposit of the instrument of ratification, Bosnia and Herzegovina became the 75th member state of the International Union for the Protection of New Varieties of Plants (UPOV) at the session of the UPOV Council, which was held on 25th and 26th October 2017, in Geneva, Switzerland.

1.6 FOREIGN DONOR SUPPORT FOR CURRENT AND PREVIOUS ACTIVITIES RELATED TO AGROBIODIVERSITY

During the last two decades a large number of foreign support projects related to PGR have been implemented in FBiH:

- South East European Development Network on Plant Genetic – SEEDNet: Conservation and utilization of plant genetic resources in South-East Europe (2004-2014)- SIDA/Sweden.
- Education, Research and Training for Global Environmental Change and Sustainable Management of Natural Resources in the Western Balkans (2012-2015) - Noragric, Department of International Environment and Development Studies.
- FP7 Balkan GEO Network – Towards Inclusion of Balkan Countries into Global Earth Observation Initiatives (2010-2013)-FP7 EC.
- Antioxidant activity and stability of bioactive compounds during processing of certain raw materials of plant origin in BiH HERD-Agriculture (2012-2014) - The Norwegian Programme in Higher Education, Research and Development in the Western Balkans, 2010-2014.
- Evaluation of fruit genetic resources in Bosnia-Herzegovina with the aim of sustainable, commercial utilization (2011-2014) - HERD – Programme for Higher Education, Research and Development (Ministry for Foreign Affairs, Norway).

A small number of projects and foreign aid initiatives have been directed to engage in agrobiodiversity issues of BiH concerning animal genetic resources. There are activities by several foreign organizations, of which USAID and SAVE-Foundation have had most activities.

In 2003, USAID made a study of biodiversity assessment in Bosnia and Herzegovina.

The SAVE-Foundation has carried out several projects that deal with the issue of agrobiodiversity. These are:

- **The Balkan Network for Agrobiodiversity** is a result of various activities for the *in-situ* / on farm conservation of rare breeds initiated by the SAVE–Foundation since 2004. Through these activities, it became clear that there is an obvious willingness to take part in cross-border regional co-operation despite differences in nationality, region or other interests. Due to this, it was possible to establish the Balkan Network with various stakeholders from all Balkan countries.
- **BushaLive** (2008) funded under the FAO Funding Strategy for the Implementation of the Global Plan of Action for Animal Genetic Resources, targets the autochthonous Busha cattle breed of the Balkans, which survives in small, highly endangered, populations in each Balkan country.

The project targets the problem of determining which and how many of the breeds exist, under which conditions and how their conservation can be managed. Bosnia and Herzegovina took part in the cross-border **SUBSIBREED** project with the aim of documenting and analyzing the indigenous European breeds. The project was also aimed at analyzing and estimating the level of support provided and needed in each country.

It should be emphasized that all results of the implemented projects will be most useful for the research community in FBiH. However, the institutional surroundings in FBiH did not continue to use the good practice derived from these projects.

When it comes to animal genetic resources, all conducted projects resulted in identifying and stating the problems of the AnGR, but unfortunately, predominantly only to the academic community. The outputs of these projects are publications that elaborate these issues.

Difficulties are often arise after completing and closing projects because of the absence of funding continuation from the budget of the FBiH for the biodiversity conservation. It is necessary to adjust the legal and institutional framework to enable the adaptation to the requirements of international conventions, which involves changes to the existing legislation for the purpose of adopting new regulations. In particular, regulatory changes are necessary to regulate the legal status of genetic resources and traditional knowledge, define clear procedures for granting access to genetic resources and procedures for fair and equitable sharing of benefits, as well as the appointment of authorized institutions for deciding upon and granting access to genetic resources, benefit sharing, monitoring and compliance, as well as the dissemination of relevant information.

2. GENETIC RESOURCES IN AGRICULTURE

2.1. OVERVIEW OF THE STATUS OF GENETIC RESOURCES IN AGRICULTURE

2.1.1. Plant genetic resources

As a result of the influence and comings of different cultures to what is now the area of BiH, many species and varieties from east and west were introduced to this area. Over time this created autochthonous germplasm based on spontaneous/planned hybridization or selection.

The first organized activities on PGR in FBiH started during the 1980's known as a project Gene Bank of Yugoslavia where the research centers from Bosnia and Herzegovina were involved in all activities. This Yugoslavian project covered inventorying, collecting, identification, multiplication, characterization and establishing a Plant Gene Bank. But, because of the war in 1990s all activities were stopped, with most of the documents and results being destroyed during the conflict.

Swedish International Agency for Cooperation and development – SIDA implemented a regional project "South Eastern European Network on Plant Genetic Resources – SeedNet" (from 2004 through 2014). Through this project were supported the activities on PGR conservation. In 2008 Bosnia and Herzegovina became an EC PGR member and in some of the Working Groups of ECPGR representatives from FBiH were participating (such as Prunus WG and Vitis WG).

After the SeedNet project there was not any organized support for the activities for PGR from the government of FBiH.

Maintenance and use of landraces and local varieties is also based on personal interest and commitment to plant heritage and cultural history. There is a trend of decreasing this diversity and increasing genetic erosion in all cultivated crops. The main factors of this erosion of agricultural PGR are social-economic changes, demographic migration, abandonment of rural areas, lack of niche markets, a lot of rural areas still have mines from the war, climate changes, pests and diseases (almost all autochthonous plum genotypes are highly susceptible to the plum pox virus), etc.

Currently, it is not possible to provide concrete and precise information about the total genetic diversity in BiH, as well as participation of local populations and landraces in the total agricultural production. Almost each garden in rural areas (often even in urban areas, too) has diverse landraces of fruits, vegetables, legumes, and corn. Crops of old varieties are mostly used for one's own needs and the rest is sold at local markets. Crops are often the only income for many families that live in mountainous regions and poor areas. A certain number of old cultivars (almost 500) of cereals are conserved in the Plant Gene Bank at the Faculty of Agriculture and Food Sciences, University of Sarajevo. The exception might be buckwheat for the last year. Buckwheat surfaces are increasing from year to year. It is used for traditional food, within the pharmaceutical industry and mostly this production is commercialized through organic production and the producers' export of this product.

Through the Operative Program for Plant Genetic Resources in Agriculture in Federation of Bosnia and Herzegovina (OPPG FBiH) there were established seven crop specific working groups (WG): Cereals and Maize, Fruit Crops, Vitis, Vegetables, Medicinal and Aromatic Plants, Industrial Plants, and Documentation and IT. Besides these seven WG's, there were defined three ad hoc WG's: Fodder Crops, Ornamental Plants, and Wild Relatives. Coordinators and members of these groups

are experts within their specific fields in FBiH. They, together with the local people and terrain co-workers, deal with inventory, collection, multiplication and regeneration, and partially on the characterization and evaluation of PGR.

The OPPG FBiH adopted by the Ministry of Agriculture, Water Management and Forestry of FBiH defined the list of mandate and target species, as well as the list of mandate varieties of target crop species. These lists were created through the previously established seven crop specific working groups. This means that the WG's formed in FBiH have defined what kind of species are of importance and priority to engage in activities related to preserving agricultural PGRs. The definition of important and priority species and varieties, was undertaken based on the experiences gained in the SeedNet project, hence the differences in number of mandatory species and varieties per working groups.

Cereals and Maize

In intensive commercial agriculture in FBiH the old cultivars of cereals have been replaced with newly introduced higher-yielding cultivars. Old cultivars are still grown but mainly in highland areas. Some of them are grown because of specific flavored bread production (integral bread) or because of resistance on biotic and abiotic environmental conditions.

The most important cultivated species of cereals and maize in FBiH are: maize, buckwheat, barley, rye, oats, wheat and millet.

Wheat

Wheat production is present in all regions of FBiH. In 2016 the yield of wheat was 86,732 tons (this is an increase of 21.2% compared to 2015's yields). Wheat is much more represented in the lowland areas, where the selected new cultivars are dominant, but it is possible to find the material that was cultivated before the Second World War. These old varieties are characterized by a small genetic potential and greater protein content. In the mountainous areas of FBiH the old wheat can be found planted together with rye. About 17 different genotypes of wheat were stored In the Gen bank. The most important genotypes of wheat for the conservation, sustainable use and breeding are two genotypes of soft wheat and two genotypes of hard wheat.

Maize

In the cultivation of maize the new hybrids dominate, with different maturity groups (the vegetation length of 90 to 180 days). Corn silage production in FBiH is about 451,151 tons and there has been a significant increase in production. There has also been a registered increase in the production of corn grain (243,760 tons). Diversity of maize hybrids makes production possible in almost all areas of FBiH. The intensive commercial production of maize is mostly present in the low-land area of the northern part of FBiH as well as in the valleys of the rivers Sava, Una, Bosna, Drina, and Spreca, etc. In maize production are also domestic maize genotypes present of early and middle vegetation lengths. Domestic varieties have mostly white and yellow grains with lower genetic potential of yield (some of them may also possess red grains); but, they have significantly higher protein content and because of that are predominantly used for human nutrition.

Sweet corn and popcorn are partially present in maize production, where the popcorn varieties have different shapes and some of them also have a local origin.

In the Gen bank seeds of more than 100 accessions are stored at -20° C. As the most important several genotypes of corn for conservation, sustainable use as well as for breeding could be selected (Bosanac, Crveni, Kokicar, Osmak, Sitni zutac).

Rye

Rye is sporadically present in cultivation with a production of 8,363 tons. This crop is tolerant to lower temperatures and acidic soil. Because of this resistance, rye is mostly present in the mountain areas of FBiH. It is more probable that it is a material of domestic origin. Only two rye accessions were stored in the Gene Bank.

Barley

Recently, barley production has been increasing and it has been used as a substitute to maize production in the regions with high summer temperatures.. The production of barley in 2016 was 27,939 tons and as such there has been a significant increase on 2015's harvest. On the other hand, barley is harvested early and it is possible to have two sowings on the same plot of land. Two-rowed barley, as well as four-rowed barley is present in the practice. It is unlikely that the old barley varieties belong to the autochthonous biodiversity. Two accessions of barley were stored in the Gene Bank.

Oats

In FBiH there exists the winter oats, which are resistant to low temperatures as well able to grow in the worse soil conditions. Generally oats are planted in the mountain areas of FBiH. This crop is known as "white" and "black" oats. White is used as an anti-inflammatory agent for urinary infections. It is more likely that old varieties of oats belong to the original biodiversity pool of FBiH.

Buckwheat

Buckwheat surfaces are increasing over the years. This crop is characterized as tolerant to low temperatures as well as on bad soil conditions. It is mostly cultivated in the mountainous area of FBiH. In the Gen bank about 50 genotypes of buckwheat are stored. This crop is used for traditional food, is used in pharmaceutical industry and mostly this production is commercialized through organic production and export of its products: buckwheat seeds, pasta, honey, meal, flour, and in pillows & mattresses. Some of the organic farmers that have achieved a good economic income from producing autochthonous buckwheat varieties are Heljda Eco - Sarajevo and Halilovici - Ilijas.

Millet

The production of this crop is very small in FBiH. Only one old variety was found – Metlas.

Maize "Osmak zuti"	Domestic buckwheat

Figure 1. Picture of Maiz variety 'Osmak žuti' (left) and domestic buckwheat (right) (SeedNet project, Drena Gadžo)

Fodder crops

Natural meadows and pastures cover 70,100 ha and represent important habitats for biological diversity, especially for fodder crops. Most of them are placed in the mountainous regions of FBiH; however, the full potential for fodder crop production is only partly used. Livestock production is emphasized in all strategic documents of FBiH and high importance is given to forage production. But just as the livestock sector has numerous difficulties so does forage production. Data about forage crops on arable land indicate that today there are less sown areas under forage than before the war in the 1990's. But it seems that forage yield per hectare is increasing. Perennial forage crops occupy the majority of arable land under this type of production. In recent years more attention has been given to maize for silage, especially in lowland areas. Among the perennials, clovers are more important than alfalfa by area sown, although the latter is more productive. Soils in FBiH are more suitable for red clover or other perennial legumes. In the statistics for BiH clovers include bird's foot trefoil and sainfoin. The dry matter yield for alfalfa, clover and grass legume mixtures is as follows: 3.36, 2.8 and 2.6 tons/ha, respectively. The greatest problem is the poor forage quality due to late mowing; farmers mow perennial legumes at late flowering or even later, as well as grasses.

Grass-legume mixtures (temporary grasslands) consist of many species of different maturities that lead to problems in defining time of mowing to get quality forage. These crops are used as green forage during the vegetation season; less often grazed and for haymaking. Silage making from perennials is not common in FBiH, but lately more and more big bales can be seen in the fields.

Most meadows are located in the lowland and lower hilly areas, but can also be found on flat areas in mountainous regions. Average yields range from 1.2 to 1.6 tons/ha. Such low yield indicates poor management, especially poor fertilization.

Pastures are low productive areas situated on shallow or rocky soils and, if used, they are permanently grazed upon.

Forage crops seed is another problem because most of it is now imported on the black market and through "holes" along the state border. The quality of imported seed is highly questionable (variety, origin, disease status and so on). Domestic seed production is ruined due to the low price of imported seed and its production is now very limited. Farmers mention that they sow alfalfa in spring and by next spring it has disappeared. Formerly there was forage crop breeding, albeit on a modest scale, producing Bosnian cultivars: BL- 422, Banjalucanka, Sonja, Biljana, Olimpik 84 (alfalfa); BL-17, Tera, Butmirka (Bird's foot trefoil); BL-4, BL Krajina (Cocksfoot); BL-B (Timothy) and Buki (Red fescue). Unfortunately, seed from domestic cultivars can only be found in very small quantities, or not at all. In the past, Bosnia was known as a seed exporter.

According to the literature and some recent inventories, FBiH grasslands include:

Phragmiteto-Magnocaricetea wet grasslands that can be found in Posavina, karst valleys, along rivers or lakes. Botanical composition of these grasslands includes different species: Phragmites communis, Iris pseudacorus, Alisma plantago, Cicuta virosa, Oenanthe aquatica, Scirpus lacustris, Typha latifolia, Lysimachia vulgaris (over 40), etc.

Molinio Arrhenatheretea grasslands are predominantly situated in lowland areas with fresh to wet soils, used as meadows or pastures. This type is the most productive grassland. The botanical composition includes the following species: Dactylis glomerata, Ranunculus acris, Festuca pratensis, Vicia cracca, Colchicum autumnale, Festuca rubra, Lychnis flos cuculi, Potentilla reptans Ranunculus repens, Bellis perennis (over 40), etc.

Festuco-Brometea grasslands occupy more or less dry areas in hilly and mountain areas. As affected by many factors of climate and soil, these grasslands include a lot of grassland associations such as: Brometo-Plantaginetum mediae, Andropogonetum ischaemi, Danthonietum

calycinae, Nardetum strictae, Agrostiodetum caninae, Potentillo aureae-Nardetum strictae, Seslerietum tenuifoliae (over 50), etc.

According to the realized inventory expeditions, it is clear that FBiH is rich in fodder crop biodiversity: wild relatives, ecotypes and genotypes imported from abroad. Up to now, the inventory is not yet finished, with the systematization, description, characterization, and horology of fodder crops yet to be done and it is is important that this be carried out for the benefit of their conservation and sustainable use.

FRUIT CROPS

Production of fruits is one of the most important sectors in agriculture in Bosnia and Herzegovina. In the last couple of years, this sector has recorded a large increase in production, especially in the subsector of berry fruits. Plums have been of huge importance for FBiH, followed by apples and pears. This increase is as a direct result of significant investments in new technology. In year 2016 plum export was around 8 million €. The export of frozen raspberries achieved 5.5 million € in the same year (mostly to EU countries).

Plum production is approximately 42,000 tons, followed by apples (33,199 tons), and pears (9,439 tons). The most important regions of intensive plum production (export oriented) are in lowland areas in the north and in the river valleys (Sava, Bosna and Drina). But, the autochthonous plum varieties with a stable yield can only be found in the regions above 500 m (because of plum pox virus).

Cherry production is 6,240 tons and this production is mostly situated in the southern part of FBiH which has Mediterranean climate conditions.

Lately, raspberry production has been increasing and about 22,000 tons were produced in FBiH (in 2016). Related to production of frozen raspberries, BiH is in 12th place in the world. Raspberry production is located in lowland areas as well as in the mountainous areas (blueberries also).

Generally in FBiH, there has been an increased interest in autochthonous fruit cultivars. In the last period, some commercial farms and cooperatives have used fruits of autochthonous cultivars for preparation of special products: Emina Association from the village Filipovici (Ustikolina-Gorazde) has protected a Slow Food Product – 'Slatko od sljive Pozegace' (sweet relish made from the plum variety Pozegacha). Their 'slatko' is prepared over a wood fire using plums grown on the banks of the river Drina. There are several organic producers of frozen berries (collected from the wild) that are produced for the domestic market and for export (Bos Agro Food d.o.o, Natural Food doo, Klas dd, Boletus from Sarajevo etc.). The most important traditional fruit products are the following: fruit schnapps (from plum, apple, pear and cornel), dry plum, a special kind of jam - “pekmez” (made from old apple and pear varieties); a special kind of marmalade - “bestilj” (made of plum), etc.

In the Operative Programme, the working group of fruit crops was established which defined the list of mandate and target species of fruit for conservation, sustainable use and breeding programmes. On the list of mandate species there are 55 different fruit species and their relatives from a great number of genera (for continental and Mediterranean climate zones): Prunus, Malus, Pyrus, Sorbus, Crategus, Mespilus, Juglans, Corylus, Castanea, Cornus, Morus, Sambucus, Fragaria, Olea, Ribes, Rubus, Rosa, Ficus, Punica, Aronia and Vaccinium. The old plum variety Pozegaca is still mostly present in FBiH. However, at the moment it is not possible to find any planting material for Pozegaca in the registered nurseries because of high sensitivity of Pozegaca to the plum pox virus. Unfortunately, there isn’t any *ex-situ* collection of plums in the whole territory of FBiH. Intensive plum orchards are mainly established by registered foreign varieties (Stanley and plum varieties from Chachak's Insitute which are resistant to the plum pox virus). The most important apple varieties in the intensive orchards of FBiH are Idared, Golden Delicious

and Jonagold. In the intensive pear orchards, Williams and Santa Maria pears are mostly present. Konjicka and Mostarska alica are the most important traditional cherry varieties in FBiH (mostly in Herzegovina). These cherry varieties could be interesting for food processing because of the high content of soluble solids. Besides these cherry varieties, there are others such as Hrust, Arslama, Karaarslama, Zuta etc. In the Federation of Bosnia and Herzegovina, it is possible to find a lot of identical autochthonous fruit genotypes typical for the whole region (Pozegaca plum, Karamanka pear, Tetovka and Kolacara apple, Hrust cherry, etc.)

A good example of synergies of conservation of natural populations and traditional knowledge could be the production and processing of cornel cherry in the municipality of Drvar. The Association "Drvarska drenjina" made the cornel cherry products recognized across Bosnia and Herzegovina as traditional products. There are a few farmers who are collectors and have registered production of old varieties (Agropodrinje, Gorazde; fruit nursery in Srebernik; Vahid Besirevic in Gradacac).

In the *ex-situ* collection Srebrenik about 31 apple varieties are maintained: Dulabija, Funtaca, Srebrenicka, Bukovija, Kanjiska, Prijedorska zelenika, Paradija, Sarenika, Tetovka, Petrovaca, Lederka, Budimka, Senabija, Samoniklica, Ljepocvjetka, etc.

Around 24 pear varieties are included in the *ex-situ* collection in Srebrenik: Jeribasma, Debelkora, Takisa, Zutaca, Zimnjaca, Huseinbegovaca, Savka, Karamut, Karamanka, Hasagicka, Sarajka, Izmirka, Tikvenjaca, Kacmorka, Zelenika , Cipeklija, Ljeskovaca, Lubenicarka, etc.

Besides these apple and pear varieties, in two other active *ex-situ* collections (in Gorazde and Gradacac), various numbers of accessions of more apple and pear varieties were identified, partly characterized, and evaluated.

Nuts

Related to nut crops, the main production of walnuts and chestnuts is based on domestic populations of Juglans regia and Castanea sativae. Among the nuts grown in FBiH, the walnut is predominant. Geographically, trees of these species can be found across FBiH. The highest production and concentration of walnut trees is present in those areas where natural chestnut populations are found. Therefore, the north-western part of Bosnia (Cazin, Buzim, Velika Kladusa), Podrinje, and the northern part of Herzegovina (the area of the municipality of Konjic and Prozor Rama) represent the main centers of production of Juglans regia in Bosnia and Herzegovina. This production is based on individual, generatively propagated trees resulting from natural selection and anthropogenic activity.

Olive, fig, and pomegranate

In the southern part of FBiH (Herzegovina) some Mediterranean crops such as fig, olive and pomegranate are cultivated. Olive production is about 303 tons (on 190 ha). The most important varieties are Oblica and Lastovka (from Croatia). There is not any intensive orchard of figs in FBiH. Mostly varieties planted in gardens are old autochthonous varieties such as Petrovaca bijela, Petrovaca crna, Saragulja, Vodenjaca, and Zutica. In the last decade one intensive pomegranate orchard was planted. The wild population of pomegranate is present across Herzegovina (mostly in Mostar, Ljubuski, and Stolac) and these fruits are rich in antioxidant biochemical compounds.

Wild fruit crops

The Federation of BiH is rich in wild fruit species, such as: Cornus mas, Rosa canina and Vacctinium mirtylis. These fruits have some commercial use in the production of organic wild fruits' products.

“Pozegaca” plum	“Konjički hrust” cherry
“Bukovija” apple	**“Zimnjaca” pear**

Figure 2. Traditional fruit varieties

Vitis

The area of vineyards has been constantly growing, and in 2015 it was estimated that 3,800 ha. produced a total yield of approximately 34,000 tons. Grapes and wine are mostly produced in the southern part of the country, in the Herzegovina region, an area with favorable climate and a long history of wine production. The most famous local varieties/wines are Zilavka (a white wine) and Blatina (a red wine), which are ideal for growing in the climatic and geographic conditions in BiH. Popular local varieties also include Vranac, Plavka, Dobrogostina, Trnjak, Krkosija, Smederevka, and Bena. There are also vineyards with other grape varieties such as Cabernet Sauvignon, Merlot, Shiraz, Chardonnay, and Sauvignon Blanc. The production is focused on high quality wine rather than table wine. The lists of Mandate varieties include 14 genotypes of Vitis vinifera species. The Faculty of Agriculture of the University in Mostar is in the process of establishing an *ex-situ* collection of Vitis PGR.

“Blatina”	”Zilavka”	“Trnjak”

Figure 3. Local vine varieties

Vegetables

The production of vegetables is one of the most important sectors in agriculture in FBiH. In the last couple of years, this sector has recorded a large increase in production. The increase in production of vegetables during the last couple of years is a direct result of significant investments in this sector. For export are interesting types of gherkins, tomatoes, and potatoes. Regarding the biological diversity of vegetables, it is important to mention that there are numerous ecotypes in the FBiH apropos its different geographical and ecological conditions: lowlands, highlands, and Mediterranean areas. The most important areas for commercial vegetable production are lowlands in the northern part of FBiH (Posavina) and river valleys, as well as in some Mediterranean areas.

One of the main handicaps of FBiH's vegetable sector is the duality of the production structure: the vast majority of producers cultivate on less than four hectares of land, while a smaller portion of cropping comes from farms of up to 10 hectares in size and few sizeable corporates or large family farms. Most of the small-scale producers are subsistence or semi-subsistence agricultural households. Fruit and vegetable processing in FBiH is largely underdeveloped.

For open field and indoor production, vegetable production area is well-developed in the Posavina region. This area is characterized by good soil quality and mainly supplies the Sarajevo markets but also its products are exported. Vegetable production is mostly organized around the river valleys; therefore, it is strongly dependent on the development of the city and the income of the city inhabitants. However, middle-size producers are offering numerous vegetable varieties. The vegetable production in Mediterranean area of FBiH has a long tradition and extremely favorable marketing and climatic conditions for early and late production. This situation has resulted in a high development level of a significant variety of vegetable crops.

The most important species of vegetables in FBiH are: onion, garlic, cabbage, collard, squash and pumpkin, pepper, okra, tomato, bean, and pole bean.

There are typical domestic vegetable products such as "tursija", "dry paprika" and pumpkin jam ("slatko od tikve").

Beans

In FBiH bean production stands at about 7,064 tons (Proof-reader's note: Is this per year? If so, say so.). Because of the ease of cross-pollination, the most diverse forms of beans and string beans are present in FBiH. They are known as "Kukuruznjak" (corn bean), "Psenicnjak" (wheat bean) or "Krompiras" (potato bean) because the beans are produced in intercropping systems. There is a significant diversity in the colour, size and shape of beans. But in FBiH it is very rare to find small grain beans present in a form of bean called "Puco". The mature and dry pod of this variety can be used for nutrition. The appearance of this variety is similar to the branded bean "Poljak" from Herzegovina (the southern part of BiH). The Poljak bean is used as a medicine for diabetes. There is also an important old variety "Sweet-bean", whose appearance is similar to that of peas, is used for roasting. The Gene Bank counts about 100 accessions of bean and 17 of them belong to the mandate varieties. Dry bean production is mostly based on the local variety of Tetovski bean, which is also present in most of the neighbouring countries, too. Besides Tetovski and the above-mentioned beans, other traditional bean varieties, such as Cucavac, Cuco, Tresnjo, Kukuruzar, Aligrah, etc., are cultivated in FBiH.

Among the legumes, okra may be of interest to conservationists, as it is present in small amounts in FBiH.

Cabbage

In 2016, in FBiH, there was around 40,180 tons of cabbage and savoy produced. (In cabbage production the most important varieties are "Bjeljinski" and "Futoski" cabbages. Dominant areas

for cabbage production are the regions of Bugojno, G. Vakuf, and Gracanica. In the Gene Bank, 100 genotypes of Brassicaceae (including cabbage) are stored.

Kale (rastan, rastika) is typical for the region of Herzegovina where it has been growing and there are few varieties of this species. About 50 accessions of kale are stored in the Gene Bank.

Onion and garlic

Onion is produced predominantly from planting material that is imported, and the onion production in 2016 was 32,435 tons. Besides the imported onion varieties, old onion varieties are present in some villages of FBiH. Konjicki luk (Konjic Onion) is a red onion variety which originates from Buturovic Polje, in the Herzegovina region. People living in Buturovic Polje are mostly engaged in agriculture and their good quality food products (Proof-reader's note: Please check that this is what you meant) such as Konjicki luk have become one of the unofficial brands of BiH. In 2017, Konjicki luk was registered with the Common Variety List. In the valley of the river Spreca, an old variety of onion (Cesmo) is cultivated, which is similar to garlic because it has cloves. This variety is extremely resistant to pests and diseases.

Garlic is predominantly produced from domestic plant materials, and it is cultivated as a winter and spring form of garlic. On the mountain of Konjuh (altitude 900 m) around 40 ha of domestic garlic is planted, with red papery skin of cloves. This garlic variety is called 'Ramski ozimi bijeli luk' (Rama winter garlic) and it originates from Rama region in FBiH; however, this garlic variety is not registered on the Common Variety list in BiH.

Tomato and Pepper

Tomato is a relatively new cultivated crop in FBiH. Tomato production is around 24,499 tons and production is mostly situated in southern part of FBiH (Herzegovina) as well as in the lowland areas in the north. Intensive production of tomato includes new hybrids (Relly, Mathias, and Bella). The variety 'Jabucar' is the most important old tomato variety in FBiH and this variety is also cultivated in the other regional countries. In the continental part of FBiH the old tomato varieties are present, and these are called 'Kvrgo' and 'Amerikanac'.

Besides those plant species, 'Capljinska paprika' from Herzegovina should also be mentioned. This is present in almost all local markets in FBiH, being one of the most popular pepper varieties. Other old pepper varieties are 'Babura' and 'Paradajz paprika'.

Pumpkin

Due to cross-pollination there are a lot of variations in pumpkin diversity in FBiH. The old pumpkin varieties are used as animal feed and for seed production. The most interesting old pumpkin varieties are 'Stambolka', 'Misiraca', and 'Biograd' pumpkins, which are used exclusively for human nutrition. There are several different traditional meals from pumpkin: roasted or boiled, pumpkin pie, pudding, jam, oil, etc. Recently, pumpkin has also been used in the pharmaceutical industry.

The list of defined mandate varieties of the most important autochthonous vegetable species is presented in OPPGR FBiH.

Tommatto from BiH	Kale from Herzegovina

Figure 4. Local vegetables varieties (SeedNet project, Lutvija Karić)

Medicinal and aromatic plants (MAP)

Medicinal and aromatic plants represent an important natural heritage of biological diversity throughout Bosnia and Herzegovina. Most collectors of MAPs belong to poorer or under-privileged groups in society and quite often depend on the additional income generated by wild-harvesting of MAPs. However, trade in medicinal plants is also an important factor in the country's political economics. Consequently, overexploitation of these natural resources has a negative impact on the plant species, the welfare of the harvesters and the economy of the country. Taking these developments into account, strategies have to be established that guarantee the long-term availability of MAP species as natural resources on a sustainable level. Uncontrolled collection of medicinal species across areas of FBiH significantly ruin genetic equilibrium in populations and genotypes of certain species (such as Adonis vernalis, Arnica montana L., Gentiana lutea L. Subsp. Symphyandra).

The consequence of such a process is genetic erosion of medicinal and aromatic plants. Therefore, it is necessary to take action in order to prevent the loss of these species and traditional knowledge that goes with them. The main extinction threats of the species are: habitat destroying, over-exploitation, changes of land use and introduction of invasive species. Modern methods of production and processing of medicinal and aromatic plants is at the beginning. Commercial production has good chances to be successful for domestic market and for export as well. A good example of commercial use of PGR is organic production of medicinal and aromatic plants, for example the production of fresh and dried plants and also the extraction of essential oils. Unfortunately there are not enough farms that cultivate land for organic production of medicinal plants. In FBiH, several MAP species are cultivated, such as: Helichrysum italicum, Calendula officinalis L., Mentha piperita L. and Melissa officinalis. Recently, the production of domestic immortelle is very important for the south part of FBiH (Herzegovina). In Herzegovina around 700 ha of domestic immortelle were planted and production of the variety Helichrysum italicum.var italicum is commercialed due to its essential oil production.

The list of mandate species of medicinal and aromatic plants includes 56 different plant species, while 13 of them are defined as target species (Gentiana lutea L. subsp. Symphyandra, Viola biflora L, Viola elegantula L., Valeriana montana L, Valeriana officinalis L., Convallaria majalis L., Platanthera bifolia L, Orchis simia L, Arnica montana L., Menyanthes trifoliate L., Adonis vernalis L., Hepatica nobilis Schre). Adonis vernalis has Status E and belongs to the highly endangered species category.

Figure 5. Immortelle (Helichrysum italicum) from Hercegovina (http://www.immortelle-herzegovina.com/)

Industrial crops

Production of industrial plants in the Federation of Bosnia and Herzegovina has been neglected over the last few decades. Processing capacities are insufficient and not well enough developed. Furthermore, restricted choice of cultivars, low yields, etc. are also obstacles. The most important industrial plants in FBiH are potato, soybean, tobacco, and sunflower. In FBiH, there are domestic cultivars, old cultivars and new cultivars imported from Europe and other regional countries. Potato production is traditionally one of the most important agricultural activities. Potatoes are produced across the whole territory of FBiH. Potatoes grown at higher altitudes produce higher yields and are of better quality. Production of early potatoes (in the Herzegovina region) is a recent trend. In 2016, potato production in FBiH amounted up to 228,009 tons, while soybean production was 6,020 tons (Green Report, 2017). The most important domestic potato variety is Fojnicki krompir.

According to the same source, tobacco production in 2016 was 491 tons. For more than two centuries, tobacco has been the dominant agricultural crop in FBiH, especially in the south of Herzegovina, with domestic varieties such as Hercegovac that have dominated farming. However, industrialization in tobacco production has led to the extinction of the cultivation of this old tobacco variety.

On the list of mandate varieties of Industrial crops, there are six genotypes of tobacco (Hercegovac, Ravnjak, Seginovac, Svijetla hercegovina, Veliki hercegovac and VH 32) and three genotypes of potato (Fojnicki, Poluranka and Rasci).

Three flax accessions have been collected – one near Sarajevo and two in Tuzla region - and stored in the Gene Bank. Hemp accessions were not collected, because they were not found during the inventory.

Success story

"Vocni rasadnik", a fruit nursery in Srebrenik, is a 100% privately owned company that produces and sells plant seedlings of fruit, flowers and ornamental trees. With 50 ha of land the company produces more than 300,000 seedlings of different continental fruit species (apple, pears, plums, cherries, sour cherries, peach, quince, medlar, chestnut, walnut, aronia, ornamental plants, and

many more). This nursery has the largest and most important *ex-situ* collection of traditional fruit cultivars in the Federation of Bosnia and Herzegovina. It offers 24 autochthonous domestic apple cultivars and 31 pear cultivars, such as: Djulabija, Senabija, Kanjiska, Lederka (apple), Huseinbegovaca, Jeribasma, Takisa, Karamanka, etc. Since 2010, this *ex-situ* collection has been a member of the European Gene bank Integrated System (AEGIS). In addition, it has a laboratory for "*in vitro*" tissue culture technique (with supporting greenhouse). "Vocni rasadnik" also has a modern Ultra Low Oxygen (ULO) storage facility (with a capacity of about 700 tons) and the nursery has started to process fruit and produce juice under the name Natura fruti.

2.1.2. Animal genetic resources

In the Federation of Bosnia and Herzegovina, different breeds of domestic animals are bred. Among them there are indigenous breeds, which are highly endangered. Those breeds have high importance as animal genetic resources.

Table 1. List of local and introduced breeds of domestic animals in the Federation of Bosnia and Herzegovina

Species	Total number of population [1) 2)]	Local breeds	Introduced breeds[3)]
Cattle	216,205	Busha, Gatachko, Posavsko	Holstein, Simmental, Viptal, Montafon, Brown swiss, Red cattle, Angus, Limousine, Charolais,
Sheep	524,608	Dubian, Kupres sheep, Privorian, Herzegovinian,	Merino Landschaf, Romanov sheep, Sjenicka
Goat	42,274	Balkan goat	Saanen, Alpine goat,
Horse	5,623	Bosnian mountain horse	Lipizzaner horse
Donkey	N/A	Herzegovinian donkey	-
Pig	89,219	SHISHKA	Landraces, Yorkshire, Pietrene
Han	9,818,000	The domestic Bosnian Herzegovina hen	Crossbreeds

1) Federal Statistic Agency
2) 2015
3) Expert opinion

According to the Program for Financial Support for Agriculture and Rural Development for 2017 (Official Gazette of the FBiH 24/2, March 2017), incentives for breeding autochthonous breeds of bovine animals (Busha) and horse (Bosanski Brdski Konj) in FBiH is of the amount € 150 per head of pure-blooded animal, and € 75 per year for crossbreeds of those breeds.

Cattle

Bosnian cattle Busha are a cattle breed that is found all over the Balkan Peninsula. It had an important role in the past due to its ability to adapt. Busha, or as it was earlier called in some parts of the country Domarac, belongs to the group of short horned cattle or Bos brachyceros *europeaus*. During the second half of the nineteenth century, due to crossbreeding, the *Busha* slowly disappeared and nowadays is very hard to find a true indigenous pure breed of it, except in the most remote and isolated parts of the country. This breed has the status of endangered breed and it is possible to find it at only one location (Buhovo, autochthonous breed center) in the FBiH as a pure breed. In this center, there are 58 animals identified as Busha. There is no herd book, semen doses, blood, tissue or hair collecting. Genomic identification was carried out in 2011 on 49 samples of Busha cattle in a cooperative assignment between the Faculty of Agriculture and Food Sciences, University of Sarajevo and Ludwig-Maximilian University of Munich.

Figure 6. Bosnian Busha cattle breed (Photo by Ervin Zečević)

Gatacko Cattle represent an autochthonous breed from Bosnia and Herzegovina. These cattle represent a mixture between two breeds: the domestic Busha cows and Alpine Gray bulls. There is a small population in the part of Herzegovina which is not under any breeding programs. The importance of this breed is reflected in the fact that it has adapted to high altitudes and has no special requirements when it comes to housing and feeding.

Also, there was an indigenous cattle breed called Posavsko which, unfortunately, disappeared from the territory of FBiH. Some individuals belonging to the populations of these cattle are still breeding in some parts of Croatia.

Figure 7. Gatacko cattle breed (Photo by Ervin Zečević)

Sheep

In the FBiH, there are four local breeds of sheep: Dubian, Kupres, Privorian, and Herzegovinian. The total number of sheep in FBiH is 525,000, but there is no data about number of animals by breed.

Dubian sheep are mostly found in the central part of FBiH, particularly on the mountain Vlashic. It is interesting because this breed does not require big quantities food and special care, while it represents an important animal genetic resource. This combination of traits has led to this breed becoming known for the famous cheese produced from its milk. There has not been any kind

of activity related to the preservation and improvement of this breed. This is the most numerous breed of all sheep breeds in FBiH (expert assessment).

Figure 8. Dubian sheep breed (Photo by Muhamed Brka)

Kupres sheep are mostly breed on the Kupres plateau. This is medium-size breed that produces better milk than wool. Currently, there is no recent data about production parameters and there are no activities related to preservation and improvement of this breed.

Figure 9. Kupres sheep breed (Photo by Muhamed Brka)

Privorian sheep are mostly bred on an area of the Vranica Mountain, at the spring of the River Vrbas. This is a medium-size breed with a strong constitution. Currently, there is no recent data about production parameters and there are no activities related to preservation and improvement of this breed.

Herzegovinian sheep were originally found in the southern part of FBiH. This breed is smaller than other types. Currently, there is no recent data about production parameters and there are no activities on the preservation and improvement of this breed.

In addition to the mentioned local breeds, introduced breeds of sheep are also kept in the FBiH. The populations of those breeds are quite small and mostly are Merino Landschaf sheep, Romanov sheep and, Sjenicka sheep.

Goats

The original Balkan goat can be found in the south-eastern parts of the FBiH. Its hair is long, thick and strong and is black, white, brown or mixed. Within the program for livestock rehabilitation, some 2,000 Saanen and Alpine goats were imported to the FBiH in 1996-7. Information obtained indicated that the majority of the imported animals did not survive the first winter, and that farmers were switching back to the traditional local varieties. When it comes to organized breeding, population monitoring and improvement, there are no activities that address these issues.

Figure 11. Balkan goat breed (Photo by Ervin Zecevic)

Pigs

Local varieties of Siska (Shishka) seem to have become extinct. This pig originated from the European wild pig (*Sus scrofa europeus*) and it was kept only in extensive farming in oak and beech forests. After major wood exploitation from the beginning of twentieth century, and importation of the exotic breeds of pigs, domestic breeds are now very rare. Today, only crossbreeds of this pig can be found. By the appearance, it looks like a wild pig. It has a big head, long but narrow and short ears, with the thighs and flat body covered with yellowish and sometimes brown strong hair. This domestic breed is very resistant to bad living conditions and diseases. Very poor results in meat production have led to the extinction of this breed.

Bosnian Mountain Horse

The majority of the horse population (some 70 percent) is comprised of the local breed, the Bosnian Mountain Horse (BMH), whilst the remaining 30% are crosses between the BMH, Lipizzaner and cold blood horses. There are two types of this breed: Glasinacki and Podveleski.

Glasinacki BMH originates from the village of Glasinac on the mountain Romanija. This area has a very good mountain pasture, so this type of horse is heavier than the other. In addition, the Arab full blood horse has influenced this type greatly. The Podveleski horse can be found in the area of Herzegovina. It is a smaller type. First stable that raised BMH was established in Gorazde in 1908.

Nowadays, the situation with this breed in FBiH is critical regarding the number of animals (6,000 animals, Annex I, Table 3). Only a few breeders in FBiH keep a very small number of these animals. There is no interest shown from the responsible institutions for the preservation of this breed which is on the edge of disappearing altogether from the territory of the FBiH. There are some breeding programs in Slovenia, Austria, and Germany concerning the preservation of this horse breed but it has all but disappeared from the area where it originated from.

Figure 12. Bosnian Mountain Horse (Photo by http://www.ptice.info/teme/692/)

Herzegovinian donkey

This donkey can be found in the region of karsts in Herzegovina. There are no records about population numbers. This population has been neglected and there is little information available about it. There is no official data about any activities addressed regarding the preservation of this breed.

The domestic Bosnian Herzegovina hen

The original domestic Bosnian hen can nowadays rarely be found due to numerous crossbreeds over time, although it once was to be found all over FBiH. The Bosnian hen is low, of fattening quantity but excellent in meat quality. It may be crossbreed with modern breeds of hens in order to improve overall performance.

2.2. CONSERVATION EFFORTS OF GENETIC RESOURCES

2.2.1. Plant genetic resources

At the beginning of this century, in the area of South-eastern Europe as well as in the territory of BiH, activities aimed at conservation and sustainable use of plant genetic resources were restored with the help of SIDA - Swedish Organization for Technical Support to Developing Countries. This initiative was conducted through a ten-year (2004-2014) regional project SEEDNet - 'The South-Eastern Europe Developing Network for Plant Genetic Resources'. The SEEDNet programme was aimed at long-term conservation and sustainable utilization of the diversity of PGR within the region through a well-coordinated network of functional national programmes. The core of SEEDNet was formed by seven regional crop oriented working groups (WG's): Cereals and Maize; Medicinal and Aromatic Plants; Vegetables; Fruit Crops and Vitis; Forage Crops; Industrial Crops, and Documentation/Information. The network activities comprised *ex*- and *in-situ* conservation, utilization of PGR, and institutional capacity building. Activities were focused on specific crops' themes: inventorying, collecting, *ex-situ* and on-farm conservation, seed and plant regeneration, characterization and evaluation, documentation and information.

Notable achievements accomplished during the SEEDNet project in the Federation of Bosnia and Herzegovina were the following:

- Close collaboration between national research institutions and farmers.
- Coordinated work among regional researchers.
- Faculty of Agriculture and Food Sciences in Sarajevo purchased gene bank equipment for *in vitro* work (partly) and molecular characterization.
- All seven working groups prepared strategies for mandate and target species, as well as mandate varieties lists for their national and regional collaborative work.
- Several persons completed courses on gene bank management/operations, on farm and in vitro conservation, MAP collecting, and for information and documentation technology (at the CGN, NGB in Sweden and Romania).
- Inventory of fruit crop plant genetic resources was done in the area Doboj-East, Tuzla, Konjic, Prozor Rama, Srebrenik, Gradacac, Gorazde, Bihac, Cazin, and Herzegovina. During the inventory, the following was discovered:
    - *Ex-situ* collection orchard of Pozegaca plums located in the village Mala Brijesnica, near Doboj. Unfortunately, this collection is now destroyed because the local administration used this land for other purposes. In this collection, 22 different accessions of Pozegaca were found.
    - On-farm collections (apple, pear, plum, cherry, walnut) located in different villages and municipalities: Klokotnica, Lukavac Rijeka, Brijesnica, Doboj-East; Tuzla, Konjic, Prozor Rama, Srebrenik and Gradacac. In these collections, ten different apple varieties, 11 different pear varieties, and 22 different plum varieties were found.
- About 216 seed accessions and 120 field accessions were regenerated.
- About 30 field accessions of buckwheat were documented with passport data.
- About six institutions with *ex-situ* fruit collections were inventoried.
- In the Gene Bank, 438 accessions of different plants (mostly cereals and vegetables) were collected and stored.
- Activities for raising public awareness were undertaken.

After the completion of the SeedNet project, activities were significantly reduced and performed through various international projects. Current activities on agricultural PGR are implemented through the same WG's, plus one new WG - Wild relatives. In the Gene Bank, there are currently more than 600 accessions (acc) which consist of the following:

- Cereals, maize and industrial crops – more than 400 accessions (maize with more than 100 accessions, beans with 100 accessions, buckwheat with 30 accessions, and tobacco with 6 accessions).
- Vegetables are represented with more than 150 accessions (cabbage species are predominant with more than 150 accessions, several onion accessions and kale with 50 accessions).

Documentation for each conserved accession in the Gene Bank is in progress, as is the regeneration of some vegetables and buckwheat.

The most important activities after SeedNet, performed through various national and international projects are:

- Inventorying of chestnut, walnut populations, almond, pomegranate (17), vineyard peach (15) and figs.
- Morpho-pomological evaluation and genetic characterization of: about 40 autochthonous and 30 modern apple cultivars, 27 autochthonous and nine international modern pear varieties in *ex-situ* collections in Srebrenik, Sarajevo, and Gorazde. Evaluation of autochthonous varieties of Vitis, chestnut (four), walnut, pomegranate, almond, populations, and figs cultivars (three).
- Pomological evaluation of cornel cherry populations and some wild fruit species (*Rosa canina, Fragaria vesca and Vaccinium mirtilys*) with the aim of sustainable use of PGR.
- Evaluation work on the buckwheat population and autochthonous bean genotypes (40 acc. collected from three regions in the Federation of Bosnia and Herzegovina) with the aim of creating sustainable use of PGR.
- Genetic characterization was carried out for: 24 traditional cultivars and 15 modern international cultivars, maintained at the *ex-situ* apple collection "Srebrenik" in Northeast Bosnia; 28 traditional pear accessions; 12 old local grapevine varieties; five local figs accessions; 13 chestnut accessions and seven almond accessions.

The participation of farmers in the conservation process is very important regarding the aforementioned activities. Our farmers are not well enough informed about the importance of the genetic resources and there is no financial support to be gotten for their engagement in conservation of PGR in the Federation of Bosnia and Herzegovina.

In the last decade, the interest of hobbyists of planting and processing autochthonous fruit and vegetable genotypes is increasing. In general, the participation in breeding and conservation programmes is often on a voluntary basis.

There exists no possibility for production, nor the putting on the market of seeds of local populations and autochthonous cultivars (small quantities and local markets are not regulated), except for the on-farm conservation through PGR Programme.

Good examples for the participation of farmers in the conservation process in FBiH and Herzegovina could be: *ex–situ* collections of apple and pear autochthonous genotypes (established by a private nursery in Srebrenik); *ex–situ* collection of apple and pear autochthonous genotypes (established by a private company Agropodrinje in Gorazde); *ex–situ* collection of apple and pear autochthonous genotypes (established by private farmers from Vahid Besirevic in Gradacac), and

the Farmers' Union Buturovic Polje that produces and conserves Konjic onions.

Organic producers and associations such as Heljda Eko and Hercegovina Bilje are involved in the cultivation and processing of buckwheat. These associations also perform purchasing, processing and selling wild medicinal & aromatic plants and herbal teas. Emina Association in Usticolina, Gorazde is also a good example of sustainable use of plum genotype Pozegaca.

2.2.2. Animal genetic resources

A practical conservation and preservation activity in order to preserve animal genetic resources and agrobiodiversity in the FBiH does not exist. Official institutions do not have any specific programs. There are no financial funds available for such activities and no system exists for the conservation of blood, tissues, genes, semen, oocytes, embryos or DNA.

The National Gene Bank does not exist as well as the systemic participation of farmers when it comes to conservation processes. At this moment, there is great torpidity when talking about the preservation of animal genetic resources. There are no institutions that currently work specifically on this issue. There are no strategies or action plans that address the issue of the preservation of animal genetic resources in FBiH.

One of the ways to promote original breeds is the direct sale of traditional products. These products can be found as part of a gastronomic offer in mountain tourist centers.

2.3. SOCIO – ECONOMIC ASPECTS OF AGROBIODIVERSITY PROTECTION

There are a number of problems facing FBiH in regard to agriculture, which pertain primarily to the use of old technical equipment (which contributes to the different quality performance of farmers' production), inadequate practices of sustainable development in agriculture (lack of subsidies for farmers, low level of awareness), lack of agro-environmental data (e.g. consumption and composition of fertilizers, pesticides, nitrogen ratios, eco-efficiency, energy use, etc.), making it difficult to assess the real impact of agriculture on the environment, including biological diversity (State of the Environment Report in BiH, 2012). In this connection, establishing a system of agricultural information and monitoring, as well as the implementation of the agricultural census, is crucial in order to obtain good quality data to enable the passage of appropriate agro-environmental schemes and sustainable development of the agricultural sector in the future.

There is evidence to show that farmers have an interest in breeding different kinds of indigenous breeds, as a result of organized programs including selection supported by expert services. The importance of those breeds has been mirrored in their adoptable value, resistance and modest needs in feeding. Those traits are very important from an economic point of view. On the other hand, it is possible to improve productivity by selection accompanied with expert surveillance and improvement housekeeping conditions. All those elements serve to contribute to the development of livestock, and the rise of traditional products of good quality on the market. Potential of indigenous breeds are still not recognized by government. This potential can be used through production and trading with characteristic traditional products which are recognizable by their cultural and traditional heritage and these are competitive on the market with higher prices than conventional products. More effort has to be made as giving a shape to the offer of characteristic traditional products in two directions: as part of the tourist offer and as a way of conservation of traditional meat and milk specialties made of autochthonic breeds. Indigenous breeds can find its place in eco system in which has had huge role in the past.

Traditionally, the breeding and production of these animals has been undertaken by women. This lends itself to gender importance in rural environments, giving women a chance to contribute

towards the total household budget, as well as serving to improve their socio-economic status. The women also played a very important role in the conservation of PGR, especially in regard to vegetable production; they are the guardians of seeds in FBiH. They deal with seeds, farming processes, and the processing of fruit/vegetables, as well as medical and aromatic plants, too.

The main opportunity for rural areas and small farms is to develop conservation and sustainable utilization of genetic resources in FBiH: working in agriculture or in processing their own traditional products where the natural resources are present and sell these on the local market. For that reason, the national programme should regulate the financial support for the small farmers who are dealing with the conservation of agrobiodiversity.

The evaluation data collected from the research community could be used in the local food processing industry and this will hopefully stimulate the use of autochthonous crops and fruits in the local food industry, especially in combination with rural tourism.

2.4. STATUS OF PUBLIC AWARENESS

A low level of public awareness regarding the importance of biological diversity conservation represents one of the issues faced by developing countries and countries with economies in transition. In FBiH this kind of public awareness is poorly developed. It is necessary to point out that, with the general aim of defining the framework for the sustainability of nature and society in this area, the process of identifying and implementing the national goals for biodiversity has never been more demanding and more needed. In the FBiH, topics from the domain of environmental protection have been included in the first, second and third cycle of the high education curricula Media is an important tool to facilitate education and to raise public awareness, and can have a major role in the creation of certain attitudes and public opinions with regard to environmental protection, including biological diversity. In FBiH, there are no studies in terms of representation and ways of interpreting of the values of biological diversity. According to available and research study data, below is an overview of print and electronic media which make an active effort to publish texts covering environmental protection topics, including biological diversity.

At the Faculty of Agriculture and Food Sciences in Sarajevo, curricula for Plant Genetic resources have been developed at all three levels of study.

The researchers from different faculties and institutes published a lot of research findings and expert publications in Bosnia and Herzegovina, and abroad, too. As a result of the SeedNet project, several publications were published (Annex 6).

Several PhD's were successfully completed related to PGR at Bosnian Universities and abroad (Croatia and Slovenia). More than 20 master's theses were elaborated upon in the field of PGR, as well as a baccalaureate thesis.

Activities related to the PGR have been presented at national and international conferences, congresses and different scientific and market meetings and fairs (Sarajevo, Tuzla, Norway, Vienna, etc.).

In FBiH, awareness of animal agrobiodiversity is at a very low level. When it comes to public opinion, this issue is almost not present or covered by any media activity. The importance of agrobiodiversity and conservation of genetic resources has not been presented to the public as an essential element of the preservation of the environment and economic stability. Most autochthonous breeds of domestic animals in the FBiH are neglected and left unplanned. Unfortunately, the status of indigenous domestic animals has not been accurately determined yet; so precise numbers of individuals and their characteristics cannot be given. The reason for this situation is insufficient interest from governmental institutions. They do not provide financial and

systemic support in order to develop action plans for the conservation of animal agrobiodiversity. This issue is only dealt with at the expert level, but so far it has been pretty unsuccessful, for the previously mentioned lack of institutional and financial assistance. There are no activities that can raise awareness regarding the importance of conservation of diversity and conservation of genetic resources. Educational activities in this field are minimal. Most activities which concern affirmation of the protection and conservation of animal genetic resources are carried out by the academic community. Academic articles and publications are, at this moment, the main source of information and awareness raising about animal genetic resources in the FBiH. Unfortunately, these publications are available to a limited number of users.

3. CONCLUSIONS

Based on the aforementioned information, the following conclusions may be drawn:

The provided overview and analysis of plant genetic resources indicates that the territory of FBiH is characterized by a high level of genetic diversity.

The FBiH, on the basis of its land resources, geographic position and the number of inhabitants engaged in agriculture, currently has potential that is not used. The number of animals is constantly decreasing and this trend does not follow the genetic improvement of animals, which is also reflected in the decline of total production.

Different types of domestic animals are kept in the FBiH, but their breed structure is not defined. There are no breeding centers or breeders' associations that can control this situation, productivity and genetic improvements of the domestic animal population, thereby taking into account agrobiodiversity in terms of detection of endangered breeds.

There is a lack of knowledge regarding the actual situation in these areas and there is no database.

There exists no adequate and harmonized law regulation.

There are a lack of priorities for drafting laws and strategy on a governmental level related to GR.

There is no secure financing of the gene bank (equipment and staff).

There are no agro-ecological supportive measures in FBiH for the conservation and sustainable use of GR (in the previous support measures, only organic production was supported for certification).

BiH is not a member of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and European Federation of Animal Science (EAAP).

There is no possibility for production, or putting on the market seeds of local populations and autochthonous cultivars (small quantities of it and lack of markets regulations). Production of the seeds of local populations is possible only trough on farm conservation in the frame of PGR programme.

There is a lack of funding for research and breeding programmes related to PGR/AGR.

The FBiH could reliably be expected to benefit from properly planned actions and management of agricultural GR, i.e. to derive profit from the economic exploitation of agricultural GR and the traditional knowledge associated with these resources, leading to macroeconomic growth.

No NGO or association is pushing the conservation and sustainable use of agricultural GR.

At the moment, it is not possible to estimate the lost or endangered crops/landraces/animals by extinction and reasons for their extinction because there does not exist any developed and established program for data collection related to the agricultural GR.

4. PERSPECTIVES AND RECOMMENDATIONS

In the FBiH, agrobiodiversity issues are not sufficiently represented and do not represent a priority in the implementation of agrarian policy. According to its position, relief characteristics and climatic factors, the FBiH has all the prerequisites for maintaining agrobiodiversity on its territory. When it comes to animal genetic resources in the FBiH, there are numerous indigenous breeds of domestic animals that have been neglected in modern times, leading to their endangerment. Agriculture of the FBiH may be one of the pillars of its development to produce branded products from indigenous breeds of domestic animals. This approach would increase the interest in breeding these animals, which would have a significant economic impact on the stimulation of their breeding and conservation. For such an approach the current institutional framework is a problem that does not recognize the capacities and importance of conservation of agrobiodiversity. To carry out activities to affirm certain breeds, to preserve diversity and genetic plant and animal resources, it is necessary to do the following:

4.1. RECOMMENDATIONS FOR CREATION AND UPGRADE OF POLICY AND LEGISLATION

To adopt legal acts addressing agrobiodiversity. Those legal acts should treat the recognition of genetic resources and all activities to be undertaken for their conservation. All responsible institutions and bodies dealing with agrobiodiversity and genetic resources should be defined by this act. To develop strategies and strategic goals concerning genetic resources with defined aims, measures and activities. To create an action plan in real time with real aims.

To plan and create a program appropriate for both entities and to develop a national program for agricultural GR for BiH; but, considering all the aforementioned facts, such an undertaking is currently not possible.

To develop a subsidies system that will be directed to breeders of indigenous breeds. Public calls for the allocation of financial resources should include the item of genetic resources. At present, this practice is not the case.

In order to implement the international regulations, conventions and protocols, it is necessary to adjust the legal and institutional framework, which involves changes of the existing legislation.

To develop preparation for ratification of the “International Treaty on Plant Genetic Resources for Food and Agriculture”.

4.2. RECOMMENDATIONS FOR IMPROVEMENT OF INSTITUTIONAL CAPACITIES

To establish agency/experts body at the Ministry for Agriculture Water Management and Forestry of the FBiH which will be in charge of preservation and dealing with genetic resources. This agency should cooperate with all other agencies and ministries on a federal and state level with clearly defined goals when it comes to genetic resources.

To involve experts and scientific institutions in programs to address the problem of conservation of genetic resources.

There is an urgent necessity to establish an institutional framework and programme to support

agriculture in helping it adapt to climate change.

To establish active cooperation with all relevant regional and international institutions in order to address the problems in this area.

A Centre for Agrobiodiversity should be established at one institution with regularly employed researchers and a regular budget. This Centre would collect information about the farmers growing local varieties, animals and then create a Register based on this information.

Specific crop/animal collections may be maintained by separate institutions on a cantonal level (supported by regular and sufficient budget from cantonal ministries).

Specifically, regulatory changes are necessary to regulate the legal status of genetic resources, gen banks, collections, to define clear procedures for regular granting for conservation and sustainable use of GR, to define the position of the established Gene Bank at the FAFS and to provide secure financing of the Gene Bank and to employ at least two workers.

4.3. RECOMMENDATIONS FOR IMPROVEMENT OF AGROBIODIVERSITY CONSERVATION

Information System on Agrobiodiversity and National Inventories should be established at both the state and federal level.

Collected material of a specific crop and animal breeds have to be described, evaluated and published. All different landraces and animal breeds need to be published in a catalogues of landraces/breeds, containing the contact information of farmers, with this information subsequently distributed to the local municipalities.

On-farm conservation needs to be supported by the Ministry of Agriculture, Water Management and Forestry of FBiH (through contracts with the farmers that maintain specific varieties/breeds). Contracted farmers should provide seeds/seamen/tissue/blood to the gene bank and information to the Centre of Agrobiodiversity.

These actions will enable:

- consistency in long-term evaluation;
- active participation of farmers;
- support in the protection of traditional products;
- stricter coordination and management among institutions and working groups of agricultural GR (including all governmental levels) should be established and developed.

To ensure collaboration with the business sector for the sustainability of diversity of plant genetic resources in agriculture, local partners and divergent stakeholders (from farmers, cooperatives, associations, NGO-s, SMS etc) should be financially supported.

To develop a strategic plan and programme to promote and protect traditional products (the only way to provide higher quantities for commercial sale and export).

4.4. RECOMMENDATIONS FOR IMPROVEMENT OF SCIENTIFIC AND PUBLIC AWARENESS

To increase public and scientific awareness, it is necessary to continuously conduct scientific research, and carry out education both for farmers and students. The issues of conservation of agrobiodiversity should be more present in educational institutions and in the media. Through the constant affirmation and presentation of traditional products the awareness of agrobiodiversity and its significance in economic and biological awareness will be raised. In order to increase the importance and meaning of the local breeds and their perception in society, projects for promotion of traditional, environmental and cultural values of the local breeds should be set.

4.5. RECOMMENDATIONS FOR IMPROVEMENT OF REGIONAL COOPERATION

Efficient evaluation and conservation could be performed through regional cooperation with results published in regional catalogues (because almost identical old varieties/breeds are commonly found in more Balkan countries with the same or different names).

To establish a Virtual Regional agrobiodiversity center (which would collect data and information about state, conservation, collecting, evaluation, traditional production, etc).

5. CASE STUDIES

Case study: Konjic Onion (Konjicki luk)

Konjic Onion (Allium cepa L.) is a red onion variety originating from the village of Buturovic Polje, Herzegovina region. People living in Buturovic Polje are mostly engaged in agriculture and their good quality food products have become one of the unofficial brands in FBiH. Due to its geographical location at the crossing points between two different climatic zones (Mediterranean and continental), together with the areas topography and isolation, it is believed that some of the unique crop varieties are still preserved by farmers from Buturovic Polje. The Konjic Onion was never listed in the Common List of Varieties in BiH or ex-Yugoslavia. Maybe one of the reasons for this is the fact that it could have been confused with the Hercegovacki Onion, a variety originating from Herzegovina and listed in the Common List. Unfortunately, we were unable to find any sample of the Hercegovacki Onion to compare it with Konjic Onion, because the samples could not be located and are presumed to be lost. The Konjic onion dry bulb is morphologically classified as "large" with an average bulb size of ≤ 100 g, with a flat globe shape with yellow skin colour. For the last 20 years farmers from Buturovic Polje, organized in the Farmers' Union Buturovic Polje, have been trying to register the Konjic Onion in the Common List of Varieties in BiH. They have reached out to Municipality officials, the Federal Ministry of Agriculture, the Federal Institute of Agriculture Butmir Sarajevo, and the Faculty of Food and Agricultural Science, Sarajevo. In 2014, we implemented a UNDP sponsored project number 00088295 "Proving authenticity of specific pepper and onion types". The project included interviews with farmers, desktop research, onion sample collecting and SSR genotyping.

According to the available data we have concluded that Konjic Onion is a traditional relict variety which has been used in Buturovic Polje for the last 70 to 100 years. Before the war, the estimated annual onion sets production was 200 tons. Estimated production in 2016 was 60 tons. Due to the topography, a two-year production process is done manually starting from seed to onion sets in the first year and from onion sets to commercial bulb in the second year. The characteristic spherical bulb shape is created by the technique of soil preparation. Farmers mostly use organic fertilizers and hand weeding. Besides Konjic Onion farmers also use the "Stuttgarter risen" variety as well.

It was found out that in 2014 the Federal Institute for Agriculture Butmir Sarajevo registered Konjic Onions and Zenica Onions in the Common Varieties List of Republic of Serbia as their own variety. From the published paper (Cota et al., 2013), it is clear that the Federal Institute wishes to present the Konjic Onion as a new variety created and owned by the Institute. Since they were registered, it is clear that the DUS-VCU certificate was issued for both varieties. With the help of Office of Ombudsmen in BiH, we managed to retrieve all relevant documents from the Federal Institute of Agriculture Butmir Sarajevo and confirmed that DUS-VCU analysis was performed in Novi Sad, Serbia. Also, we confirmed that the Federal Institute has submitted an application for variety registration in BiH. SSR genotyping of the Konjic Onion of the samples provided by farmers was conducted, compared with most important commercial onion varieties in BiH and one autochthonous variety from Slovenia. We have concluded that the Konjic Onion is genetically different compared to the other varieties.

Past

Project results were presented at a round table session with representatives from the Farmers' Union, Buturovic Polje, and the Federal Ministry of Agriculture. Some of the conclusions were:

- Until variety registration, farmers will continue to produce Konjic Onions informally and are eligible to apply for state subsidies.
- The Federal Ministry of Agriculture cannot provide assistance to farmers to register the Konjic Onion since the Common Variety List in BiH is under the jurisdiction of the Ministry

of Agriculture of BiH. The Common Variety List Committee has not convened for 5 years due to political reasons.

- The Federal Ministry of Agriculture acknowledges the enormous role that farmers play in the conservation of autochthonous vegetable varieties in BiH.
- The Farmers' Union, Buturovic Polje, has to make further organizational steps and improvements in order to become an official producer and distributor of Konjic Onion planting materials in the future.
- Farmers and the Federal Ministry of Agriculture should work together to come to a compromise as to which varieties should be registered as "Conservation Variety" and which as "Common Variety" in the ways which will guarantee their future in EU integration process.

Present: In June 2017, the Common Variety List Committee met for the first time in five years. The first case they discussed was Konjic Onion registration. It was registered as "Common Variety" owned by Federal Institute of Agriculture Butmir, Sarajevo. A note was made that there are reasons to believe that Konjic Onion is an autochthonous variety and not a "new variety", as stated in registration submitted by the Federal Institute of Agriculture Butmir, Sarajevo.

Future perspective: There are many unresolved issues regarding the registration and conservation of autochthonous varieties in BiH. Most of them are due to political and legal problems, misunderstandings, as well as because of a lack of political willingness to reform the existing legislation according to EU standards. An example of this may be the lack of a legal regulations regarding the ownership over such varieties and the transparency of the process. The legal framework related to the ownership over the varietes is on a state level, and not on the entity level. One of the problems is a lack of financing to implement projects which would collect samples of potential candidate varieties from across BiH, as well as a lack of financing for research regarding genotyping and qualitative and quantitative analyses. One of the biggest problems is also a lack of financial support to famers who practice "on-farm" conservation. Now, when Konjic Onion is registered, projects for modernization, education and legalization of farmers' organizations are required. Farmers organized in the Farmers' Unions need to organize themselves into enterprises registered for seeds production, otherwise the autochthonous varieties will continue to be illegally produced.

Case study: Center of indigenous breeds Buhovo

The Center for the Preservation of Indigenous Breeds of Domestic Animals at Siroki Brijeg (Buhovo), was founded in 2003. There is the nucleus of herds of endangered indigenous breeds of domestic animals in the Center. The reason for founding this Center was the preservation and protection of indigenous breeds of domestic animals, and through this, the preservation of biological diversity in the FBiH. Buhovo Center is designed to implement activities in education and promotion of ANGR as a part of the tourist offer of this center and the town of Siroki Brijeg.

This center is the only one in the FBiH trying to preserve genes of autochthonous breeds of the FBiH, but its work is based on volunteerism without the continuous assistance of the institutions responsible for animal production. This center aims to educate and raise awareness regarding the importance of indigenous breeds and the preservation of genetic resources.

At the center there are mostly all the more important indigenous breeds of domestic animals of the FBiH, but its work and survival are of concern due to the lack of financial support offered by relevant institutions.

At the current time, the Center is home to Busha cattle (58), donkeys (60), herds of sheep (Herzegovinian strain) (60), goats (Balkan domestic goat) (40), and domestic hens (50). The Center represents a collection of animals belonging to the autochthonous breeds of domestic animals. Currently, there are no breeding or mating programs in the Center.

ANNEX 1

STRUCTURE OF AGRICULTURAL PRODUCTION

Agricultural area by categories of use (in '000 hectares)

	Agricultural area	Cultivated land						Ponds, reed beds and fishponds
		Total	Arable land and gardens	Orchards	Vineyards	Meadows	Pastures	
2011	1,141	696	390	44	5	257	442	3
2012	1,145	719	396	43	5	275	424	2
2013	1,151	722	402	44	5	271	427	2
2014	1,149	719	401	45	5	268	428	2
2015	1,180	746	428	45	4	269	432	2

FBiH Statistical Yearbook (2016)

Arable land by categories of use (in '000 hectares)

	Arable land and gardens	Sown area						Fallow land and other arable land
		Total	Cereals	Industrial crops	Vegetable crops	Fodder crops	Plant nurseries	
2011	1,009	527	289	6	72	132	4	478
2012	1,006	527	304	8	78	137	3	416
2013	998	517	305	8	75	129	3	478
2014	1,011	501	290	9	73	129	2	508
2015	1,029	516	301	11	74	130	3	510

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Livestock, poultry and beehives (in number)

	Cattle		Pigs		Sheep				
	Total	Cows and heifers in calf	Total	Sows and first farrow sows	Total	Ewes for breeding	Horses	Poultry	Beehives
2011	213,466	162,287	87,499	7,631	519,671	405,963	6,491	8,788,000	207,595
2012	214,978	161,546	91,730	7,733	517,171	400,839	6,148	9,447,000	209,146
2013	217,278	160,312	88,649	8,745	523,779	403,151	5,849	10,515,000	214,826
2014	215,478	159,810	88,081	9,046	532,021	405,748	5,903	10,279,000	219,385
2015	216,205	162,549	89,219	9,226	524,608	404,165	5,623	9,818,000	228,991

FBiH Statistical Yearbook (2016)

ANNEX 2

LIST OF INSTITUTIONS AND GOVERNMENTAL BODIES

Institution	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina within Council of Ministers of Bosnia and Herzegovina
Contact details	http://www.mvteo.gov.ba/
Role in agrobiodiversity protection	Defining of policies, basic principles, coordinating activities and harmonizing plans of the entity authorities and institutions at the international level in the fields of agriculture, energy, environmental protection, development and use of natural resources and tourism is within the responsibility of the MoFTER. The MoFTER runs procedures for conducting the international agreements in the field of agriculture, as well as procedures for obtaining membership to international bodies, as well as overseeing procedures for signing project agreements between Bosnia and Herzegovina and international organizations.
Capacity assessment (human and infrastructure)	Within the MoFTER there are two divisions dealing with agrobiodiversity issues: 1. **Water resources, tourism and environmental protection division**, with its three departments, it has 18 employees, and within it there is the Department of Environmental Protection, with eight employees. This division is in charge of cooperation with international organizations and institutions in BiH, and abroad within the competencies of the Ministry in the area of environmental protection, especially in the implementation of international obligations of Bosnia and Herzegovina. Also, it is responsible for monitoring and coordination of the preparations for signing and implementation of the international agreements that BIH accedes to, in the area of environmental protection. 2. **Division for agriculture, food, forestry and rural development**, with its four departments, it has 26 employees. Within it, there is the Department for International Relations and Project Coordination, with four employees. This division is in charge of establishing the framework for the development of sector strategies, policies, programs and measures, and coordinating them with the aim of harmonized approach to development of agriculture in the entire country. This division runs the procedure for entering into a contractual relationship with the International Treaty on Plant Genetic Resources for Food and Agriculture - ITPGR - which represents a legally binding international framework for conservation, sustainable use and equitable distribution of plant genetic resources for food and agriculture, in accordance with the Convention on Biological Diversity - CBD. In addition, this division coordinates Bosnia and Herzegovina activities within the Commission on Genetic Resources for Food and Agriculture – (CGRFA) within the UN Food and Agriculture Organization (FAO) through the nomination of a national focal point(s) for participation in the work of the Commission. Also, this division runs procedures for obtaining membership to Phase IX of the European Cooperative Programme for Plant Genetic Resources (ECPGR) which will be enabled by the signing of the Letter of Approval and the nomination of the National Coordinator.

Important specific actions undertaken by the institution	State of the Environment Report of Bosnia and Herzegovina. Sarajevo, BiH, 2012. Strategic Plan of BiH for Harmonization of Agriculture, Food and Rural Development 2008-2011, 2008. Annual Report on the State in the Sector of Agriculture, Food and Rural Development, 2016. Report on the International Assistance for Agriculture, Food and Rural Development 2016 to Bosnia and Herzegovina.
Requirements for further enhancement of capacities	Strengthening capacity for the implementation and coordination of international and national programmes and projects (including training of staff) related to agrobiodiversity (establishing special divisions which would deal with issues of collecting and reporting data related to agrobiodiversity). Strengthening of inter- and intra-entity cooperation.

Institution	Administration Office of BiH for Plant Health Protection (PHPO)
Contact details	http://www.uzzb.gov.ba/
Role in agrobiodiversity protection	Performs administrative and related technical tasks in line with the Plant Health Protection Low. The PHPO cooperates, informs and exchanges information with the official international plant protection authorities and organizations (EU, EPPO, WTO, FAO, IPPC, UPOV, etc.).
Capacity assessment (human and infrastructure)	It consists of five departments: Department of Plant Protection; Department of Seeds and Planting Material of Agricultural Plants and Protection of Varieties; Department of Phytomarmaceuticals and Mineral Fertilizers; Risk Analysis Department and Legal, Financial and Human Resources Department. It has 22 employees.
Important specific actions undertaken by the institution	Creation of a variety list and other activities related to plant protection and recognition of varieties. Focal point for UPOV convention.
Requirements for further enhancement of capacities	Enhance implementation through participatory planning, knowledge management and capacity building (institutional and human); strengthening of capacities at the institutional and individual level related to plant agrobiodiversity.

Institution	State Veterinary Office of Bosnia and Herzegovina
Contact details	http://www.vet.gov.ba/
Role in agrobiodiversity protection	Proposes regulations and coordinates the implementation of unique measures, methods and procedures for the control of infectious and parasitic diseases of animals from List A and B of the International Code of Ethics of O.I.E. Proposes veterinary conditions for international traffic (exports from Bosnia and Herzegovina and imports to Bosnia and Herzegovina) of animals, raw materials, waste and products of animal origin. Proposes conditions for the registration of objects for slaughtering animals and the implementation of a unique procedure for the registration of facilities for the production, processing, processing, processing or storage of products and raw materials of animal origin intended for export or import. Proposes regulations for the implementation of a unique program for the monitoring and control of residues for animals, and products and raw materials of animal origin. Coordinates the work of the border veterinary inspection and proposes regulations for the establishment of a uniform documentation for the import, or export of animals, raw materials, waste and products of animal origin, and the establishment of a single information system of the border veterinary inspection; Cooperates with international veterinary, health and similar institutions and associations (O.I.E., WHO, FAO, European Commission, etc.).
Capacity assessment (human and infrastructure)	Veterinary staff: 51 Administrative staff: 23
Important specific actions undertaken by the institution	n/a
Requirements for further enhancement of capacities	Enhance implementation through participatory planning, knowledge management and capacity building (institutional and human); strengthening of capacities at the institutional and individual level related to animal agrobiodiversity.

Institution	Ministry of Agriculture, Water Management and Forestry of FBiH
Contact details	www.fmpvs.gov.ba
Role in agrobiodiversity protection	Responsible institution for creation of policy and legal documents and their implementation.

Capacity assessment (human and infrastructure)	The Ministry of Agriculture of the Federation of Bosnia and Herzegovina (FBiH) is highly decentralized. It consists of departments for agriculture, veterinary services, water resources and forestry. Besides this ministry there are seven regional ministries of agriculture on the level of cantons from which Federation of Bosnia and Herzegovina is consisted of. For the other three regions (cantons) of FBiH, agricultural affairs are under the jurisdiction of the Ministry of Economy (Sarajevski, Bosansko-Podrinjski and Zapadno-Hercegovacki). On a municipality level, there are 200 agricultural administrators. All employees are financed by the government funds on a different level (national, entities, cantons, district Brcko, municipalities). Currently, most of the activities of the Ministry of Agriculture of the Federation Bosnia and Herzegovina are directed towards the reconstruction of the agricultural production, preparation of the strategy for agricultural development and the establishment of an institutional infrastructure for agriculture in market economy conditions. The number of employees at this ministry is 98. The total number of employees within all of the cantonal ministries is 107; however, the exact number of employees at public enterprises is not known. There is not a sufficient number of employed expert staff involved in the conservation of agrobiodiversity, which complicates the process of implementation of activities that needs to respond to world trends in this area. Developed strategic documents do not address thoroughly the issue of conservation of animal genetic resources. Plant health protection administrative office staff: 6 Veterinary staff: 6 + 1
Important specific actions undertaken by the institution	Rural Development Program for FBiH 2013-2020, 2012. Mid-Term Agricultural Sector Development Strategy in the Federation of BiH for the period of 2015-2019, 2014. The content directly or indirectly related to biological diversity is occasionally published on the websites of Federal Ministry. The development of strategic documents that do not address thoroughly the issue of conservation of animal genetic resources.
Requirements for further enhancement of capacities	Enhance implementation through participatory planning, knowledge management and capacity building (institutional and human); strengthening of capacities at the institutional and individual level related to agrobiodiversity. Activities on the development of specific programs that will deal with autochthonous breeds, preservation of animal genetic resources and establishment of a gene bank. Formation of a database with implemented projects and status of agrobiodiversity.

Institution	Ministry of Environment and Tourism of FBiH
Contact details	http://www.fmoit.gov.ba/
Role in agrobiodiversity protection	The Ministry of Environment and Tourism has been appointed as the operational focal point on behalf of BiH for the implementation of the Convention of Biodiversity. Accordingly, the Ministry is responsible for communication with international institutions, initiating activities in line with the Convention and coordination with other relevant authorities and stakeholders in Federation of Bosnia and Herzegovina.

Capacity assessment (human and infrastructure)	n/a
Important specific actions undertaken by the institution	Taking part in preparing the Strategy and Action Plan for Protection of Biological Diversity in Bosnia and Herzegovina (2015-2020).
Requirements for further enhancement of capacities	Establishment and strengthening of the institutional framework for the implementation of effective agrobiodiversity protection measures. Establishment of financial mechanisms for the sustainable management of agrobiodiversity (conservation and sustainable use)

Institution	Environmental Fund of the Federation of Bosnia and Herzegovina
Contact details	http://www.fzofbih.org.ba/
Role in agrobiodiversity protection	Collecting and distributions of financial resources for environment protection in the territory of the Federation of BiH.
Capacity assessment (human and infrastructure)	The number of employees at this ministry is 48. There are no planned budget funds for conducting of activities on agrobiodivesity protection.
Important specific actions undertaken by the institution	n/a
Requirements for further enhancement of capacities	Strengthening of capacities at the institutional and individual level related to agrobiodiversity. Secure financial resources for agrobiodiversity.

Institution	Faculty of Agriculture and Food Sciences, University of Sarajevo
Contact details	http://www.ppf.unsa.ba/
Role in agrobiodiversity protection	Inventorying, collecting, missions, phenotypic and molecular characterization, evaluation, documenting and storing of PGR, research projects for use of PGR, education with course programs on PGR on undergraduate and postgraduate level, elaboration of M.Sc. and Ph.D. thesis on PGR, participation in creation and implementation of governmental policy on PGR, participation in elaboration of strategy documents (studies, strategies, programs and action plans on biodiversity).
Capacity assessment (human and infrastructure)	105 employees, out of which 50 hold Ph.D.'s, trial field, various laboratories for phenotypic, agronomic and qualitative PGR analysis, laboratory of molecular genetic analysis, inventory collection of seed samples.
Important specific actions undertaken by the institution	Inventorying, collecting, missions, characterization, phenotypic and molecular characterization, evaluation, documenting and storing of PGR, research projects for use of PGR. Genotyping of an indigenous breed of cattle, participation in programs dealing with conservation and inventorying of autochthonous breeds.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on agrobiodiversity.

Institution	Faculty of Agriculture and Food Technology, University of Mostar
Contact details	http://aptf.sve-mo.ba
Role in agrobiodiversity protection	Inventorying, collecting, missions, phenotypic and molecular characterization, evaluation, documenting and storing of PGR, research projects for use of PGR, education with course programs on PGR on undergraduate and postgraduate level, elaboration of M.Sc. and Ph.D. thesis on PGR, participation in creation and implementation of governmental policy on PGR, participation in elaboration of strategy documents (studies, strategies, programs and action plans on biodiversity)
Capacity assessment (human and infrastructure)	In the 11 institutes, there are 20 permanently employed teachers and researchers.
Important specific actions undertaken by the institution	Inventorying, collecting missions, phenotypic and molecular characterization, evaluation, documenting and storing of PGR. Genotyping of an indigenous breed of cattle, participation in programs dealing with conservation of autochthonous breeds, inventory.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on agrobiodiversity

Institution	Agro Mediterranean Faculty of Dzemal Bijedic University, Mostar
Contact details	http://www.unmo.ba/en/agro-mediterranean-faculty.aspx
Role in agrobiodiversity protection	Inventorying, collecting, missions, phenotypic and molecular characterization, evaluation, documenting and storing of PGR, research projects for use of PGR, education with course programs on PGR on undergraduate and postgraduate level, elaboration of M.Sc. and Ph.D. thesis on PGR, participation in creation and implementation of governmental policy on PGR, participation in elaboration of strategy documents (studies, strategies, programs and action plans on biodiversity)
Capacity assessment (human and infrastructure)	There are 15 permanently employed teachers and researchers.
Important specific actions undertaken by the institution	Inventorying, collecting, missions, characterization, phenotypic and molecular characterization, evaluation, documenting and storing of Mediterranean PGR.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on plant agrobiodiversity.

Institution	Biotechnical Faculty, University of Bihac
Contact details	http://btf.unbi.ba
Role in agrobiodiversity protection	Inventorying, collecting, missions, phenotypic and molecular characterization, evaluation, documenting and storing of GR, research projects for use of PGR, education with course programs on GR on undergraduate and postgraduate level, elaboration of M.Sc. and Ph.D. thesis on PGR, participation in creation and implementation of governmental policy on PGR, participation in elaboration of strategy documents (studies, strategies, programs and action plans on biodiversity).
Capacity assessment (human and infrastructure)	n/a

Important specific actions undertaken by the institution	Inventorying, collecting, missions, characterization, phenotypic and molecular characterization, evaluation, documenting and storing of PGR.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on plant agrobiodiversity.

Institution	Institute for Genetic Engineering and Biotechnology (INGEB), Sarajevo
Contact details	http://www.ingeb.unsa.ba
Role in agrobiodiversity protection	Molecular genetic characterization of agrobiodiversity.
Capacity assessment (human and infrastructure)	Laboratory for Molecular Genetics of Natural Resources with seven employees.
Important specific actions undertaken by the institution	Genetic identification of breeding flocks and young salmonid species (for the purpose of fertilizing or restoring the fish stock); Selection of fish breeding (salmon species) using molecular-genetic markers; Genetic characterization of BiH indigenous varieties of fruits and vegetables using molecular-genetic markers; Genetic characterization of BiH autochthonous livestock breeds using molecular-genetic markers; Genetic characterization of BiH indigenous species of forest trees using molecular-genetic markers; Genetic identification and testing of parenting with horses, cattle and dogs; molecular-genetic analysis for the purpose of determining the purity and identification of raspberry samples.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on plant agrobiodiversity.

Institution	Institute for Agriculture of FBiH Sarajevo Federal Agromediteranean Institute Mostar Agricultural Institute of Canton Tuzla Agricultural Institute of Unsko- Sanski Canton in Bihac;
Contact details	http://www.fzzp.com.ba/ http://www.faz.ba/ http://www.vladatk.kim.ba/uprave-i-upravne-organizacije/upravne-organizacije-u-sastavu-ministarstva/poljoprivredni-zavod https://www.akta.ba/Firma/poljoprivredni-zavod-usk-bihac/
Role in agrobiodiversity protection	Breeding selection work in livestock breeding; Certification of seeds and planting material of agricultural plants; Control of the quantity and quality of agricultural products and their processed products, mineral fertilizers and plant protection products; In the field of continental fruit production, tobacco production; Education of farmers and care of the land as the basic natural resource in the continental climatic region, as well as other plant and animal production; Cantonal ministries have limited powers at the level of Tuzla and Una-Sana Canton.

Capacity assessment (human and infrastructure)	The infrastructure of both Institutes is organized through the four departments, but only two are working on agrobiodiversity: the department for animal technology, and the department for plant technology. These two departments are active in selection, introduction, certification, viticulture, fruit and wine production, operations of the Reporting and Forecasting Services of the Federation of Bosnia and Herzegovina in the domain of plant health protection, transfer of technology, consultancy services in agriculture about vegetable, fruit and wine growing, monitoring and development animal and plant production and technology, registration and identification of animals, keeping a unique database on the registration of property and labeled domestic animals for the whole Federation of Bosnia and Herzegovina, work on the breeding and selection service in the field of cattle breeding, sheep breeding, goat farming, poultry farming, fisheries and beekeeping; introduction of new, modern technologies in animal production and processing technology of animal products, performing consulting services in the domain of animal and plant production and food technology, production of the expertise on analytical and information documentation materials within the competence of the department, carrying out scientific research and professional operational tasks, achieving cooperation with competent institutions and organizations.
Important specific actions undertaken by the institution	The Institute in Sarajevo planted the *ex-situ* collection of old apple and pear varieties, but last year it was destroyed.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on plant agrobiodiversity.

Institution	National Museum, Sarajevo;
Contact details	http://www.zemaljskimuzej.ba
Role in agrobiodiversity protection	Conservation and public awareness.
Capacity assessment (human and infrastructure)	The National Museum has a lack of funds and currently the status of this institution is unresolved. The museum has a total of five employees (one ornithologist, 1 entomologist, 2 botanists, and 1 horticulturist).
Important specific actions undertaken by the institution	IBulletin of the National Museum of Bosnia and Herzegovina, 1996. Botanical garden with a lot of authentic Bosnian plant species, 60 bushes of old botanical roses.
Requirements for further enhancement of capacities	Laboratory equipment and human resources for work on plant agrobiodiversity.

Other research Institutions that are partly involved in agrobiodiversity are the following:

Faculty of Nature Sciences and Mathematics of University in Sarajevo http://www.pmf.unsa.ba

Faculty of Nature Sciences and Mathematics of University in Mostar https://fpmoz.sve-mo.ba/index.php?lang=hr

Faculty of Nature Sciences and Mathematics of University in Tuzla http://pmf.untz.ba/

ANNEX 3

LIST OF NGOS, CSOS, FARMERS ORGANIZATIONS

1	Alliance of Farmers Associations Federation Bosnia and Herzegovina,
2	Alliance of Vegetable Producers in Federation of Bosnia and Herzegovina,
3	Alliance of Fruit Producers in Federation of Bosnia and Herzegovina,
4	Emina Alliance, Ustikolina-Gorazde
5	Alliance Drvarska Drenjina
6	Producers' Alliance of berries in Bosnia and Herzegovina is an umbrella organization for the production of berries in BiH
7	Horticultural scientific society of Bosnia and Herzegovina
8	NGOs (there are 99 registered)
9	Fruit crops nursery “Srebrenik“,
10	PMG VIP Gradacac
11	Agros, Gorazde
12	Plant d.o.o. Tuzla
13	Farmers Union Buturovic Polje - Konjic

ANNEX 4

LIST OF NATIONAL LAWS

- Law on Protection of New Varieties of Plants in BiH (Official Gazette of BiH, no. 14/10)
- Law on Genetically Modified Organisms in BiH (Official Gazette of BiH, no. 23/09)
- Law on Agriculture, Food and Rural Development in BiH (Official Gazette of BiH, no. 50/08)
- Law on Plant Health Protection in BiH (Official Gazette of BiH, no. 23/03)
- Law on Seeds and Seedlings of Agricultural Plants in BiH (Official Gazette of BiH, no. 3/05)
- Regulation on Recognition of Varieties of Agricultural Plant Species in BiH (Official Gazette of BiH, no. 6/11)
- Regulation on Registration of Varieties in the Variety List of BiH (Official Gazette of BiH, no. 6/11
- Law on Nature Protection (Official Gazette of Federation of Bosnia and Herzegovina, no. 33/03)
- Law on Recognition and Protection of Varieties of Agricultural and Forest Plants (Official Gazette of Federation of Bosnia and Herzegovina, no. 31/00)
- Law on Seeds and Seedlings of Agricultural Plants (Official Gazette of Federation of Bosnia and Herzegovina, no. 55/01)
- Law on Seeds and Seedlings of Forest and Horticultural Species of Trees and Shrubs (Official Gazette of Federation of Bosnia and Herzegovina, no. 71/05 and 8/10)
- Agricultural Law (Official Gazette, Federation of Bosnia and Herzegovina, 88/07)
- Law on agricultural organic production (Official Gazette, Federation of Bosnia and Herzegovina, 72/16)
- Veterinary law of Bosnia and Herzegovina (Official Gazette, Bosnia and Herzegovina, 34/02, November 22th 2002)
- Law about arable land from (Official Gazette, Federation of Bosnia and Herzegovina, 2/98)
- Law about veterinary drugs (Official Gazette, Federation of Bosnia and Herzegovina, 15/98)
- Law about improving animal production (Official Gazette, Federation of Bosnia and Herzegovina, 23/98)
- Veterinary law of the Federation of Bosnia and Herzegovina (Official Gazette, Federation of Bosnia and Herzegovina, 46/00)
- Law on subsidies in agriculture and rural development (Official Gazette, Federation of Bosnia and Herzegovina, 42/10)
- Animal Husbandry Law (Official Gazette, Federation of Bosnia and Herzegovina, 66/13)
- The Decree on the Founding of the Federal Council for Agriculture and Rural Areas (Official Gazette, Federation of Bosnia and Herzegovina, 2/13)

LIST OF NATIONAL STRATEGIC AND PROGRAM DOCUMENTS

1. Medium-term strategy for Advisory Services of the Federation of Bosnia and Herzegovina (2017-2021)
2. Development strategy of the Federation of Bosnia and Herzegovina 2010 – 2020
3. Medium-Term Agricultural Sector Strategy for the Federation of BiH (2006-2010)
4. Medium-term development strategy of the agricultural sector in Federation of Bosnia and Herzegovina for period 2015-2019.
5. National Biodiversity Strategy and Action Plan (NBSAP BiH 2008-2015)
6. National Biodiversity Reports: First, Second, Third and Fourth were developed in the course of the period 2005-2010
7. The Federal Nature Protection Strategy, the Federal Air Protection Strategy, and the Federal Waste Management Strategy with Action Plan
8. Climate Change Adaptation and Low-Emission Development Strategy for Bosnia and Herzegovina were adopted by the Council of Ministers of Bosnia and Herzegovina on 08. October, 2013. (http://www.pardee.du.edu/sites/default/files/climatechangeadapt.pdf)
9. Operative Program for Plant Genetic Resources in Agriculture in the Federation of Bosnia and Herzegovina (2014). (http://fmpvs.gov.ba/upload_files/1440616945-361_1204_1816_b.pdf)
10. Strategy and Action Plan for Protection of Biological Diversity in Bosnia and Herzegovina (20152020).http://www.unep.ba/tl_files/unep_ba/PDFs/NBSAP%20BiH_20160426_eng.pdf
11. Rural Development Program for FBiH 2013-2020 (2012).

    http://hdr.undp.org/sites/default/files/nhdr_en_web_30102013.pdf
12. Annual Report on the State in the Sector of Agriculture, Food and Rural Development FOR 2015 (2016).

    http://www.mvteo.gov.ba/izvjestaji_publikacije/izvjestajidefaultaspx?id=8246&langTag=bs-BA

LIST OF INTERNATIONAL AGREEMENTS/CONVENTIONS

- Convention on Biological Diversity (CBD - Rio de Janeiro, 1992) by ratifying it in 2002.
- FAO (Food and Agriculture Organization
- Bosnia and Herzegovina become an ECPGR member in 2008, the last year of the VII phase.
- The International Union for the Protection of New Varieties of Plants (UPOV)

ANNEX 5

LIST OF REFERENCES FOR GENETIC RESOURCES IN AGRICULTURE

1. Medium-term strategy Advisory Services Federation of Bosnia and Herzegovina (2017-2021). Ministry of Agriculture, Water management and Forestry of FBiH, Sarajevo (2016).
2. Federation of Bosnia and Herzegovina in Figures Agency for statistics of FBiH (2017).
3. Agency for statistics of BIH, First Release No1 Sarajevo (2016). http://www.fzs.ba/wp-content/uploads/2017/07/F-BiH-u-brojkama-2017.pdf
4. Agrobiodiversity – the key to food security, climate adaptation and resilience, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, (2011). https://www.giz.de/expertise/downloads/giz2011-en-agrobiodiv-food-security-climate-change.pdf
5. Bosnia and Herzegovina - Country Profile, Biodiversity Facts Status and trends of biodiversity, including benefits from biodiversity and ecosystem services, https://www.cbd.int/countries/profile/default.shtml?country=ba#measures
6. Medium-term development strategy of the agricultural sector in Federation of Bosnia and Herzegovina for period 2015-2019 http://fmpvs.gov.ba/upload_files/1467797735-StrategijaKonacnaverzijazaFMVS06052015.pdf
7. Annual report about the agricultural state in the Federation of Bosnia and Herzegovina for 2016 Green Report, Ministry of Agriculture, Water management and Forestry of FBiH, Sarajevo, (2017). http://fzs.ba/wp-content/uploads/2017/02/SG2016.pdf
8. Strategy and action plan for protection of biological diversity in Bosnia and Herzegovina (2015-2020). Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina Sarajevo, (2016).
9. Operative Program for Plant Genetic Resources in Agriculture in the Federation of Bosnia and Herzegovina (2014). http://fmpvs.gov.ba/upload_files/1440616945-361_1204_1816_b.pdf
10. Country report on the state of plant genetic resources for food and agriculture in Bosnia and Herzegovina http://www.fao.org/docrep/013/i1500e/Bosnia%20and%20Herzegovina.pdf
11. Fifth National Report to the United Nations Convention on Biological Diversity of Bosnia and Herzegovina http://www.unep.ba/tl_files/unep_ba/PDFs/Fifth%20National%20Report.pdf
12. Assessment of development results evaluation of UNDP contribution Bosnia and Herzegovina https://www.oecd.org/countries/bosniaandherzegovina/46817943.pdf
13. Agricultural Sector Policy Note for Bosnia and Herzegovina : Trade and Integration Policy Notes https://openknowledge.worldbank.org/handle/10986/13238
14. USAID/Bosnia and Herzegovina Country Development Cooperation Strategy 2012-2016 http://pdf.usaid.gov/pdf_docs/pdact703.pdf

15. Animal genetic resources in Bosnia and Herzegovina, Veterinary Office of BiH, Sarajevo, (2003).
16. Development strategy of the Federation of Bosnia and Herzegovina 2010 – 2020
17. Scoping Study for Evaluating the Implications of Acceding to and Implementing the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in Bosnia and Herzegovina. UNEP-Bosnia and Herzegovina http://www.unep.ba/tl_files/unep_ba/PDFs/Scoping%20Study.pdf
18. Country Pasture/Forage Resource Profiles Bosnia and Herzegovina. FAO (2009)
19. Directorate for European Integration BiH. http://dei.gov.ba/dei/media_servis/vijesti/default.aspx?id=10523&langTag=hr-HR

ANNEX 6

LIST OF REFERENCES FOR CONSERVATION EFFORTS OF GENETIC RESOURCES

1. Rare Breeds and Varieties of the Balkan, Atlas 2009, Waltraud Kugler, Monitoring Institute Sttutgart (2009)
2. Bosnia and Herzegovina Fourth Report to the United Nations Convention on Biological Diversity 2010 Biodiversity Targets National Assessments, (2010).
3. Bosnia And Herzegovina Biodiversity Assessment, Dave C. Gibson, Ron Sissem, Samir Dug, (2003)
4. Conclusions of the International Workshop on Shorthorn Cattle of the Balkan Pogradec, Albania, September 11 - 13th 2008, SAVE - Monitoring Institute (2008)
5. Genetic diversity of the eight brachiceros cattle breeds as revealed by 105 microsatellite markers, I. Medugorac, A. Medugorac, M. Förster, J. Ramljak, A. Ivankovic, I. Russ, B. Luntz, K. Kume, HP. Grunenfelder, Workshop on shorthorn cattle of the Balkans (busha workshop) 11-13 september 2008, Pogradec, Albania (2008).
6. Strategy and action plan for protection of biological diversity in Bosnia and Herzegovina (2015-2020). Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016)
7. Bosnia and Herzegovina Fourth Report to the United Nations Convention on Biological Diversity 2010 Biodiversity Targets National Assessments, (2010).
8. Bosnia and Herzegovina Biodiversity Assessment, Dave C. Gibson, Ron Sissem, Samir Dug, (2003).
9. 9. Strategy and action plan for protection of biological diversity in Bosnia and Herzegovina (2015-2020) Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, Sarajevo, (2016).
10. Fifth actional Report to the United Nations Convention on Biological Diversity of Bosnia and Herzegovina http://www.unep.ba/tl_files/unep_ba/PDFs/Fifth%20National%20Report.pdf
11. Scoping study for evaluating the implications of acceding to and implementing the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in Bosnia and Herzegovina http://www.unep.ba/tl_files/unep_ba/PDFs/Scoping%20Study.pdf
12. Country report on the state of plant genetic resources for food and agriculture in Bosnia and Herzegovina (http://www.fao.org/docrep/013/i1500e/Bosnia%20and%20Herzegovina.pdf)
13. European Rural Parliament 2015 National Report from Bosnia and Herzegovina
14. SeedNet Story – Report of SeedNet Project (2013)
15. Overview and Assessment of Support Measures for Endangered Livestock Breeds (SUBSIBREEDS), 2014. https://www.rfp-europe.org/fileadmin/SITE_ERFP/Projects/ERFP/SUBSIBREED-BOOK_9_sept.pdf

16. Josip Copa et al (2013): Yield and Mineral Composition of Two New Onion Varieties From Bosnia And Herzegovina" IV International Symposium: AGROSYM 2013: 10.7251/AGSY1303251C.
17. Josip Copa et al (2014): Qualitative and quantitative characteristics of the new varieties of onion, Agroznanje, vol. 15, br. 1, 65-74.
18. "Exploring, collecting and characterizing the local forms of industrial crops from SEEDNet area" (WG Industrial crops) - local cultivars of potatoes and industrial crops have been collected.
19. "Characterization of apple local varieties (*Malus domestica Borkh.*) from South East European region" and "Collection and field evaluation of local plum (*Prunus domestica*) genetic resources from South East European network" (WG Fruit and Vitis) - collection and characterization of local cultivars. Collected data and photos taken are to be compiled into two separate pomologies of Balkan local cultivars of apple and plum.
20. "Identification, characterization and conservation of old and autochthonous vine varieties in Eastern European countries" (WG Fruit and Vitis) - local Vitis cultivars have been identified and described for both morphological and ampelografic characters and unique accessions have been identified with the help of DNA markers.
21. Resetnik I. et all: Genetic diversity and demographic history of wild and cultivated/naturalized plant populations: evidence from Dalmatian sage (*Salvia officinalis L., Lamiaceae*). The Journal PloS one, 2016.

ANNEX 6a

LIST OF NATIONAL COLLECTIONS - PLANT

National/entity collection		Conservation status						
		No of samples		Completely documented	Characterized	Evaluated	Multiplicated	Duplicates in other GB
CROPS		*ex-situ*	*in-situ*	approximate % of the total crop samples				
CEREALS and Maize								
CEREALS and Maize		100		About 70%		About 70%		
Barley	*Hordeumvulgare*	15		About 70%		About 70%		
Buckwheat	*Fagopyrumesculentum*	50		About 70%		About 70%		
Millet	*Panicummiliaceum*							
Oats	*Avenasativa*	5		About 70%		About 70%		
Rice	*Oryzasativa*							
Rye	*Secalecereale*	2		About 70%		About 70%		
Sorghum	*Sorghumbicolor*							
Wheat	*Triticumaestivum*	17		About 70%		About 70%		
LEGUMES								
Beans	*Phaseolusvulgaris*	100		About 70%		About 70%		
Adzukibean	*Vignaangularis*							
Broadbean	*Viciafaba*							
Chickpea	*Cicerarietinum*							
Cowpea	*Vignaunguiculata*							
Lentil	*Lensculinaris*							
Peas	*Pisumsativum*							
Soybean	*Glycinemax*							
FODDER CROPS								
Alfalfa	*Medicagosativa*	17		About 70%		About 70%		
Clover	*Trifoliumsp.*							
Commonsunfoin	*Onobrychissativa*							
Ervil	*Viciaervilia*							
Fodderbeet	*Betavulgarisssp. vulgaris*							
Grass	*Dactylisglomerata*							
Lupine	*Lupinusspp*							
Meadowgrass	*Poaannua L*							
Safflower	*Carthamustinctorius*	2						
Sainfoin	*Onobrychisviciifolia*							
Timothy	*Phleumpratense*							
Trefoil	*Lotussp.*							
Vetch	*Viciasativa*							
Vetchling	*Lathyruscicera*							

INDUSTRIAL CROPS								
Anise	*Pimpinellaanisum*							
Castorbean	*Ricinuscommunis*							
Cotton	*Gossypiumhirsutum*							
Flax	*Linumusitatissimum*							
Hemp	*Cannabissativa*							
Hop	*Humuluslupulus*							
Peanuts	*Arachishypogaea*							
Poppy	*Papaversomniferum*							
Rapeseed	*Brassicanapus*							
Sesame	*Sesamumindicum*							
Sugarbeet	*Betavulgaris*							
Sunflower	*Helianthusannuus*	2						
Tobacco	*Nicotianatabacum*							
VEGETABLE CROPS								
Asparagus	*Asparagusofficinalis*							
Broccoli	*B. oleraceavar. botrytis*							
Brusselssprouts	*B. oleraceavar. gemmifera*							
Cabbage	*Brassicasp.*	150		About 70%		About 70%		
Capsicum								
Calabash, Gourd	*Lagenariasiceraria*							
Carrot	*Daucuscarota*							
Cauliflower	*Brassicaoleraceavar. Botrytis*							
Celery	*Apiumgraveolens*							
Celery	*Apiumgraveolensvar. Dulce*							
Chard	*Betavulgarisvar. Vulgaris*							
Chicory	*Cichoriumintybus*							
Cress	*Lepidiumsativum*							
Cucumber	*Cucumissativus*	1						
Cucurbita		14		About 70%		About 70%		
Eggplant	*Solanummelongena*							
Endive	*Cichoriumendivia*							
Fennel	*Foeniculumvulgare*							
Garlic	*Alliumsativum*							
Kale	*B. oleraceavar. acephala*	59		About 70%		About 70%		
Kohlrabi	*B. oleraceavar. gongylodes*	4						
Leek	*Alliumampeloprasum*							
Lettuce	*Lactucasativa*	1						
Melon	*Cucumismelo*							
Mustard	*Sinapissp.*							
Mustard	*Sinapisalba*							
Okra	*Abelmoschusesculentus*							
Onion	*Alliumcepa*	4		About 70%		About 70%		
Orache	*Atriplexhortense*							
Parsley	*Petroselinumcrispum*	1						
Parsnip	*Pastinacasativa*							
Pastinaca	*Pastinacasativa*							
Patiencedock	*Rumexpatentia*							

Pepper	*Capsicumannuum*	4						
Potato	*Solanumtuberosum*	12		About 70%		About 70%		
Pumpkin	*Cucurbitasp.*							
Radish	*Raphanussativusvar. radicula*							
Redbeet	*Betavulgaris*							
Rocketsalad	*Erucasativa L*							
Spinach	*Spinaciaoleracea*							
Spinach	*Spinaciaoleracea*							
Tomato	*Licopersiconesculentum*							
Turnip	*Brassicarapa*							
Watermelon	*Citrulluslanatus*							
Zuccini	*Cucurbitapepo*							
FRUIT CROPS								
Almond	*Prunusdulcis*		7					
Apple	*Malussylvestris*	98	39	70	About 80%	About 80%	About 80%	
Apricot	*Prunusarmeniaca*							
Blackberries	*Rubusspp.*							
Blueberry	*Vacciniumspp*							
Cherry	*Prunusavium*		6		About 30%		About 30%	
Chestnut	*Castaneasativa*		13	13	About 70%	About 70%	About 70%	
Currants	*Ribessp.*							
Fig	*Ficuscarica*		5	5				
Grapevine	*Vitisvinifera*		12	12	About 70%	About 70%	About 70%	
Hazelnut	*Corylusavellana*							
Mulberry	*Morusspp*							
Olive	*Oleaeuropaea*							
Peach	*Prunuspersica*		4		About 80%	About 80%	About 80%	
Pear	*Pyruscommunis*	24			About 80%	About 80%	About 80%	
Persimmom	*Dyospyrossp.*							
Pistachionut	*Pistaciavera*							
Plum	*Prunusdomestica*		23	1	About 70%		About 70%	
Pomegranate	*Punicagranatum*		17		About 70%		About 70%	
Quince	*Cydoniaoblonga*							
Raspberry	*Rubusspp*							
SourCherry	*Prunuscerasus*		2					
Strawberry	*Fragaria x ananassa*							
Walnut	*Juglansregia*		8		About 70%	About 70%	About 70%	
MEDICINAL AND AROMATIC PLANTS								
No data		40						

ANNEX 6b

LIST OF NATIONAL COLLECTIONS - ANIMAL

Current status of breed diversity, number of breeds for which characterization has been carried out and their status in conservation programs

	Current Total		At Risk		Widely used		Lost (last 20 years)		At population level			At individual level		
									Baseline survey	Genetic distance	Protection status	Performance recording	Genetic evaluation	Molecular evaluation
	L	I	L	I	L	I	L	I						
Cattle	2	8	2	0	0	1	0	0	0	1	0	0	0	1
Water Buffalo	0	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Sheep	4	3	0	0	2	1	0	0	N/A	N/A	N/A	N/A	N/A	4
Goats	1	2	1	0	0	2	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Horses	1	1	1	1	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Donkeys	1	0	1	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Pigs	1	3	1	0	0	3	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Chicken	1	1	1	0	0	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Turkey	0	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Ducks	0	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Geese	0	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Honey bees	0	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A

- L = Locally Adapted or Native; I = Introduced/Imported (Recently Introduced and Continually Imported).
- Breeds at risk use FAO classification (http://www.fao.org/docrep/010/a1250e/a1250e00.htm).
- Consider breed characterization during the last ten years.
- Baseline survey summary data describing the identification and observable characteristics, location, uses and general husbandry of the AnGR for each species used in the country for food and agricultural production.
- Genetic distances among breeds computed from molecular analyses.
- Protection status: *In-situ* (includes all measures to maintain live animal breeding populations, including those involved in active breeding strategies in the agro-ecosystem where they either developed or are now normally found, together with husbandry activities that are undertaken to ensure the continued contribution of these resources to sustainable food and agricultural production, now and in the future); *Ex-situ* conservation (genetic material within living animals but out of the environment in which it developed – *Ex-situ in-vivo*, or external to the living animal in an artificial environment, usually under cryogenic conditions including, the cryo-conservation of semen, oocytes, embryos, cells or tissues - *Ex-situ in-vitro*.
- Performance recording is based on individual animal data for milk yield, growth, reproduction, etc.
- Genetic evaluation refers to estimation of breeding values.
- Molecular evaluation includes information of markers, DNA, blood type, protein alleles, etc.

ANNEX 7

ACTIVITIES FOR RAISING PUBLIC AWARENESS

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