TCP/ALB/3401 CONSERVATION AND MANAGEMENT OF ENDANGERED LOCALLY ADAPTED CROP VARIETIES

COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE IN ALBANIA

DRAFT

Agim Pepkolaj
Ndoc Faslia
Belul Gixhari

Albania, November 2015

TABLE OF CONTENTS

ABBREVIATIONS

ATTC	Agricultural Technology Transfer Center
CWR	Crop Wild Relatives
ECPGR	European Cooperative Programme for Plant Genetic Resources
EU	European Union
FAO	Food and Agriculture Organization
GDP	General Domestic Product
MARDWA	Ministry of Agriculture Rural Development and Water Administrations
PGRFA	Plant Genetic Resources for Food and Agriculture
SEEDNET	South East European Development Network
SIDA	Swedish International Development Agency
WFP	Wild Food Plants
WIEWS	Early Warning System on Plant Genetic Resources

Executive summary

Albania is a country in Southeast Europe which borders Montenegro to the northwest, Kosovo to the northeast, Macedonia to the east, and Greece to the south and southeast. It has a coast on the Adriatic Sea to the west and on the Ionian Sea to the southwest. The country has a total area of 28,748 km², with a population of about 4 million people, 30% of which has migrated to other European countries.

The majority of the country territory is hilly and mountainous. The coastal lowlands have typically Mediterranean climate, while highlands have continental climate. Due to the climate and territory variability, the country is very rich in terms of flora and many different crops are grown.

The agricultural sector is very important for the economy as it provides employment for more than half of the active labour force in the country. The vast majority of farms are small (< 2 ha) and their production is in part for self-consumption and in part marketed. In general, farmers cultivate a mixture of annual and perennial crops, such as wheat, maize, bean, vegetables, alfalfa, fruit trees, olives etc.

Although the country is very rich in plant genetic resources, it should be noted that the interest and attention to the conservation and sustainable use of these resources took off in the '90s. Following the establishment of the National Genebank in 1998, significant efforts have been undertaken to identify, collect and conserve plant genetic resources for food and agriculture. Nevertheless, these resources, which are the base of food security, still face serious problems and threats that require continued surveillance as well as national and international coordinated efforts.

As per the preservation of plant genetic resources for food and agriculture (PGRFA) in Albania, the greatest efforts have been dedicated to *ex-situ* conservation, undertaken by the National Genebank, which is under responsibility of the Agricultural University of Tirana, and five Agricultural Technology Transfer Centres (ATTCs), under the responsibility of the Ministry of Agriculture Rural Development and Water Administration (MARDWA).

Albanian National inventory of base collections includes in total of 4105 accessions. Out of these, 3219 accessions are maintained as seeds under long-term conservation at the National Genebank and the remaining 886 accessions are conserved in the field collection (614 by the National Genebank and 272 by ATTC Vlora). Working collections of about 8000 seed accessions of mainly wheat, bean and vegetables, are maintained at ATTC Lushnja.

Since 2009, several collecting missions have been carried out with support from FAO, SIDA and MARDWA. These missions have significantly contributed to increase the coverage and diversity of the germplasm stored in the National Genebank, in particular local crop varieties and their wild relatives, as well as medicinal and aromatic plant species.

During the implementation of the SEEDNet Project (2005-2011), the national collection of fruit trees was established at the National Genebank.

Despite these achievements, it is considered that quite a large diversity of PGRFA in Albania has not been taken care of. Indeed the situation of PGRFA occurring *in-situ* appears quite problematic. Albania ranks third in the world as per concentration of priority crop wild relatives (CWR)[1] and national parks and protected areas cover more than 80,000 hectares. Nevertheless the management plans of these areas do not address the management of CWR and wild food plants (WFP), two very important gene-pool, which represent a major source of adaptive diversity particularly at risk if not adequately preserved.

Under the circumstances currently faced by the country of changing climates and increasing human and financial resource scarcity, the sustainable use of PGRFA is of capital importance and can offer great opportunities. Sustainable use of PGRFA entails the development and/or simply the introduction and testing of new crop varieties. It critically depends on farmers and breeders having access to the genetic diversity in order to develop and grow adapted and more productive varieties, able to use more efficiently lower amounts of inputs under a changing environment where pests and diseases are increasingly more aggressive. PGRFA can also be sustainably used through their direct introduction for production on farm, for land restoration and traditional and local varieties play also an important social and cultural role

The lack of a national strategy and programmes for the collection, conservation and sustainable use of plant genetic resources, together with the lack of funds, inter-institutional coordination, public awareness and the limited human capacity, available for dealing with PGRFA management, remain for Albania, a serious and urgent issue, to be addressed in the near future.

[1] Holly et al. 2013. A prioritized crop wild relative inventory to help underpin global food security http://www.sciencedirect.com/science/article/pii/S0006320713002851

Chapter 1. Introduction

1.1 Albania and its agricultural sector

Albania is a small Mediterranean country, which lies in southeast Europe (western part of Balkan Peninsula). Its population amounts to about 4 million people and the country area totals 28 748 km². The agricultural arable land represents approximately 24% (690 000 ha) of its territory, 36% of which is under forest and 15% under pastures. The average agricultural land per capita is therefore below 0.2 ha, which is the smallest throughout Europe.

Albania benefits from a Mediterranean climate, characterized by mild winters with abundant precipitation and hot and dry summers. The total annual precipitation is about 1500 mm. The country has relatively abundant fresh water resources (seven main rivers run from east to west).

Despite its small size, Albania holds a rich biological diversity and flora. This is due to its geographical position in the Mediterranean region and in the Balkan Peninsula and to the occurring different types of landscape (Paparasito et al. 1988). Albanian Flora includes about 3,250 plant species or about 30% of European Flora (Paparasito et al. 1988), of which 30 are endemic species and about 180 sub-endemic species (Vangjeli et al. 1995).

The agricultural sector continues to be one of the most important sectors of the economy which contributes to about 22% of the GDP (year 2014) and provides employment for more than half of the active labour force in the country. The agricultural land reform implemented after 1990, produced a fragmentation of the agricultural land into thousands of small family farms, which characterize the agricultural sector.

Production is predominantly oriented to both family consumption and the market. In general, farmers cultivate a mixture of annual and perennial crops, such as wheat, maize, vegetables, alfalfa and fruit trees. Mainly cattle and poultry production characterize the livestock sector.

Agricultural activities which are mostly run by individual farmers, in recent years have seen a progressive expansion of inter-farm cooperatives for purchasing and marketing inputs and agricultural products. Some agri-businesses targeting vegetable production, orchards and vineyards, and in some cases dairy products are being developed by family enterprises of landowners. Such market-oriented farm operation is gradually increasing in number although it is hampered by the farm size which, on average, is still in a range of 2-3 ha.

In terms of cultivated area, the main agriculture crops are: forage crops 35% of the cultivated area with an average yield of 23.2 t/ha, wheat 20% with an average yield of 4.2 t/ha, maize 13% with an average yield of 5.1 t/ha, vegetables 8% with an average yield of 26.6 t/ha, and white bean 4% with an average yield of 1.5 t/ha. The rest (about 20%) is planted with fruit trees, olives and vineyards.[2]

[2] Ministry of Agriculture, Statistical Yearbook 2014

During the last 15 years, the acreage of individual agriculture crops has changed as the result of an increase of market demand for livestock products, fruits, and vegetables. Cereal cultivations have decreased considerably: only in the last 5 years, wheat cultivation area has decreased by 10%. During the same period, cultivation area of forage crops has increased by more than 18%.

Seed production and distribution systems are entirely based on private operators who deal with importation and marketing of seeds needed for cultivation by farmers. Albania is a small market and nearly 80% of the needs for seeds are met by imports. The remaining 20% is met by farmers' saved seed. Plant breeding programmes are almost non-existent in the country and all the new cultivars released in the country in the past years come from abroad.

Crop yields depend to a large extent on the quality of the seed used for cultivation. Based on the statistical data, about 89% of arable land cultivated with wheat is planted with seeds of uncertified quality; for maize this proportion decreases to about 13%, as more than 85% of the crop is grown from imported hybrid seed. For vegetable crops also, about 17% of the surface is cultivated with seeds of uncertified quality. It is to be noted that a good part of the arable land, especially in remote mountainous areas, is cultivated with local varieties of vegetables, maize and fruit trees.

Despite the progress made in the agricultural sector, farmers still continue to face many obstacles that are beyond their control. These include, *inter alia*, small and fragmented land holding, limited access to markets and poorly developed relationships with agribusinesses at the commercial and agricultural supply chains, limited access to credit, and poor rural infrastructure.

Albania is currently a candidate country for membership in the European Union, and in this context, the agricultural sector is facing major challenges. These challenges have to do with the low level of technology applied in agriculture, including mechanization, as well as the low standards applied in production, food safety and consumer protection, and the increasing competition from products coming from abroad.

1.2 Plant genetic resources for food and agriculture

Out of the 3,250 plant species spread all over Albania, it is estimated that about 700 species are considered as plant genetic resources for food and agriculture. Currently, about 15 arable species, 15 forage species, 35 vegetable species, and 20 fruit-tree species, are cultivated in the country. In addition to these agricultural species, medicinal and aromatic plants, which widely occur in the country, comprise an important natural economic resource, not totally and sustainably exploited yet.

In addition to these agricultural species, more than 300 species of medicinal and aromatic plants (MAPs) belong to the Albanian flora that occur in the wild. They are important natural and economic resources of the country. About 182 of these species are rather widespread and many of them are harvested and exported. Over-harvesting, improper management, together with

habitat changes across most parts of Albania in the last two decades are threatening the genetic diversity of several MAP species. Sixty-eight medicinal species are considered endangered and 40 MAPs are included in the National Red Data Book.

Many traditional cultivars play an important role in agricultural production. A very high diversity occurs among and within traditional cultivars of crops such as maize common bean and vegetables cultivated in the country. Good examples are the widespread landraces of maize (Reçi, Dukati, Sulova,Yzberish 58, Gushtak, etc.), onion local ecotypes (Miras, Drishti), local bean cultivars (Kallmet, Shale, Luzni, Eçmenike etc.).

The diversity of forage crops is represented by some cultivated grass and leguminous species, such as local alfalfa ecotype (Tomin), but there is a much higher number of plant species that compose the annual and perennial meadow flora.

The diversity of fruit trees is also very wide. The fruit trees are everywhere in Albania as a result of the great diversity of species and cultivars, which are adapted to a great variety of climatic and soil conditions. Such conditions provide the premises to allow for centuries the cultivation of a large number of Mediterranean fruit-tree cultivars.

Currently, there are many species and varieties of fruit-trees, olives, and grapes that have a high level of adaptability to particular agro-ecosystems, with high nutritious and taste values, suitable for competitive markets, particularly for bio and typical products. The rich diversity in the field of arboriculture and the ancientness of their cultivation is clearly expressed by the fact that many cultivars are named according to their place of cultivation such as “Hoçishti apple”, “Gjeçe apple”, “Zhei apple”,“Tropoja plum”, “Elbasani double plum”, “Karkanjozi pear”, “Pinari pear”, “Vakufi pear” etc.

In viticulture, the autochthon varieties include “Sheshi i Zi”, Sheshi i Bardhë”, “Kallmet”, while the most popular autochthon olive varieties include “Kaninjoti”, “Kokërrmadh i Beratit”, “Kokërrmadh i Elbasanit”, “Krypsi i Krujës”, “Ulliri i Bardhë i Tiranës”, etc.

Despite plant genetic resources play an essential role for the agriculture and food security of the country, the level of attention given to their collection, conservation and sustainable use appears overall insufficient.

Table 1. Number of accessions collected with support by FAO project TCP/ALB/3401

Year	Vegetable accessions	Fruit tree accessions	MAPs
2013	75	13	76
2014	117	116 (43 vineyards accession)	90
2015			21
Total	192	129 (43 vineyards accession)	190
	551 (43 of vineyards accession identified)		

During the past 3 years, 31 surveying and collecting missions have been carried out throughout the country with FAO support. Nine surveying and collecting missions targeted fruit trees, 10

vegetables and 12 medicinal and aromatic plants. During these missions a total of 551 accessions were collected and stored in the long term conservation facilities of the National Genebank.

Overall *ex-situ* conservation of PGRFA in Albania has shown considerable progress over the past years as it has benefitted from institutional support and arrangements between the Agricultural University of Tirana and the Ministry of Agriculture which have been built since the establishment of the National Genebank.

On the other hand, institutional support to *in-situ* conservation (including on farm conservation) has been over the years discontinuous, as past efforts, such as the establishment of a *National Network for on farm conservation*,[3] failed to set up sustainable institutional arrangements. As a result, on farm conservation is actually organized on a voluntary basis by farmers only.

Although farmers in many areas of the country (especially in remote areas) cultivate their local crop varieties, they hardly know about the germplasm stored *ex-situ* and its value, which therefore becomes in practice not accessible. Furthermore, as mentioned above initiatives and public funds for *in-situ* and on farm conservation are overall absent.

During recent times, the constant abandonment of rural farming in Albania, combined with the progressive introduction from abroad of commercial varieties and the expansion of land use for social developments represent unprecedented threats to the local crop diversity of traditional farming systems and major causes of genetic erosion.

Furthermore, changing climatic conditions, including heat stress intensification and changed rainfall patterns have put an increased pressure over natural habitats with negative consequences on occurrence and distribution of crop wild relatives in the country. This phenomenon is particularly alarming as these species represent an important reservoir of diversity for crop improvement and adaption to changing environmental conditions.

For the same reasons mentioned above, also a large number of traditional cultivars have been lost or nearly lost. For instance, presently there are no wheat primitive cultivars; also many maize open pollinated cultivars are lost etc. To some extent, vegetable crops are an exception in this respect, as many farmers successfully cultivate local populations and the market demand for their products is increasing.

1.3 Genetic erosion in Albania

In Albania, erosion of plant genetic resources has occurred in the past and is still occurring. The main evidence of this phenomenon is the continued loss of local varieties from farmer's fields. Even though, a systematic assessment of the occurrence of genetic erosion in PGRFA in the country has not been carried out, experts affirm that based on observations, as well as time comparisons, genetic erosion has already affected almost all plant groups.

[3] SEEDNet project from 2005-2011

Until 1990, the agricultural economy was organized in the form of state farms or cooperatives, where everything was planned by the state and farmers did not carry out any private agriculture activity. In such conditions, the care and the direct support for the conservation and use of the local plant diversity had been very low. This has caused huge genetic erosion, resulting in losses of the diversity of valuable plants for agriculture and food in particular traditional cultivars.

Based on observations carried out by agriculture research institutes, and according to the data taken during some collection missions carried out during 1941 (H. Stube) and after the 1990 (K. Hammer, L. Xhuveli, D. Pignone, etc), it results that during the last fifty years, the genetic erosion of some species was estimated about 94% for *Triticum aestivum*; 100% for *Triticum durum*; 100% for *Triticum turgidum*; 83% for *Triticum monococcum*; 76% for *Avena* spp.; 59% for *Hordeum vulgare*; 78% for *Vicia ervila* and 42% for *Vicia sativa*. The main driving factors of genetic erosion included:

- The replacement of local varieties by foreign varieties and hybrids.
- In the wild flora, mainly for aromatic and medicinal plants, one of the main causes of erosion is over harvest, particularly when harvesting occurs without respecting the plant biological criteria for natural regeneration. Fires also may cause irreparable damages, if occur during certain phonological stages.
- Social-economic changes and demographic migration, abandonment of rural areas, mainly hilly and mountain areas, which are richer in plant genetic resources.

Habitat changes across most parts of Albania have also eroded wild populations of medicinal and aromatic plants species (MAPs). In the last two decades several MAPs have been reportedly affected by the phenomenon of genetic erosion. Sixty-eight medicinal species are considered as endangered and 40 MAPs are included in the National Red Data Book.

Chapter 2. Status of *In-Situ* Conservation and Management

2.1 Surveying and inventorying plant genetic resources for food and agriculture

Surveying and inventorying are activities that engage team of crop experts and taxonomists, and require a good knowledge of the agricultural territory together with adequate transportation facilities, which in many cases are not easily available within research institutions of the country. The lack of dedicated resources from existing research institutions has so far limited these important activities making them extremely dependent on external funding such as international and/or regional projects.

To date, the level of surveying and inventorying of existing PGRFA in Albania is still relatively low and requires much more attention and adequate planning on a routine basis from managers and policy-makers of the public institutions, such as Agricultural Technology Transfer Centres, the University and environmental agencies.

Since 2012 a total of 304 surveys have been carried out targeting 39 plant species in 108 villages. 40% of the surveys have targeted vegetable species, while 30% fruit trees, including apples, pears, plums etc. String beans, pears, oregano, apples, winter savory, wild plums, pepper plants and tomatoes were among the most frequently surveyed crops; cereals were surveyed only once (maize), while no surveys were reported for fodder species (see table 2).

Out of the six public institutions dealing with plant genetic resources in Albania, only two of them, the National Genebank and ATTC Lushnje, reportedly undertook surveying and inventorying activities.

About 32% of the 39 surveyed species were crops, the remaining ones were wild species, mainly MAPs and few crop relatives.

The diversity within four important crops was found threatened:[4] one out of three surveyed varieties of *Phaseolus vulgaris* and *Prunus domestica*, one fourth of tomatoes varieties and one sixth of apple trees varieties were reportedly threatened.

Table 2. Number of surveys carried out in Albania per crop/crop group/plant group from January 2012 to June 2014.

Crop/plant group		**Number of surveys**	**Crop/plant group**		**Number of surveys**
String beans	Mashurka	36	Wild Apple	Mollë e egër	1
Pears	Dardha	32	Mulberry	Man	1
Oregano	Rigon	24	Wild pear	Gorricë	1
Apples	Mollë	20	Chamomile	Kamomil	1
Winter savory	Trumëz	17	Lemon balm	Bar blete	1
Wild Plum	Kumbull e egër	13	Peppermint	Menta	1
Pepper plants	Spec (spp. speci)	11	Micromeria	Bishtmiu	1
Tomatoes	Domate	11	Common pink bean	Fasule e larme	1
Perforate St John's-wort	Lule basami	7	Primrose	Agulicja	1
Sage	Sherebelë	6	Field mustard	Sinap	1
Onion	Qepë	5	White-Felted Germander	Bar majasell	1
Plums and sloes	Kumbulla dhe kulumria	4	Maize	Misër	1
Oregano	Rigon i bardhë	4	Goosefoot	Labot i bardhë	1
Thyme	Timus	4	Chickpea	Qiqër	1
Common yarrow	Mijëfletëshi	3	Cantaloupe	Pjepër kantalup	1
Cucumbers and gherkins	Tranguj dhe tranguj të vegjël	3	Muskmelon	Pjepër	1
Broad beans	Plaqi, bathe	3	Okra	Bamje	1
Pomegranate	Shegë	2	Lentils	Thjerrëz	1
Great Yellow Gentian	Sanzë	2	Eggplant	Patëllxhan	1

As per the wild species surveyed, which were mainly MAPs, as much as 31% of them were found threatened.

These rather negative results are even more alarming if we consider that the territory covered by the surveys was a very limited portion of the country rural areas.

[4] "threatened PGRFA" are considered any crops, crop varieties, crop wild relatives or wild food plants which are no longer cultivated or do no longer occur *in situ* in most of their previous areas of cultivation or occurrence.

Table 3. Wild species surveyed and found threatened during 2012-2014

Gentiana lutea	*Primula veris*
Hypericum perforatum	*Salvia officinalis*
Malus sylvestris	*Satureja montana*
Origanum vulgare	*Sideritis raeseri*

2.2 Supporting on-farm management and improvement of plant genetic resources for food and agriculture

On farm management of plant genetic resources in Albania is focused only on some farm demonstrations which are aimed at testing varieties for their production capacities and improved cropping techniques. On farm trails are generally focused on species and varieties introduced from abroad with local varieties used as a control group.

Reported data indicate that on farm management activities have been mainly carried out for local forage varieties (2 local varieties of alfalfa, 2 local varieties of oat) and for leguminous crops (2 local varieties of bean). About 70 farmers were reportedly engaged in these activities during the last few years.

The surveys carried out in the regions with high diversity, show that the area cultivated with local varieties accounts for about 60% of the total crop area of beans, from 25 to 40% of alfalfa, 30% of maize and 50% of the total crop area of vegetables. The data collected shows that there has been no initiative to support activities related to: assessment of farmers' knowledge, characterization and evaluation of local varieties, studies on local varieties population structure, on farm breeding or seed multiplication and distribution of local varieties.

Also the surveys show that there are no activities related with local varieties assessment for utilization and management, or activities for socio-economic assessment of PGRFA on farm management and improvement. In general, the cultivation and multiplication of local crop varieties is part of a tradition preserved in some remote mountainous areas which are characterized by an extensive agricultural system with low mechanization levels and low inputs. The conservation and multiplication of these local crops is made spontaneously by farmers, in general without any support by institutions or specific projects.

In a well-organized PGRFA programme, germplasm should flow roundly from farmers to crop improvement programmes and quality multiplication systems, through *ex situ* conservation facilities, and reach back the farmers as improved seed material. In some cases, whereas locally adapted varieties are needed to reintroduce germplasm that was lost in disaster situations or to simply increase the crop diversity in the farm, the circle can be limited to the farmers and the seed- or field-bank(s). A measurement of this germplasm flow can provide an indication of efficiency of the "PGRFA conservation-use system". Data reported about the germplasm delivered by the National Genebank to farmers, either directly or through intermediaries, indicates a rather limited flow. There are about 3219 seed accessions stored in National Genebank and only 9 accessions have been delivered to farmers during the last three years. These include 3 farmers' varieties of tomato, 2 farmers' varieties of pepper, 1 of wheat, eggplant, alfalfa and oat. The lack of farmers' knowledge about the existence and importance of these

plant material stored in the National Genebank and in the Agricultural Technology Transfer Centers is considered as one of the main reasons for this poor interaction.

2.3 Assisting farmers in disaster situations to restore crop systems

Flooding caused by heavy rainfall events is the most serious and, nowadays, frequent natural disaster occurring in Albania, particularly in the northwest and southwest of the country. During the last three years, these regions have been flooded three times, causing considerable damages to agriculture. In some areas, the flooding lasted 30-40 days causing unrecoverable damages to fruit tree plantations, greenhouses, fodder plants, and of course annual crops. In these cases the government has partly compensated with money the damages suffered by farmers, but according to the information gathered, there have been no initiatives to provide seeds for planting as an aid after disaster situations. Furthermore, a disaster-risk management policy for restoring crop system after disaster situation is presently lacking in the country.

Considerable damages have been caused by prolonged drought and lack of irrigation systems. In these cases the largest damages were caused to vegetable and cereal crops, but despite this, there has not been any supportive initiative for farmers undertaken by the government or other institutions in the country.

Seed import, production and distribution systems are mainly controlled by commercial companies in the country. In case of disasters, the country does not have any specific disaster risk management policy for restoring crop systems that include seed security provisions. In addition farmers' organizations, which are almost inexistent, have so far been unable to provide seed aid for households affected by disaster situations. Currently no assessment is carried out to evaluate the impact of the disaster on farmers' seed systems.

2.4 Promoting *in-situ* conservation and management of crop wild relatives and wild food plants

In-situ conservation in Albania is undertaken in national parks and protected areas, which in total amounts to about 80 thousand hectares. The main function of these parks and protected areas is the preservation of flora and fauna in general, especially the forest flora (trees and shrub species).

In Albania a comprehensive inventory of CWR or WFP occurring in national parks and protected areas is presently missing, and, in general, the management plans of national parks and protected areas do not specifically address issues related to the conservation and management of crop wild relatives and wild food plants. Rough estimations indicate that there are a total of 130 CWR species in Albania[5]. 25 CWR species and 18 WFP species are conserved *in-situ* in protected areas in the country, 14 and 11 of which are in areas with management plans, respectively.

[5] www.cwrdiversity.org

Although national parks and protected areas have management plans, currently, these plans do not address specific needs associated to the CWR and WFP conserved. Nevertheless, the management of these areas indirectly contributes to the preservation of these plant groups.

Also during the past years there have been no activities related to the implementation of management practices, involvement of local communities or implementation of plans to encourage public participation on *in-situ* conservation of CWR and WFP.

2.5 Gaps and needs

Gaps:
Lack of survey and inventory of CWR in National Parks
Lack of survey and inventory of local landraces
Lack of a system for *on farm* conservation in Albania

Needs for CWR:
National strategy that addresses CWR and on farm management
Management plans for CWR in National Parks and Protected Areas
Evaluation of genetic diversity of CWR
Monitoring of genetic erosion
Research and Collection
Strategies
National collaboration

Needs for *On Farm* Conservation
Research
Training of farmers

Based on the above mentioned situation it is needed to undertake some important actions as following:

- Compilation of the list of wild crop relatives and wild food plants which are present in the country.
- Compilation of the list of plant species which need to be conserved *in-situ*. This will serve as a base for further activities on conservation and management of these PGRFA.
- Definition of the list of priority species for *in-situ* conservation, initially evaluating the most threated ones.
- Identification of the appropriate zones as protected areas for *in-situ* conservation of PGRFA
- Revision of the management plans of protected areas in relation to their adaptability toward *in-situ* conservation of plant genetic resources
- Monitoring and identification of local varieties of all crops, which are cultivated by farmers as well as collection of information for their cultivation and usage.
- Promotion of production and distribution of local varieties to be used in on farm conservation.

- Direct and indirect support for on farm conservation as well as measures on processing and marketing of local production out of the local varieties/farmers' varieties.
- Drafting of specific disaster risk management policies for restoring crop systems that include seed security provisions, in order to assist farmers in disaster situations.

Chapter 3. Status of *Ex-situ* Conservation

3.1 Supporting targeted collecting of plant genetic resources for food and agriculture

In Albania, an overall national strategy for collecting and conserving plant genetic resources is currently missing. Nevertheless, a comparison of stored material against the mandate of the National Genebank, as well as historical and geographical references, is periodically carried out for the identification of gaps in the genebank holdings and for undertaking targeted collecting missions to fill the identified gaps that, otherwise, could not be filled by accessing other regional or international Genebanks.

Based on the above methodology, 17 crops which show incomplete geographical coverage have been identified, 14 with missing CWR and 15 with missing historical and/or known farmers' varieties (see Table 4). In addition, urgent needs for the collection of endangered plant species relevant to food and agriculture in areas considered particularly exposed to risks were recently recognized.

Table 4. Gaps in the National Genebank holdings

Crop	Incomplete geographical coverage	Missing crop wild relatives	Missing known historical and/or farmers' varieties	Crop	Incomplete geographical coverage	Missing crop wild relatives	Missing known historical and/or farmers' varieties
Almond		✓	✓	Mulberry			✓
Apple		✓	✓	Okra		✓	
Bilberry	✓			Onion		✓	
Cabbage		✓	✓	Oregano	✓		
Cantaloupe		✓		Parsley			✓
Cherry		✓		Pear		✓	
Chickpea			✓	Pepper		✓	✓
Common bean	✓			Peppermint	✓		
Common yarrow	✓			Perforate	✓		
Cucumber	✓			Plum	✓		
Eggplant			✓	Pomegranate			✓
Fennel	✓			Pumpkin		✓	
Goosefoot			✓	Quince			✓
Grapevine	✓	✓		Runner bean		✓	✓
Leek	✓		✓	Sage	✓		
Lemon balm	✓			Sorrel			✓
Lettuce	✓			Thyme	✓		
Melon		✓		Tomato		✓	✓
Mountain tea	✓			Winter savory	✓		

Notwithstanding the total lack of public funds available to address these needs, during 2009-2014, there have been some collecting activities for these plant species in high risk areas of the country through the support of the FAO project TCP/ALB/3401: 9 surveying and collecting missions have been conducted for fruit trees, 10 for vegetables, and 12 for medicinal and aromatic plants. During these missions, 551 accessions were collected and secured under long-term storage in the National Genebank. Furthermore, 43 *Vitis* accessions were inventoried for future collecting.

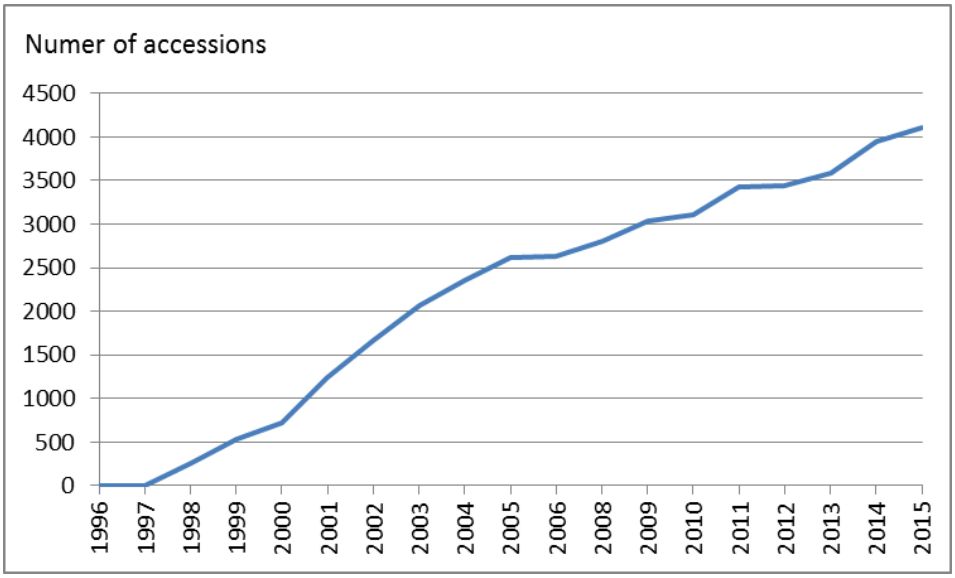
The above mentioned collecting missions covered less than 25% of territory. Due to the limited financial means, it was not possible to fulfill the collections geographical gaps of all the targeted plant species.

3.2 Sustaining and expanding ex-situ conservation of germplasm

The country counts on a National Genebank, which was established in 1998 and is run by the Agricultural University of Tirana. The National Genebank disposes of a long term conservation facility which consists of a dark room with 15 deep freezers with the capacity of storing 4500 seed samples in 8.78 m^3.

During the last years, the country has experienced a positive trend in annual capacity for sustaining *ex-situ* collections. Compared to the year 2010, human and financial resources in the institutions dealing with *ex-situ* conservation four years later were reportedly 8-10% higher; nevertheless, these increases appear insufficient to satisfy all current and future needs. On the other hand over these years there has been a significant and constant increase of the investments in the infrastructure.

Figure 1. Cumulative number of accessions conserved in the national *ex situ* base collections (1996-2015)

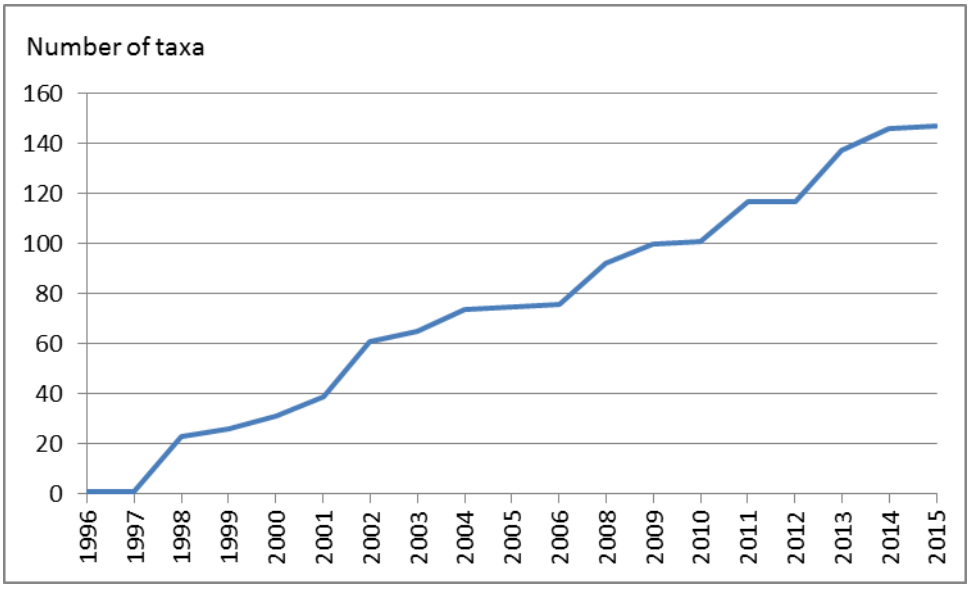


Ex-situ conservation is organized in the form of base collections stored in the National Genebank and in the form of working and active collections that are managed by the five Agricultural Technology Transfer Centres (ATTC). Albanian national inventory of base collections includes a total of 4,105 accessions (see Figure 1). Out of these 3,219 accessions are maintained as seeds under long term conservation at the National Genebank and the remaining 886 are conserved in the field, 614 by the National Genebank and 272 by ATTC Vlora. These accessions of the national inventory represent about 147 different plant species (see Figure 2).

The Albanian working collections are composed of 8000 seed accessions which are maintained in the ATTC Lushnja (mainly wheat, bean and vegetable plants). An accurate inventory of these working collections is missing as documentation of these holdings is overall poor and in most cases either on paper only or scattered and non-standardized in several digital formats.

In order to reduce the risk of introducing duplicate accessions a molecular characterization of stored as well as newly collected accessions may be conducted in particular for the fruit tree germplasm whose cloned materials tend to show different phenotypic characteristics in different environments.

Figure 2. Cumulative number of taxa conserved in the national *ex situ* base collections (1996-2015)



3.3 Regenerating and multiplying ex-situ accessions

Regeneration is an essential operation under the responsibility of the National Genebank which maintains the Albanian base collections of orthodox seeds. Regeneration should take place either to increase the amount of stored seeds in the genebank for individual accessions, which will allow for more distribution of samples if needed, and/or to increase the viability of the seeds above an agreed minimum level or international standard.

According to the germplasm curators there is an urgent need to regenerate the accessions stored in the National Genebank and other public institutions. This is particularly due to the fact that a large proportion of the germplasm stored in the National Genebank was originated from and previously conserved by former agricultural research institutions which no longer exist. These materials which were transferred to the National Genebank more than 12 years ago should be evaluated and regenerated. In fact, they were reportedly maintained in non-optimal conditions by these institutions prior to their transfer and, after it, their germination was never tested.

At present out of the 3219 seed accessions conserved under long term storage conditions in the National Genebank about 10% have been regenerated and about 50% of the remaining accessions needs to be regenerated. No financial provisions are currently available to satisfy this urgent need.

3.4 Gaps and needs

Gaps

Capacity for regeneration in Albanian GenBank and ATTC too

Needs

Increase of facilities in Albanian GenBank and ATTC too
Improvement of management
Collecting and recollecting
Reintroducing and repatriation
Training

- Identification of plant species which are considered as plant genetic resources for food and agriculture[6]
- Support for organization of collecting missions for enrichment of genetic material in conservation.
- An accurate inventory of all *ex-situ* accessions conserved in the state institutions in Albania
- Determination of needs for regeneration, evaluation and multiplication of conserved germplasm in the coming five years.
- Increase the conservation capacities of the National Genebank by at least 20%, compared with actual capacities.
- Introduction of new conservation techniques for PGRFA in the National Genebank, (e.g. cryo-preservation; *in vitro* tissue culture).[7]
- Provision of the necessary equipment's and introduction of marker analyses in the National Genebank.[8]
- Regeneration of all accessions conserved in National Genebank should take place during a five year period, in close collaboration with the ATTCs in order

[6] Why is this needed? This problem has Not been discussed in any previous paragraph – deletion is suggested
[7] Aspect not discussed in the narrative. Are we sure that this would reduce costs to maintain the fields collections? – deletion is suggested
[8] A part from a single sentence, this issue has Not been adequately discussed in any previous paragraph – deletion is suggested – if kept it should be moved to the USE section under the characterization

to take advantage of existing facilities and expertise and reduce regeneration costs

- Increase the annual budget for collection, conservation and use of PGRFA

Chapter 4. Status of Sustainable Use

4.1 Expanding the characterization, evaluation and further development of specific collection sub-sets to facilitate use

Overall the characterization and evaluation of genetic material in storage, is at low levels. With regard to all the national *ex situ* holdings, about 188 accessions of bread wheat, 50 accessions of durum wheat, 104 accessions of maize and 117 accessions of beans and other vegetables have been characterized for 8 to 27 morphological traits. Out of these 459 accessions, during the last five years, 105 accessions have been characterized: 40% belonging to legume crops, 30% to olive cultivars and 20% to tobacco cultivars.

The low level of characterization is caused by two reasons: firstly, needs for characterization and evaluation of germplasm stored in the National Genebank or in active collections in ATTC have not been sufficiently prioritized; and consequently, there has been no financial support to carry out such activities at the required level.

The low level of characterization activities is also reflected on the publications made on this subject: since 2012, 9 publications have been produced for scientific journals of the country and abroad, mainly focused on legume crops, grape and olive cultivars. During the same period there have been no publications for trait-specific collection subsets, nor were core collections developed.

Relatively limited is also the amount of genetic material distributed by the National Genebank in the last four years: 20 accessions have been given to the Faculty of Natural Science, 88 accessions to the Agriculture University of Tirana, 19 accessions to the Novi Sad University of Serbia and 19 accessions to the national genebank of Ukraine. These include 12 accessions of peas, 10 of beans, 40 accessions of oregano, and 21 of alfalfa. No accessions have been reportedly distributed by the National Genebank to farmers or to private companies or to foreign stakeholders.

4.2 Supporting plant breeding, genetic enhancement and base-boarding efforts

Albania is a small market and nearly 80% of the needs for seeds are met by imports. The rest of the needs are met by farmers themselves and some breeding activities. For that reason, during the last 6-7 years, public and private crop breeding programs were very limited and focused on wheat, maize, bean and alfalfa. ATTCs under the responsibility of the Ministry of Agriculture coordinated these efforts which mainly consisted in a simple selection of some local varieties, and were never integrated into a formal plant breeding program. AGROARFA is the only private company carrying out plant breeding in the country. They focus on wheat and maize.

About 20 professional employed at the National Genebank, the Agricultural University of Tirana and the Agricultural Technology Transfer Centers have plant breeding academic background and experience. Nevertheless, as mentioned above, due to the lack of breeding programmes in the country, most of them are currently engaged in activities which are not directly related with plant breeding.

In the private sector about 37 crop breeders by training are employed in companies which deal with the seed and seedling market. As almost all private companies do not have any formal plant breeding activity, these professionals deal with the multiplication of seeds, seedling production, crop cultivation, distribution of planting material to farmers etc.

4.3 Promoting diversification of crop production and broadening crop diversity for sustainable agriculture.

Monocultures and crop production systems, which rely on very few crop varieties, increasingly dominate crop agricultural systems. The lack of diversification in these systems may increase their vulnerability to yield losses due to pests, diseases and abiotic stresses. Agricultural systems with a broader range of crop varieties and species are overall more stable and resilient to climatic vagaries.

Few small-size projects promoting diversification of crop production and broadening crop diversity have been implemented during the last three years by the Ministry of Agriculture and its ATTCs. Activities carried out in the context of these projects, have mainly aimed at the evaluation and multiplication of local varieties of grasses and legume forages.

No studies have been reported on assessing/monitoring crop diversity and/or intraspecific diversity in crops in the agricultural systems of the country. Such studies could assist to develop a strategic actions to reduce the vulnerability of the agricultural systems.

In relation to new crops or wild species introduced into cultivation, 5 new plant species have been introduced from abroad, 3 of which are used as rootstocks, and few hectares of wild *Lotus corniculatus* have been introduced into cultivation.

4.4 Promoting development and commercialization of all varieties, primarily farmer's varieties/landraces and underutilized species

In production systems oriented to large markets, a few crops provide for a large proportion of the consumer needs. However, many more species, including farmers' varieties/landraces of both major and minor crops, are still used by farmers and local communities to meet local demands for food and enrich their diets. These varieties may have potential for wider use, particularly in breeding, and could contribute significantly to sustainable livelihoods through improved food and nutritional security, income generation and risk mitigation.

In Albania, the on-going transformation of the agricultural systems is progressively leading to the marginalization of locally adapted varieties, including farmer's varieties/landraces and

underutilized species. Without a policy to study and promotes development and commercialization of locally adapted varieties and minor crop species the risk of losing these materials and the opportunities associated with them increases.

During last 5-6 years, there has not been any program, project or activity promoting development and commercialization of farmers' varieties/landraces or underutilized species. The only research reported on farmers' varieties/landraces or underutilized species are some yield comparative trials for local crops such as alfalfa and common bean which have carried out by the Agricultural Technology Transfer Centers.

Despite the absence of policies, programs or projects to support such activities, experts indicate that there is potential for commercialization for more than 20 underutilized crops and species and for more than 80 local varieties. However, activities for their characterization and evaluation, crop improvement, postharvest processing, and seed multiplication are either on a planning stage or absent.

4.5 Supporting seed production and distribution

Private companies account for about 95% of the seed produced and distributed in the country, the remaining 5% is carried out by ATTCs, which produce a quantity of wheat and hybrid maize seed and fruit tree seedlings.

The number of seed enterprises has been increased from year to year and based on the data obtained from National Seed and Seedling Institute, which is the official institution responsible for controlling the production and certification of seeds and planting materials, 14 legal subjects are presently registered. The private enterprises, which mainly deal with import and marketing of seeds, introduce every year new species and varieties and sell them to farmers. According to the Official Catalogue of Species and Varieties, during 2012-2015, 306 new varieties were registered, 27% of these were maize hybrids, 16% tomatoes, and 9% cucumber varieties. All new released varieties were improved varieties introduced from abroad.

The 5 most widely cultivated annual crops are alfalfa, wheat, maize, vegetables and common beans. Cereals, vegetables and alfalfa are dominated by imported varieties, while common bean is dominated by local varieties. In 2012, above 80% of the seed used for maize and vegetables was certified and almost all introduced from abroad; while for wheat only 19% of crop area was sown with certified seed, 40% of which was imported. In the case of common bean the local varieties are sown with farmer saved seed of uncertified quality. This is also the case in many marginal and mountainous areas sown with local varieties of alfalfa, maize and bean which are not easily accounted for in the statistics.

Law No. 10416, dated 7.4.2011, on sowing and multiplication of plant materials determines the basic criteria for production and marketing of the seeds and seedlings in the country. The law is implemented with the Ministerial Decree DCM No. 86, dated 30.1.2013 on criteria of marketing, certification and testing of varieties of cereal seeds. This legislation is constantly amended and updated in conformity with EU legislation and regulations. At present in Albania there are no

specific policies related to the production and distribution of seeds which form part of a comprehensive strategy for seed and plant genetic resources.

4.6 Gaps and needs

- Prioritization of needs for assessment and characterization of germplasm stored in Genebank or in active collections in agricultural technology transfer centers.
- Increase the financial support to carry out such activities at the required level.
- Increase the public awareness on the importance of plant genetic resources, mainly local varieties, to be used by farmers.
- Increase the financial support for plant breeding programmes, which include local varieties, crop wild relatives and wild food plants.
- Increase the institutional coordination between stakeholders, which deal with plant breeding, seed production and distribution in the country.

Chapter 5. Status of Institutional and Human Capacities for PGRFA conservation and use

5.1 Building and strengthening national programmes

A number of stakeholders contribute to the conservation and sustainable use of PGRFA in Albania from the private and from the public sectors. In many cases and opportunities these stakeholders, particularly those belonging to public institutions, have worked together, frequently complementing each other's. They did it without a framework agreement or a mutually formulated and agreed plan, in other words a strategy, which could focus one or several problems and identify practical and feasible actions to address and solve them.

Currently in Albania, is also lacking a national entity with an advisory or even coordinating role for PGRFA activities. Such a coordinating entity in many countries takes the form of a national committee, a representative body with combined expertise to cover the different aspects of the management of PGRFA which usually derive from existing institutions and processes. A core team from existing key institutions could be appointed to coordinate and drive the preparation of the strategy.

The strategy is generally drafted based on an assessment on the state of PGRFA the preparation of which has involved the widest array of stakeholders and all aspects of the PGRFA continuum, from conservation, through use to seed delivery have been covered.

Since many years the country has also been active and benefited from collaboration at regional and international levels, including within the European Cooperative Programme for Plant Genetic Resources (ECPGR) and to the International Treaty on PGRFA, where a National Focal

Point from the National Genebank of the Agricultural University of Tirana, is appointed to represents the country.

5.2 Promoting and strengthening networks for plant genetic resources for food and agriculture

Albania is member of the European Cooperative Programme for Plant Genetic Resources (ECPGR) and has a representative in all Working Groups which operate in the framework of this programme. Also the country is an active contributor to the FAO World Information and Early Warning System on Plant Genetic Resources (WIEWS), the European Search Catalogue (EURISCO), the South East European Development Network (SEEDNET), and the Genebank Documentation System (SESTO).

Currently the country has two networks in which the national stakeholders are members: the Innovation Research and Agriculture Consultation Network which includes all the Agricultural Technology Transfer Centers that deal with plant genetic resources and the advisory service offices in some region of the country; and the Plant Genetic Resources Centre which includes state institutions, private companies and farmers who are interested in crop improvement.

Regarding the number of publications produced by national stakeholders, within the framework of networks, the information shows that during the last four years there were about 20 publications in total. These publications have been focused on genetic diversity of landraces, assessment and evaluation of morphological traits for some crops, chemical diversity among some aromatic plants, etc.

5.3 Constructing and strengthening comprehensive information systems for plant genetic resources for food and agriculture

Notwithstanding the importance given to *ex situ* conservation in Albania, to date none of the national institutions involved in these activities use a database management system which makes use of the internet technology for handling and sharing the associated information. Passport data on *ex situ* collections (4105 accessions) are accurately managed through spreadsheets and are accessible on the internet through the Albanian Genebank Database under the Plant Genetic Resources Center web site[9], as well as regional or international publishing systems, namely EURISCO, the on-line catalogue of the European network of *ex situ* National Inventories, and the FAO World Information and Early Warning System on PGRFA (WIEWS).

With regard to *in situ* holdings, in particular crop wild relatives and wild food plants, no information system is being used to document, map or monitor these resources. The only possible source of information about crop wild relatives in the country is the Crop Wild Relatives portal,[10] which publishes the Harlan and de Wet CWR Inventory, and the Albanian Genebank Database, which reports their passport information only.

[9] www.QRGj.org
[10] www.cwrdiversity.org

Although there are a number of farmers' varieties cultivated spontaneously *on farm*, these varieties are not fully identified and documented in any publicity available information system. During last 6-7 years, 95 accessions were characterized. These data are however not accessible through the internet.

The number of improved varieties released since 2012 were reportedly 306 in total. These varieties are registered only in the official catalogue of the National Institute of Seeds and Seedlings. They can be accessed under the Plant Genetic Resources Center web site.[11] The main international system of information for PGRFA in which Genebank is more active, is EURISCO Catalogue which is frequently updated.

5.4 Developing and strengthening systems for monitoring and safeguarding genetic diversity and minimizing erosion of plant genetic resources for food and agriculture

Genetic erosion is a complex phenomenon which occurs in genebanks, in the wild and in farmers' fields. During the past years even with the application of molecular techniques, it has not been possible to clearly define its magnitude.

In many countries rich of diversity, like Albania, the extent of genetic erosion is a cause of particular concern. The international community has in many occasions tried to identify practical, effective indicators and techniques to monitor genetic diversity, which once applied could provide a comparative baseline against future measurements. Nevertheless, no direct and effective indicators have been made available so far.

The importance of monitoring and safeguarding genetic diversity and minimizing PGRFA erosion is also reflected in the Second Global Plan of Action for PGRFA.[12] Priority activity 16 of the Second Global Plan of Action recognizes the complexity of the phenomenon and calls for the implementation of several approaches or mechanisms, not only *one system*.

The monitoring framework of the implementation of the Second Global Plan of Action and its indicators, as adopted by the FAO Commission on Genetic Resources for Food and Agriculture and successfully applied for the first time in Albania through the FAO project TCP/ALB/3401, can be one of these approaches and contribute to an indirect assessment of the extent of PGRFA erosion if periodically updated. This monitoring framework has the advantages to focus on the different aspects of PGRFA conservation and management *in situ*, *ex situ* and on farm, and of being periodically reviewed by the FAO Commission. Similarly, it sets up a mechanism for reporting through the key stakeholders which daily work with PGRFA conservation and use, the national *in situ* and *ex situ* conservation system. Such an inclusive networking mechanism that facilitates a periodic flow of information represents the essential basic structure of any effective monitoring system.

[11] www.QRGj.org
[12] www.fao.org/wiews

International cooperation in researching improved methodologies for surveying *in situ* and on farm PGRFA and the development of direct, practical and informative indicators of genetic erosion or genetic diversity, as well as the revision and improvement of the current monitoring framework are nevertheless required to further advance in this priority.

5.5 Building and strengthening human resource and capacity

During last five years there has been an increase in human resource and capacity in the area of PGRFA together with new academic opportunities. In the post-graduate curricula of the Agricultural University a *Master of Science* on management of plant genetic resources, as well as a *Philosophical Doctorate* programme on PGR, organized by the Department of Plant Sciences and Technologies, have been recently introduced.

Regarding the professional staff actively engaged with PGRFA conservation and use activities, a total of 28 people are presently working in the National Genebank, Agricultural University, and at the ATTC of the Ministry of Agriculture.

During the last five years, 9 professional staff have completed their PhD programme and 34 have attended short courses and seminars on PGRFA related subjects. Within the same timeframe, a total of 41 students have completed their MSc programs in the Department of Plant Sciences and Technologies of the Agricultural University of Tirana.

5.6 Promoting and strengthening public awareness of importance of plant genetic resources for food and agriculture

Albania lacks a formal public awareness programme for promoting PGRFA conservation and utilization, however a number of activities and events that took place in last 6-7 years contributed to promote the conservation and sustainable use of PGRFA and to raise public awareness about their value.

During this period two symposia focusing on plant genetic resources were held with participation of experts, private companies and other groups of interest. In these symposia discussions focused inter alia on issues related to the promotion, preservation and management of these resources. The Regional Workshop for Europe on the *Update of the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture*, was organized in 2010 by FAO in collaboration with the Faculty of Agriculture and Environment, Agricultural University of Tirana, and Biodiversity International.

In 2014, the 8th Conference on Medicinal and Aromatic Plants of Southeast European Countries was held in Durres. The conference was organized by the Agricultural University of Tirana, the Albanian Academy of Science and the Association for Medicinal and Aromatic Plants of Southeast European Countries. It gathered 320 local and international experts and researchers from over 40 countries of Europe, Africa and Asia.

All these activities had wide media coverage and served to drive the attention of the public opinion and policy makers to the importance of these resources.

Public awareness campaigns are nevertheless periodically needed to maintain high the attention of direct stakeholders and final beneficiaries on the importance and value of these resources and the conservation and sustainable use activities associated with them.

5.7 Gaps and needs

Gaps:
National coordinating PGR structures- national committee
Germplasm documentation systems accessible and used by all institutions
Capacities and qualified staff in all institutions appear insufficient

Needs:
Improved national and international relations
National PGRFA strategy and policy
Develop national coordination
Develop national networks
Public-private sectors and NGOs collaboration
Training and education at different levels and within different fields
Publication and facilitated access to characterization and evaluation data of all accessions
Period public awareness raising campaigns

Recommended actions:

- Development of a national strategy/ national strategic plan, for conservation and sustainable use of plant genetic resources for food and agriculture, associated with an action plan and the necessary financial costs, needed for implementation.
- Promote the public awareness of importance of plant genetic resources for food and agriculture.
- Provision of training courses of the entire staff involved in conservation and management of plant genetic resources.
- Developing of systems for monitoring and safeguarding genetic diversity and minimizing erosion of PGRFA.
- Establishment of a national entity or a national committee for the coordination of all activities related with conservation and use of PGRFA.
- Completion of the necessary legal framework on conservation and utilization of PGRFA