CURRENT POLITICAL COMMITMENTS' CHALLENGES FOR *EX SITU* CONSERVATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Abstract. This article is an overview regarding capacity building needs for supporting political commitments' implementation and furthermore, the development of new political, technical and scientific measures for ensuring the proper conservation of biodiversity and considering in a cost-effective way *ex situ* conservation tools and methods. Domesticated and wild species, threatened and not threatened native species belonging to the natural capital, due to anthropic pressure and climate change may be drastically affected for their status of conservation in their ecosystems of origin. Thus, *ex situ* conservation is important to be taken into consideration for ensuring the proper conservation of native species. Still, *ex situ* conservation is a tool which is in use for many activities for many years such as: research, trade, industry, medicine, pharmaceuticals and agriculture. Romania needs to further develop its specific legislation framework in specific domains such as trade of exotic and native threatened species as well as for other domains such as zoos and aquaria, seeds exchange between botanical gardens, bioprospecting, wild threatened species rescue, capture and reintroduction, collection, access for benefit sharing. Also for agriculture should be developed *ex situ* conservation measures closely connected with breeding programmes dedicated to plant genetic resources for food and agriculture (i.e. gene banks conservation, breeding programmes, *on farm* conservation). Only by harmonizing at the legal level, based on science, all these specific domains, extremely sensitive, dealing with *ex situ* conservation it will be possible in the future to secure food and ecosanogenesis ensuring the appropriate status of *in situ* conservation of biodiversity as a whole. As it is not possible to apply conservation measures, either *in situ* either *ex situ* either both, to all species it is appropriate to further develop strategic tools for prioritizing our efforts in a cost effective manner.

Keywords: agrobiodiversity, *ex situ*, crops, *on farm* conservation.

INTRODUCTION

The *ex situ* conservation concept was developed for the first time in 1958 by Cugnac [8], long time before its official adoption under the Convention on biological diversity signed in 1992 in Rio de Janeiro, Brazil. Exotic species have been adapted to new conditions for commercial or educational purposes for many centuries. During the last decades, *ex situ* conservation methods for plants animals and microorganisms proved to act as valuable tools in studying and preserving these biological resources for different purposes. In agriculture, exercising wild plants domestication and cultivation or wild animals breeding represent common attempts for domesticating species applied from the beginning of our civilization. As a consequence, an important part of wild biodiversity become part of our today products and services and due to further pressures on biodiversity generally speaking it become compulsory to find ways and means for ensuring its conservation through *in situ* and/or *ex situ* methods. Such issues have been promoted from the science level up to the highest political agenda during '80 and by now they are covered by the Convention on biological diversity and almost all conventions targeting biodiversity. Thus, according to the provisions of art. 2 of the Convention, *ex situ* conservation means the conservation of components of biological diversity outside their natural habitats [34] and it is targeting all levels of biodiversity such as genetic, species and ecosystems. According to the same article's provisions, *biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*. To this definition during the Conference of the Parties it was also added the ethnical value of biodiversity including tradition and traditional knowledge belonging to indigenous and local communities. Thus, today, at the political level, biodiversity is considered as a very complex concept where human being exists into and is in connection to and with biodiversity which defines their identity. Furthermore, this article is trying to answer the question why do we need *ex situ* conservation for agrobiodiversity and underline the need to adopt a strategy in this regard also considering the provisions of art. 9 of the Convention, which states that this is mainly necessary in relation with *in situ conservation of biodiversity, as a complementary way for succeeding in the process of biodiversity conservation*. Therefore, each Party at national level should develop the appropriate capacity building required for this scope and further it should develop tools and methods for finding the best balance between *in situ* and *ex situ* conservation for ensuring the optimal status of conservation of genetic resources, species and ecosystems. We need to underline that it is a must that this balance should includes cost-effective assessments. The main scope of this article is to emphasis the need for implementing a coherent policy and legal framework regarding *ex situ* conservation in direct connection with *in situ* conservation or *on farm* conservation and coherently and consistently implemented with the breeding programs for ensuring food security and ecosanogenesis.

MATERIAL AND METHODS

This paper is a review regarding capacity building needs for *ex situ* conservation of biodiversity in Romania considering international political commitments and the national legal framework. Therefore in our assessment we studied political papers, international decisions under international agreements such as Convention on Biological Diversity and Plant Treaty on the subject of agricultural biodiversity and also relevant scientific papers. It was applied the Albert Humphrey' SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) regarding the national legislation looking especially to the negotiation language for international use.

RESULTS

Romania ratified the Convention on biological diversity (CBD) through the Low 58/1994. Thus, our country recognized the scientific evidences supporting the adoption of art. 9 of the CBD underlying the main provisions for *ex situ* conservation. Still, the provisions of art. 9 are legally binding commitments, through which each Contracting Party *shall, as far as possible and as appropriate, and predominantly for the purpose of complementing in-situ measures to adopt specific measures*. This means political, legislative and technical measures – scientifically supported and covering all types of activities in which biodiversity is directly involved. As a consequence it is obviously that such a target will not be reached without a coherent and integrative research programme at national level and harmonized at regional level.

At the political level, among the five measures provided by the Convention we would underline the significance of the second regarding the obligation to (b) *establish and maintain facilities for ex-situ conservation of and research on plants, animals and micro-organisms, preferably in the country of origin of genetic resources*. In other words each contracting Party is committed to adopt *ex situ* conservation measures meant to preserve – as a secondary tool – *in situ* biodiversity when scientific evidences are requiring this in promoting the cost-effective implementation of the provisions of art. 9. Moreover, *ex situ* conservation is further supporting biodiversity development for other needs through biotechnology according to the provisions of art. 8 g and 19 of the Convention.

Thus, based on an inventory of all species – which is compulsory under the provisions of Annex I of the Convention each Party should know the trend of the status of conservation of biological diversity according to the Strategic Action Plan adopted by the Conference of the Parties. In other words it is important to know and monitor the trends of biodiversity and to ensure the optimum conditions for its conservation either *in situ* either *ex situ* either both.

In case this biodiversity trend is negatively influenced, due to different drivers and pressure, than this Party should *take appropriate actions and facilitate ex situ conservation through research programmes* and according to the next paragraph of art. 9 (c) *to adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions*. We need to underline that a cost effective assessment study should be also realized in order to maintain the best balance between *in situ* and *ex situ* conservation based on the provisions of art. 18 of the Convention [10].

Summarizing, all Parties should be aware that they should identify the most cost-effective approach and methods to describe the status, trends and threats for biodiversity using specific indicators and applying specific standards. generally accepted at international level.

For biodiversity, as a general concept and particularly for wild biodiversity, strategic indicators have been developed and adopted earlier during '90 at international level and today they are well expressed through the Streamlining European Biodiversity Indicators [32] at the European level, developed under a project started in 2005 which are under continuous development. These technical indicators are dedicated for wild biodiversity and also for agriculture, waters, intellectual properties rights, traditions – all components of biodiversity in close connection with social and energy indicators. Almost each Western European country, based on specific national requirements further developed these technical indicators and adopted the national indicators up to a media of 100. Still, Romania needs to further develop its own national indicators based on the peculiarities of the country and applying a bottom up approach science based.

Similar methodologies for developing such a range of indicators have already been developed at the European Union level for assessing the status of agrobiodiversity too – the so called domesticated biodiversity.

In the context of the Plant Treaty (International Treaty on Plant Genetic Resources for Food and Agriculture), agrobiodiversity as part of biodiversity as whole as it is defined by the Convention on biological diversity, is considered in close relationship with the adopted FAO [6] in 2004 and published in 2005 as *being the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems.*

Thus, through the adoption and ratification of the Plant Treaty, new definitions and concepts have been

agreed at political level and adopted as such for crop variety, landrace, *ex situ* collection, centre of origin and centre of crops diversity, etc. These concepts, scientifically based, should also be accepted by the scientific community for further supporting the Plant Treaty implementation. Their acceptance are adding value in the process of further decisions adoption under the Conference of the Parties of the Convention on biological diversity as well as of the Plant Treaty. A specific legally binding requirement under the Plant Treaty is in relation with art. 5.1 which addressed the Contracting Parties for *promoting an integrated approach to the exploration, conservation, monitoring and sustainable use of plant genetic resources for food and agriculture*. However such legally binding provisions are imposing to the Parties the need for efforts prioritization considering thousands of crops' varieties existing and in the same time according to art 5 b), each *Party shall be involved in promoting the collection of plant genetic resources for food and agriculture and relevant associated information on those plant genetic resources that are under threat or are of potential use*. Thus, standards should be in place at national level for creating the appropriate framework for implementing in a coherent manner the provisions of this article. Descriptors already developed at international level for describing best a crop should be used by the scientific community working with these genetic resources and applied accordingly.

As well as in the case of wild biodiversity where the status of conservation is assessed according to the International Union for Conserving Nature' methodology [21], generally accepted and validated at international level – quantifying the status of conservation of crop varieties and landraces should be appropriate assessed for prioritizing our efforts in a cost effective manner dedicated for the conservation and sustainable use of crops and some principles in developing a theoretical methodology are already published [1].

We should mention that before the adoption at the global level of the Plant Treaty, the Food and Agriculture Organization already established the Intergovernmental Commission on Plant Genetic Resources in 1983, renamed in 1995 as the Commission on Genetic Resources for Food and Agriculture (CGRFA) which currently comprises 160 countries plus the European Union. As a highly professional committee the CGRFA coordinates, oversees and monitors the development of the Global System for the Conservation and Utilization of Plant Genetic Resources for Food and Agriculture, which is comprised of the Commission itself and the non-binding (International Undertaking (IU) [14], the Global Plan of Action (GPA), the International Fund for Plant Genetic Resources, the World Information and Early Warning System, Codes of Conduct and Guidelines for the Collection and Transfer of Germplasm, the International Network of *Ex situ* Collections under the auspices of FAO, and the international network of *in situ* conservation areas and crop-related networks. Thus, the national obligations under the Plant Treaty are high and international standards are already in place. Also we underline that *ex situ* conservation for agrobiodiversity is extremely important for ensuring food security in a changing world.

At the global level in 1996 at the 4th meeting of the ITCPGR the document ITCPGR/96/3 was adopted [31], as the first worldwide assessment of conservation and sustainable utilization of the world's plant genetic resources based on national reports of 154 countries. This report underlined among others the need for adequate conditions into *ex situ* collections and the need to strengthen links between breeders and farmers for avoiding crops genetic erosion, all based on scientific evidences. Under the Global Plan of Action the working group discussed in 1996 different issues in connection with *ex situ* conservation such as *ex situ* collections, threatened *ex situ* accessions, planned collecting of PGRFA and expanding *ex situ* conservation [30]. Still up today no methodology was developed for assessing the status of conservation of crops varieties and after more than 15 years it is still of high actuality the results of this report. The third group, "Utilization of plant genetic resources" contains specific priorities targeting the further development of plant genetic diversity. We may underline that under this topics a series of postdoctoral projects are supported in our country by the European Social Fund, through the Human Resources Development Operational Programme 2007-2013, the project POSDRU/89/1.5/S/63258 Postdoc School for Zootechnical Biodiversity and Food Biotechnology based on Ecoeconomy and Bioeconomy Required by Ecosanogenesis [3, 4, 8, 18, 20, 23-27]. The fourth group, "Institutions and Capacity Building," contains specific priorities in supporting the Parties for the best approach for capacity building in this domain. Our country needs to further develop its own institutional capacity in this regard and a special consideration should be paid too for plant genetic resources for food and agriculture.

On the other hand noting that in 2004 during the 10th meeting of the CGRFA [28] it was discussed among others the Animal Genetic Resources (AnGR) - Global Strategy and the need for extra-budgetary financial resources, particularly for capacity building and further development of information systems, it become clear that also animal genetic resources should be under conservation and breeding programmes too at national level. One year later under AnGR Sept 2007 at the 1st Conference addressed the prioritizations for a strategic plan [15].

Bali declaration adopted during 2011 under the Plant Treaty gave a special attention to climate change adaptation and mitigation measures development and implementation in agriculture and also emphasizes the need for *ex situ* and *on farm* conservation giving a very important role to farmers and smallholders and to the need of connecting to scientists for the achievements of the Treaty goals [2].

Once standards are generally accepted and established for *ex situ* conservation another important domain to be assessed should be trading. Wild and domesticated species as "specimens" are the subject of trade and specific requirements are in place for endangered species. Under these circumstances another very important international multilateral environment agreement is the Washington Convention adhered by Romania through the Law 69/1994 [9]. Washington Convention known as the CITES Convention is treating differently the *ex situ* conservation issue being preoccupied rather on captivity for trade or non-trade purposes and also is taking into account species of high interest for agriculture. We may add that during COP11 (10-20 April, 2000) of the Washington Convention have been underlined difficulties in compiling a list of animals bred in captivity for commercial purposes, and recommended listing species of critical conservation concern, all in relation with the *ex situ* conservation similar with those covered by the CBD. During the COP12 (3-15 November, 2002) discussions continued on topics related to Registering Captive Breeding Operations for plants and for animal bred in captivity. Also maybe for the first time it was raised the issue of criteria for captive facilities [11].

Standards for animal breeding are defined under CITES such as: zoological institutions, education centers, rescue centers and captive-breeding centers in accordance with CITES. Such discussions regarding the registering of the captive breeding operations continued during COP14 (3-15 June 2007) deciding the need for review of the CITES – listed plant taxa, selection of species, reiterating the collaboration with the Convention on Biological Diversity (CBD) on the Global Strategy for Plant Conservation. Also during the COP 14 of the Washington Convention it was adopted the report prepared by Ireland regarding the relationship between *ex situ* production and *in situ* conservation [28, 29].

Considering again the Convention on biological diversity, during the first COP it was also addressed the issue related to the *ex situ* conservation when it was discussed if this subject should or not referred to the genetic resources before being treated by the Convention under other international instruments [16]. These debates continues almost during all Conferences of the Parties to the Convention and now it is generally agreed that this should addressed only genetic resources not covered by the instruments already covered by the FAO's agreements.

The *ex situ* conservation topics is really broad and it links with different other topics such as [i] agricultural biodiversity conservation, [ii] enters into direct conjunction with the development of the future access for benefit sharing international regime and in relation with [iii] the traditional knowledge addressed by the art. 8 (j) of the Convention and also by the Plant Treaty.

To note under the same topics at the 4th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (June 1999) it was discussed *ex situ* collections acquired prior to the entry into force of the Convention and not addressed by the CGRFA [30, 36], noting that the Executive Secretary's invitation for input had resulted in information from five international bodies: FAO, IPGRI, Botanic Gardens Conservation International (BCGI) [5], International Species Information System (ISIS) [19], and World Federation of Cultural Collections (WFCC) [37]. During the COP8 of the Convention on biological diversity, important issues have been addressed again such as pets, aquarium species, live bait, live food and plant seeds, biocontrol agents; *ex situ* animal breeding programmes and modalities for facilitating the use of genetic material stored in *ex situ* gene banks.

DISCUSSIONS

Considering the above international political commitments and international legal framework we will try to underline some important issues in relationship with *ex situ* conservation of agrobiodiversity in our country. It is important to underline that Romania implemented at different level *ex situ* conservation measures addressed either by the Convention on biological diversity either by the Plant Treaty or by the Washington Convention or even by other relevant international instruments. Different political programs are covering the environmental and agricultural policies which unfortunately are not well imbricate and therefore different overlaps or gaps exist. It is well known that at the European Union level, different projects have been implemented in supporting plant conservation. Based on the European Policy different institutions are in charge with seeds *ex situ* conservation such as The European Native Seed Conservation Network (ENSCONET) and the Millennium Seed Bank at the Royal Botanic Garden Kew. Moreover, the Botanic Gardens Conservation International (BGCI) is assessing information on living plant collections in Europe, available through the Plant Search website and is compiling a consolidated list of threatened European species as a step towards a formal European Red List. The EURISCO database holds data on national inventories of *ex situ* holdings of plant genetic resources [13]. Romania is represented in EURISCO by the Gene Bank from Suceava which should be part of the national strategy for *ex situ* conservation and should be involved by the Ministry of Environment in issues such as traditional knowledge, biotechnology, local communities, plant genetic resources under the Convention on biological diversity.

Also at the European level actions are politically supported to be taken for adaptation and mitigation to climate change with special focus on species particularly threatened by the effects of climate change which should be identified and assessed for the need of their inclusion into *ex situ* collections. Also, species storage and restoration measures should be implemented by evaluating on own hand existing *ex situ* collections and other needs in order to improve their conservation status and benefit by evaluating the

quality of associated data (e.g. provenance). Priority should also be given to threatened species with little information on their ecology, biology or conservation status.

Conservation actions and research should be taken through promoting tested methods for *ex situ* conservation, research and re-introduction case studies (e.g. cryopreservation of bryophytes at Royal Botanic Garden Kew, latest research on seed containers and standards of seed preservation). Therefore, for crops the European Standards already adopted through EURISCO are officially adopted in the Gene Bank from Suceava. Still other gene banks belonging to research institutes or universities are functioning today but there are not officially adopted standards according to the international requirements adopted at the European level.

By adopting such standards already developed by the EURISCO which has the mission to provide a web catalogue receiving data from the national inventories, and provides access to *ex situ* plant genetic resources information in Europe is of outmost importance [12]. In this regard, the EURISCO standards' requirements for seeds *ex situ* collections from gene banks are listed into the web site and are grounding the quality and consistency of the data. It also should be mentioned that the taxonomic support is essential (i.e. classical and molecular taxonomy), to provide in the best cost-effective way a clear identification of taxons in the *ex situ* collections [35]. Thus, the methods should be standardised and harmonized for official recognition and an equilibrium should be reached between classical and molecular taxonomy based on scientific and economic valuation on a case by case basis.

The need for *ex situ* conservation in agriculture in our country is supported by the fact that in the last 20 years at least 457 varieties, created by the public research have been erased from the Official Catalogue for varieties and hybrids from 1989 and an important number of varieties or hybrids are not recognized as being erased for the Catalogue before 1990. Also, there are no official specifications regarding their including into conservation programmes either *ex situ* either *on farm*. We would mention that two varieties of maize registered before 1989 are still cultivated (Lovrin 400 and Turda 200) proving their value also for the famers. We have to mention that the Romanian scientific community was interested in surveying maize local population starting with 1970 when it was revealed that at least 3500 different maize landraces are maintained *on farm* [22]. Based on these historical date became clear that farmers have a great impact in maintaining old cultivars and may support the maintenance of valuable plant genetic resources in a cost-effective way. By now such surveys are not higlhly coordinated at the national level even they exist. During our missions we revealed in Sibiu county some old maize landraces (e.g. Lăpuşneac) not existing into the Official Catalogues for varieties and hybrids starting with 1986 but which is considered by local communities as a valuable plant genetic resource (fig. 1). Regarding the crop's breeding research it is more clear that lot of research institution still keep under *ex situ* collections old varieties for further breeding experiments and also for fundamental research. However, at the national level it is not a coherent official crops' breeding and conservation programme in place in order to ensure that all plant genetic resources for food and agriculture are well preserved in the best cost-effective way for ensuring food security.

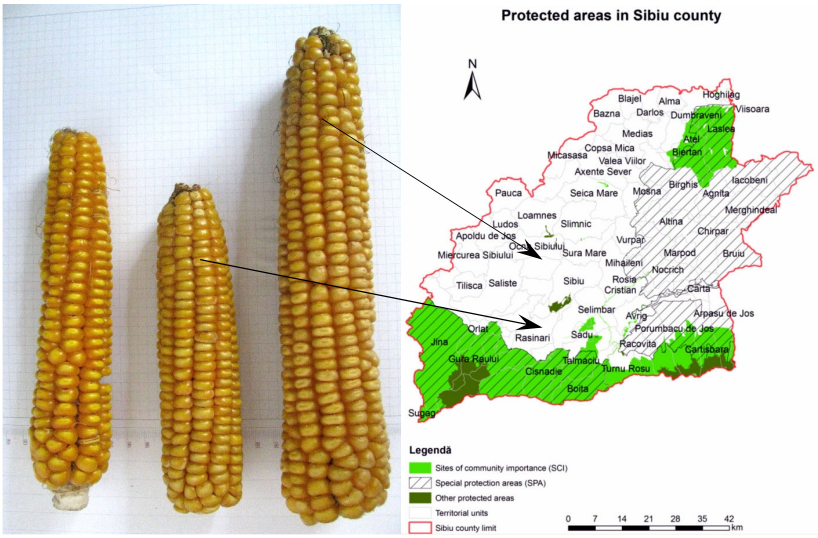

Figure 1. Maize landraces collected from Sibiu county. In the left side is Lăpuşneac local population.

Based on our surveys conducted in Sibiu County and also compared with the official and scientific literature, we are advancing the idea that crops diversity suffered in the last 60 years in Romania, five major shifts causing and official crops genetic erosion process as following:

1. Before 1958 -1962 which is the year of forced communist collectivization and characterized mainly by the presence of crops landraces not highly productive but well managed by the small landholders and also some new crops varieties as a result of

scientific breeding programmes research started after 1927 [17].

2. Between 1962 and 1989 when old landraces have been replaced in force by new crop varieties, based on a national agriculture reform in supporting the intensive agriculture. During that period an impressive national network of research institutes was developed which created varieties and hybrids for almost all important crops for our country.

3. Between 1989 and 2004 when the market place shits from the communism to democracy, when plant genetic resources for food and agriculture have been massively cancelled form official catalogues.

4. Before entering into the European Union, between 2004 and 2007, Romania negotiated the list of crops varieties for complying with the European Union legislation already in place and proposed for cancellation crops varieties without considering the need for their conservation either on farm either ex situ.

5. After 2007 as a European member state Romania should comply with the provisions of the Directive 53/2002 regarding crops genetic resources. Unfortunately, Romania took no measures for the conservation either *ex situ* either *in situ* of crop varieties even some of them are still valuable plant genetic resources for the Romanian scientists. Article 20 of this Directive states at the point 2 that without prejudice to Council Regulation (EC) No 1467/94 of 20 June 1994 on the conservation, characterization, collection and utilization of genetic resources in agriculture (1), specific conditions shall be established in accordance with the procedure referred to in Article 23(2) to take account of developments in relation to the conservation *in situ* and the sustainable use of plant genetic resources through growing and marketing of seed of landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion. At the paragraph 3 of the same art specific provisions targets landraces and varieties that are compulsory to be accepted in accordance with the provisions of this Directive. Actually this article' provisions are in line with UPOV regarding their acceptance in particular the results of unofficial tests and knowledge gained from practical experience during cultivation, reproduction and use and the detailed descriptions of the varieties and their relevant denominations, as notified to the Member State concerned, shall be taken into account and, if sufficient, shall result in exemption from the requirement of official examination. Upon acceptance of such a landrace or variety, it shall be indicated as a 'conservation variety' in the common catalogue.

Based on these results we consider that it is a must that Romania should take care of its own plant genetic resources for food and agriculture as part of agrobiodiversity for securing food.

As a consequence we consider that it is a important for our country to adopt a methodology for red listing crops varieties in avoiding other shifts in the evolution of our crops diversity due the transition of economy which will contribute to domesticated species conservation either *in situ* (on farm) either *ex situ* (in gene banks) for ensuring food security and further use in crop's breeding. We underline that these results are supporting the idea that genetic erosion in crops is highly influenced by the historical transitions periods at the country level and therefore adopting a red list will provide grounds in supporting food security and ecosanogenesis [1, 4].

Romania should promote and adopt a strategy for *ex situ* conservation closely connected with *in situ* conservation in supporting the positive trend of biodiversity status of conservation. In this regard for agrobiodiversity the infraspecific level should be monitored in our attempts of preventing and limiting genetic erosion and securing *on farm* conservation of endangered crop varieties and landraces as well as livestock.

The *ex situ* conservation strategy should cover wild species, domesticated species and microorganisms and a national data base should help in functioning a national electronic archive. New legislation should be in place in order to enable officially adopting measures for *ex situ* conservation (i.e. standards, registering, networking, facilities).

Regarding wild and domesticated species new legal acts should adopt measures, standards and methodologies for the recovery and rehabilitation of threatened species at national level and for their reintroduction into their natural habitats or *on farm* in case of crops varieties or valuable landraces or livestock. Such measures are extremely important also as adaptation measures under the climate change for food security and ensuring ecosanogenesis.

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