

THEORETICAL METHODOLOGY FOR ASSESSING THE STATUS OF CONSERVATION OF CROP LANDRACES IN ROMANIA

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Abstract. *On farm* conservation of crop landraces or old traditional crops is essential for further supporting food security and new policies in relation with biodiversity conservation and climate change responses such as adaptation and mitigation. In order to improve the genetic resources knowledge regarding crop landraces' germplasm diversity a new methodology for assessing their status of conservation through a landscape approach by also taking into account the climate change vulnerability of certain ecosystems compared to others and specific environment requirements is proposed. Developing new policies in applying dynamic action plans in agriculture, according to environmental factors, climate change impact and tolerance degree of crop landraces, may originate from these types of integrated studies. Based on the above mentioned rationale this proposed methodology will be further used for developing a Red List for crops in Romania.

Keywords: crop landraces, red list, *on farm* conservation

INTRODUCTION

Red lists of threatened wild species are already in common use all over the world [15] and such lists are already published in Romania [3, 7]. Even biodiversity as a concept developed by the Convention on biological diversity includes agricultural biodiversity [8], for crops plants still similar approaches have been developed ten years later and only in few countries [12, 16]. Developing and adopting such red lists is a milestone in the action taken for fighting against the biodiversity loss and for agriculture such lost is tremendous especially because of economic reasons [4]. On the other hand genetic erosion is the common threat to the sustainable use of plant genetic resources to meet the needs and aspirations for future generations [6, 20]. Thus, even the term genetic erosion was originally used for crop plants and scientists are aware about that threat, it became more important for the scientific community later and we may say that this is mostly concerned with the rapidly disappearing landraces (i.e. at the infraspecific level) with their important quality and resistance characters, rather than the loss of entire species of crop plants [10-13].

There are different pressures regarding the crop landraces disappearance and it comports some peculiarities in Romania regarding genetic erosion which even it was identified 30 years before [17, 24] no specific measures are in place today.

This article is proposing a specific methodology for developing a red list for crops species endangered with extinction through adopting the landscape approach in defining the classification categories. The proposed methodology is supporting the need for *on farm* conservation as part of a national system in place for preserving agricultural biodiversity. Furthermore, based on the published red list it will be possible to implement an appropriate *on farm* conservation strategy through a synergic approach between landscape conservation, climate change and biodiversity conservation for food/feed safeguarding.

MATERIAL AND METHODS

The status of conservation for old crop varieties in Romania will be assessed versus the methodology based on that described by Hammer and coworkers [13] starting with 1991 [10] compared with the Red list of Threatened Plants, IUCN [15] and taking into consideration certain peculiarities related to the landscape approach at the local level. The Red List of vascular plants in Romania is another scientific tool taken into consideration for our approach [7].

Regarding the landscape approach into this methodology are discussed principles and guidelines adopted at the European Level through the Recommendation CM/Rec (2008) 3 of the Committee of Ministers to Member States on the Guidelines for the implementation of the European Landscape Convention [22]. We support to adopt this approach as a response to the today tendencies of agricultural intensification in protected areas which may induce dramatic consequences on biodiversity [5, 9, 21].

Based on this methodology and according to the IUCN Red List, the Crop Red List for Romania will be developed alphabetically and the status of conservation will be indicated in the same manner such as for the IUCN Red List of Threatened Plants and also correlated with the public database developed by the Gene Bank from Suceava.

RESULTS

According to the IUCN Red List of Threatened Plants the following categories exists: EX – Extinct, EW – Extinct in the Wild, CR – Critically Endangered, EN – Endangered, VU – Vulnerable, LR/cd – Lower Risk/conservation dependent, NT – Near Threatened (includes LR/nt – Lower Risk/near threatened), DD – Data Deficient, LC – Least Concern (includes LR/lc – Lower Risk/least concern), (NE) - Not Evaluated (Fig., 1) and it was successfully applied for the threatened vascular plants in Romania [7].

For crop species such approach is not suitable based on Hammer and coworkers researches because for example according to the IUCN all species of *Triticum* belong to the subcategory 'Extinct in the wild' which means for crop plants 'not existing in gardens or fields' (i.e. *on-farm*) [13]. We will nominate in our study this approach as the "Hammer approach". According to this approach a different scheme categories compared to the IUCN was proposed as following: Ex – Extinct, (Ex/E) Extinct/Endangered, (E) – Endangered, V – Vulnerable, (R) – Rare and (I) indeterminate. According to the results of Hammer and Khoshbakht the highest percentages of threatened crop plants are found in the smallest families.

One of the extremes nominated by the researchers is the *Eucommiaceae* family with only one species. For large families the number of threats ($\geq 100 - 1000$ species) rarely exceed 5% and from the families with more than 1000 species only the *Leguminosae* and *Palmae* show higher rates of threat. The authors consider that there is a weak positive correlation ($r = +0.26$) between the number of threatened species and the number of threatened crop plant species within the families.

Due to the fact that the scope of our proposed methodology is narrowed compared to the scope of this approach we are considering to develop for a small scale a different methodology. Because our study is mainly focused in assessing groups of crop landraces for food/feed security purposes in specific agricultural landscape units we are considering very important to take into consideration the landscape approach

considering also climate change vulnerability of the assessed agro-ecosystems versus crop landraces [14].

In Romania exists lots of specific areas rich in agrobiodiversity, namely in Transylvania (e.g. protected areas such as Hartibaciului Plateau, Târnavă Valley, etc.), where traditional farming communities proved, during time, to maintain a high level of agrobiodiversity without negative impact on wild biodiversity making possible during the last 4 years the official recognition of a high number and surface of protected areas. Such equilibrium is really hard to be maintained when local communities are the inhabitants of these ecosystems and still it appears that traditional agriculture and wildness protection developed a specific equilibrium. In other words the status of crop landraces conservation is highly correlated with the resilience maintenance capacity of these ecosystems which are defining today these protected areas.

For supporting this methodology an investigation was realized in Moşna locality in Sibiu county where some important landraces for the local communities have been found in the first stage of farmers interviewing: cabbage and maize (Fig. 1). The local community is part of the Hartibaciului Plateau and is well committed in preserving these local crop varieties *on farm*. Still, due to the intensive agriculture pressures the traditional practices are replaced with organic or even conventional practices. Based on our investigations the two landraces belonging to Moşna Sibiu are not registered into the data base of the Genbank Suceava, only 75 landraces from 30 localities being registered.



Figure 1. Moşna's Cabbage (left) and Moşna's maize (middle) landraces and local small farmer (right) from Moşna, Sibiu county (photo original, Oct. 2010).

A very interesting feature of agricultural system in this region of the country is the small plots area (usually below 1 ha) belonging to a subsistence farming system. However in Romania over 69% of the agriculture is a subsistence agriculture [23], which is not ideal from the today economical point of view but it is highly valuable for continuing preserving wild biodiversity and for a future new economic strategy in this regard. However, such type of agro-ecosystems may become part of landscape units and in other words this type of agriculture may be considered as a tool for wild species protection and further in the appropriate development of incentive innovative measures devoted for nature protection especially for those lands located inside or in the neighboring of the protected areas.

Taking into account the specificity of the subject and the narrowing of the scope of this methodology compared to "Hammer approach" the impact of

agricultural and environmental policies, national trends for agriculture products trade, existing financial programmes and climate change vulnerabilities in relation with the landscape approach we are proposing a list of 9 categories for crop species assessment, as following:

1. Extinct (Ex) -crop landraces are not anymore used in farming and are missing from the Genebank – Suceava and other reserves;
2. Extinct *on farm* (ExF) - crop landraces exists only in gene banks;
3. Endangered *on farm* (EF) - crop landraces are conserved *on farm* into subsistence farming system in few locations - not correlated for the landscape approach; not commercialized and not promoted;

4. Endangered within *ex situ* (EE) (crop landraces are still conserved only *ex situ* into the GeneBank Suceava or few accessions - on voluntary basis);
5. Vulnerable *on farm* (VF) (crop landraces are conserved *on farm* into subsistence farming system, farmers are committed for commercialization and exists more locations not correlated for the landscape approach for cultivation but no policy or financial programmes are in place);
6. Vulnerable within *ex situ* conservation (VE) (these crop varieties are conserved only into *ex situ* in gene banks and other reserves under special conservation programmes)
7. Rare crop plants conserved *ex situ* and *on farm* only in few locations
8. Least concerned – (LC) it is a low risk but *on farm* conservation is supported by the well organized local communities level and farmers are committed for commercialization (crop landraces are conserved *on farm* and there is implemented a landscape approach).
9. Indeterminate (I) – data are not yet evaluated.

DISCUSSIONS

For the landscape approach this methodology will be discussed also for the political commitments and obligations taken by our country under the European Landscape Convention (ratified through the Law 451/2002) [19] and relevant issues are discussed below based on the Recommendation CM/Rec (2008)3 of the Committee of Ministries to Member States on the Guidelines for the implementation of the European Landscape Convention [22].

According to the landscape definition based on the European Landscape Convention this is *as an area, as perceived by people, whose character is the result of the action and interaction of natural/and human factors* (Art. 1 of the Convention) and according to these guidelines *it implies recognition of the rights and responsibilities of populations to play an active role in the processes of acquiring knowledge, taking decisions and managing the quality of the places where they live.*

As a consequence if the landscape's inhabitants are devoted for conserving *on farm* crops' landraces it might be possible to involve all these local communities in a broader project dedicated to *on farm* conservation. In other words the social component of the subject may be further covered, according to the same Recommendation, *through public involvement in decision-making and in the implementation and management of such decisions over time being regarded not as a formal act but as an integral part of management, protection and planning procedures.*

Our methodology is assessing also the farmers commitments in continuing *on farm* conservation not only as family or individuals [23] but as a community.

Based on this guideline for implementing the art 1 of the Convention the *management of landscape is a continuing action aimed at influencing activities liable to modify landscape.* Based on this recommendation the traditional agriculture practices into the protected

areas should be the most desirable agricultural practices. *It can be seen as a form of adaptive planning which itself evolves as societies transform their way of life, their development and surroundings. It can also be seen as a territorial project, which takes account of new social aspirations, anticipated changes in biophysical and cultural characteristics and access to natural resources.* Thus, providing a legal base for protecting crop landraces in agricultural landscapes where local communities using such genetic resources are committed to preserve their traditional knowledge it might be possible through a coherent policy to ensure at the local level the legal protection of such old crops varieties also through the implementation of *on farm* systems [1].

Regarding the quality objectives of a landscape approach according to this document *certain natural and/or historic elements of places may be given particular attention in order to preserve their specific role, particular historical meaning, and environmental and other very may bring into attention important Transylvanian historical elements too.* And in relation to this point it is also important for this purpose the *potential, for example, in parts of the territory devoted to agriculture, hedges, planted areas....* Thus according to these recommendations a traditional agriculture which is proved to be valuable for preserving both genetic resources and wild threatened species may become the subject of a landscape approach for traditional agricultural ecosystems.

According to the same document *the instruments used may range from forms of legal protection to grants to owners and farmers for upkeep, replanting or integration and to forms of improvement possibly accompanied by teaching material which provides guidance and passes on traditional methods of landscape upkeep* a lot of instruments may work in helping the implementation of such an approach. At least from political point of view there exists such possibilities of protecting agricultural landscapes too when it is considered to be a valuable natural resource at the local and national level. For the part II. 2.3. regarding the participation, awareness raising, training and education also some important references are presented in relation with agriculture, traditions and landscape which may be exploited in active aging purposes – being very well known the fact that the rural population is continuing aging in our countryside and they may provide a valuable source of information for training purposes.

Based on appendix no. 1 it is clear that it is not possible to implement a coherent programme for *on farm* conservation of crop landraces without taking into account landscape planning. In this respect it is very important to set boundaries for such agricultural landscapes and also for their units in order to avoid negative impacts such as the contamination with other relative crops when it might be the case (e.g. maize). In the same appendix it is an explanation regarding the landscape unit: *The expression "landscape unit" is used to emphasise the importance of systematically studying the places concerned from the landscape perspective. It would be wrong to focus solely on just*

one form of analysis (for example, ecological, geographical, historical, visual, etc.). However, several terms based on different forms of landscape description and site interpretation may be used, as already happens in various states (for example: unit, area, system, structure, element (not only territorial but also linear, in networks, etc)).

Due to this later in this approach the types of ecosystems, habitats, wild species under protection, incentive measures assessment for their proper effectiveness are considered. We will add also climate change – dimensions of the subject according to the decisions taken under the United Nation Framework Convention on Climate Change (UNFCCC).

Regarding the financial aspects of the subject it is important to underline that the process in assessing the status of conservation *on farm* of crop landraces will look for possible solutions to be adopted through national governmental programmes (new incentive innovative measures).

On farm conservation of crop landraces should be developed further with the support of science communities. A crucial role in *ex situ* conservation of these local crops varieties is played by the Genebank from Suceava and also by other institutes such as the National Agriculture Research and Development Institute - Fundulea and the Network of National Institutes for Varieties Registering. However, important *ex situ* conservation pools are today in some other laboratories belonging to universities or other research institutes all over our country but unfortunately there are no public databases or web portals regarding these genetic resources. In the public database developed by the GeneBank Suceava, according to the Eurisco standards, 13,961 passports for crops and wild relatives from all parts of Romania and couples of other countries are registered in 2010.

In order to underline more the need for such an approach we mention that the traditional practices and knowledge applied by local communities into protected areas and the neighboring areas of Hartibaciului Plateau and other protected areas in our country are under threat to be converted into conventional agricultural practices providing much income but less protection to nature conservation and a huge vulnerability status to local crops varieties, generally associated with the loss of biodiversity.

The reasons why these local communities preserved over long period of time these genetic resources pools are hard to be explained but generally the lack of political and financial supports can be mentioned and as a consequence it was a sort of social resistance towards the negative impact of a negative policy at the local level. Traditional knowledge associated with agricultural practices applied by local communities in relation with these crop landraces should be exploited and further should be used in grounding a new political strategy for agro-biodiversity preservation in our country [2].

The methodological proposal described in this article is mainly developed based on the latest scientific results [11-13, 15] corroborated with some specific features due to national and local levels peculiarities.

This approach is new in our country and it is necessary to be applied for food and feed safeguarding especially in relation with the climate change impact.

This methodology is imposing the close cooperation between scientists, farmers and policy makers based on the ecosystem and landscape approaches as scientific concepts.

Through this tool we are trying to improve the understanding of specific problems and constraints faced with particular crops thereby facilitating integrated approaches to their solutions.

Thus, the conservation of local communities' plant genetic resources as well as their effective use in national crop research programmes will be scientifically and technically grounded in order to be further promoted at national level for generating *on farm* conservation programmes for local and national level. This will ultimately lead to the acceptance at the policy level of the potential of these crop species in contributing to food security under the future climate change challenges. Further it is expected that the political commitment will be obtained as a prerequisite in adopting appropriate governmental programmes for genetic resources conservation in line with international political commitments taken under the Food and Agriculture Organization and under the Convention on Biological Diversity.

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REFERENCES

- [1] Antofie, M.M., (2009a): Traditional knowledge - International trends and national constrains, *Annals. Food Sciences and Technology*, 10 (1): 92-96.
- [2] Antofie, M.M., (2009b): International trends in the implementation of the agricultural biodiversity concept, *Annals. Food Sciences and Technology*, 10(1): 120-125.
- [3] Botnariuc, N., Tatole, V., (2005): *Cartea Roşie a Vertebratelor din România*. EAR, pp: 1-325.
- [4] Brush, S.B., (2000): The issues of in situ conservation of crop genetic resources. pp: 3-26. In Brush, S.B. (ed.): *Genes in the field: On-farm conservation of crop diversity*. IPGRI, IDRC. Lewis publishers.
- [5] Butler, S.J., Vickery, J.A., Norris, K., (2007): Farmland biodiversity and the footprint of agriculture. *Science*, 315: 381–384.
- [6] Change, T.T., (1985): Principle of genetic conservation. *IOWA State Journal of Research*, 59: 325-348.
- [7] Dihoru, Gh., Negrean, G., (2009): *Cartea roşie a plantelor vasculare din România*, (Red book of vascular plants of Romania) Academiei Romane Publishing House, pp: 1-630.
- [8] Glowka, L., Burhenne-Guilmin, F., Synge H., (1994): *A Guide to the Convention on Biological Diversity*. Gland, IUCN. pp: 1-161.
- [9] Gordon, L.J., Peterson, G.D., Bennett, E.M., (2008): Agricultural modifications of hydrological flows create ecological surprises. *Trends in Ecology and Evolution*, 23: 211-219.

- [10] Hammer, K., (1991): Checklists and germplasm collecting. FAO/ IBPGR. Plant Genetic Resources Newsletter, 85: 15-17.
- [11] Hammer, K., (1995): How many plant species are cultivated? In: International symposium on research and utilization of crop genetic resources, Beijing, p. 6.
- [12] Hammer, K., (2004): Resolving the challenge posed by agrobiodiversity and plant genetic resources: an attempt. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, Beiheft, 76: 184.
- [13] Hammer, K., Khoshbakht, K., (2005): Towards a "red list" for crop plant species. *Genetic Resources Crop Evolution*, 52: 249-265.
- [14] Houet, T., Loveland, T.R., Hubert-Moy, L., Gauchere, C., Napton, D., Barnes, C.A., Sayler, K., (2010): Exploring subtle land use and land cover changes: a framework for future landscape studies, *Landscape Ecology*, 25: 249-266.
- [15] IUCN (2001): IUCN Red List Categories: Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, pp: 1-191.
- [16] Joshi, B.K., Upadhyay, M.P., Gauchan, D., Sthapit, B.R., Joshi, K.D., (2004): Red Listing of Agricultural Crop Species, Varieties and Landraces. *Nepal Agricultural Research Journal*, 5: 73-80.
- [17] Kellner, E., Giura, A., 1979: Studiul colecțiilor de plante cultivate și cooperarea internațională în domeniul resurselor vegetale (The study of plant collections and international cooperation in genetic resources). *Probleme de Genetica Teoretică și Aplicată*, 9: 77-95.
- [18] Khoshbakht, K., Hammer, K., (2008): How many plant species are cultivated? *Genetic Resources Crop Evolution*, 55: 925-928.
- [19] Lege nr. 451, 2002 pentru ratificarea Convenției europene a peisajului, adoptată la Florența la 20 octombrie 2000 *Monitorul Oficial, Partea I nr. 536 din 23 iulie 2002 (Law 451/2002)*.
- [20] Malice, M., Baudoin, J.P., (2009): Genetic diversity and germplasm conservation of three minor Andean tuber crop species, *Biotechnology, Agronomy, Society and Environment*, 13(3): 441-448.
- [21] Maron, M., Fitzsimons, J.A. (2007): Agricultural intensification and loss of matrix habitat over 23 years in the West Wimmera, south-eastern Australia. *Biological Conservation*, 135: 587-593.
- [22] COE (2008): Recommendation CM/Rec (2008): 3 of the Committee of Ministers to Member States on the Guidelines for the implementation of the European Landscape Convention ([link](#) accessed in October 2010).
- [23] Savoiu, Gh., Manea, C., Manea, C., (2007): "The Romanian Rural Economy – a Resource of Growth and Regional Cooperation, or a Source of Conflicts and Insecurity? *Romanian Economic Journal*, Department of International Business and Economics from the Academy of Economic Studies Bucharest, 10(25): 186-199.
- [24] Szabo, A.T., (1981): Problems of genetic erosion in Transylvania, Romania. *Bulturpflanzen*, 29: 47-62.

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