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TRADITIONAL SAXON HOME GARDENS AS HOT-SPOTS FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE CONSERVATION - CASE STUDY IN ROMANIA

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Abstract

One of the future challengesin ensuring food securityis accessing a broader diversity of plant genetic resources for food and agriculture (PGRFA). Today, heterogenous agricultural lands are considered hotspots for biodiversity, and they also exist in the hilly mountain areas of Romania's Carpathians. The scope of this article is to describe Saxon traditional home-gardens related to the land use of households and cultivated crop species in Moșna commune, Sibiu County, Romania. The survey was conducted with the support of authorities and local stakeholders. The results of this study revealed that the maintenance of crop species structure and land use in traditional households has been ongoing for more than two centuries. Today, these home gardens cover 26% of the total area of a household and are cultivated mainly with vegetables. Generally, a household should have a surface area ranging between 5,000 and 1,500 m^2. The first local council decision in Romania in 2019 supporting the recognition of 20 landraces, the Saxon church garden, and 15 traditional home gardens as heritage values was officially adopted. Among the oldest and most popular landraces cultivated in home gardens, we identified Moșna cabbage, garlic, celery, dill, and Saxon raspberry. The results of our study also support the idea that these traditional households are functional agro-ecosystems with a positive impact on food security for the future and generally on biodiversity conservation.

Key words**:** agricultural land use, intangible culture heritage, landraces, on farm conservation, traditional knowledge, Saxon origin home-gardens

INTRODUCTION

Traditional knowledge (TK) is a concept that was coined for biodiversity conservation at the global political level through the Convention on Biological Diversity in 1992 in the Preamble as well as in Art. 8 j. [22]. The same concept was further used in the provisions of Art. 5 and in direct relation to plant genetic resources for food and agriculture (PGRFA) by the International Treaty on Plant Genetic Resources for Food and Agriculture or Plant Treaty that was adopted in 2001 and has today 150 parties, including Romania [44]. In direct connection with the plant breeding strategy, we mention that also The International Union for the Protection of New Varieties of Plants (UPOV) first adopted in 1961, has recognized the genetic value of landraces [45]. Today, 73 parties, including Romania, are signatory to this Treaty that regulates the trade of new crop breeds at the global level. A direct connection was proven to exist between TK and landraces cultivation due to the need to clarify terms for researchers working in crops breeding [105]. Based on this analysis, Zeven is first defining the autochthonous landraces as genetic resources that have been cultivated for more than 100 years in the same agroecosystems, and they are also under traditional low input agricultural systems. We mention that it is not an easy process to investigate the TK and local knowledge (LK) related to the conservation of biodiversity which is of intangible heritage value [33,62]. In this regard traditional landscapes, agricultural lands, households, and home gardens should be investigated for crop diversity, structure and land use that should be maintained for

more than 100 years to become reference traditional agricultural ecosystems in the support of the future rural sustainable development. It became more than obvious that TK should be based on a historical approach covering all these subjects when we are performing such assessments [60]. From 1989 on, the term TK included the knowledge related to environmental protection and agricultural sustainability; however, later, scientists became aware of new barriers based on which new subjects needed to be defined when applying such a concept in real-life situations [101]. Thus, Prof. Matsui defines new topics brought up by the evolution of various civilizations in direct relation to community development mechanisms, which may or may not be faster. For this reason, TK may now be regarded as archaic for the current historical period [60]. Nonetheless, the application of a historical perspective may serve to provide scientific validation for the customary or indigenous knowledge of a particular kind of community assessment [23,61]. Among these, we may include historical evidence of community existence in daily life as well as the continuity of its existence as a side effect of the progress and continuous transformation of the community, as traditional and local knowledge are the expression of the society's choice and being open, including towards trades exchanges [15, 48, 67].

In the case of traditional and local knowledge associated with agriculture, there is nowadays a high level of interest due to the need to ensure food security for the future as well as to develop resilient rural communities [37]. Such ideas are also considered at the European level, as we are facing dramatic climate change effects, especially affecting the food chain and endangering food security for the future [59]. At the global level, one of the relevant definitions regarding TK included subjects such as agricultural practices, seed selection systems, and environmental protection issues [46]. Other researchers are interested in developing this term by defining specific indicators that are related to the investigations of traditional agricultural practices for supporting food security at the global level [35, 71, 98]. Of high interest is to continue following these scientific achievements to understand better innovative approaches and mechanisms applied and to further extend them to specific rural communities that may need such assessments to support food security for the future [25].

Based on the latest scientific evidence, traditional and local knowledge includes knowledge related to wild and domesticated diversity conservation (i.e., species collecting, use and management), agricultural practices (i.e., seed selection systems, cultivation practices for crops, shrubs, and fruit trees), as well as knowledge related to land use management at household and community levels (i.e., urban, and outside urban areas) [95]. Thus, traditional land use management is discussed for different well-settled communities all over the world [76], including nomadic communities [91].

The traditional land use in urban and/or outside urban areas of rural communities is considered today to be of outmost importance when applying the historical approach, proving in this way its role in supporting biodiversity conservation at the landscape level [100]. It is well established today that such relevant examples for European countries are those represented by terroirs in France and similar landscapes in other European countries [29], as well as drystone enclosures in Ireland [57] or traditional agricultural plots in Germany or Austria [52]. At the global level, specific traditional transformed landscapes are well documented, and their roles in biodiversity conservation, such as the Satoyama in Japan [51], or rice traditional landscapes in Asia [18], are worldwide recognized. Relevant similar studies have been published for North America [28, 56], Central America [54], and South America [81]. In Africa, such traditional landscapes are mostly connected to indigenous local communities [1, 58, 84]. In all these scientific publications, the direct relationship between traditional landscapes and biodiversity conservation is well documented, and therefore, at the global level, they are recognized as hotspots for biodiversity conservation [41]. The above-

mentioned authors are stating that heterogenous agricultural lands that also include forests, riparian areas, live fences, and isolated threes are relevant for the conservation of biodiversity in Meso-America. Furthermore, the Convention on Intangible Heritage, adopted by UNESCO in 2003, includes TK related to husbandry and nature conservation [21]. Even though the subject of 'traditional agricultural practice' is not specifically defined, the TK related to the maintenance of the Mediterranean Diet, may include traditional agricultural practices [12, 19]. It is also the case of studies concerning the traditional pomegranate from Azerbaijan [4]. The traditional cultural landscapes (TCL), which include heterogenous agricultural lands mostly conserved by subsistence agricultural practices, become the real focus where such heritage values should be studied for local communities [39], especially in relation to developing innovation for fighting against climate change effects and maintaining food security [32, 87].

During the past 20 years, different tools and methods have been developed and published for the evaluation of traditional agro-ecosystems or heterogenous agricultural lands [97]. However, these cannot be applied without amendments or the need to explore more variables that are imposed aside from the relief and heterogeneity of the landscapes by local communities' beliefs and traditions. Nowadays, it is well established that traditional rural agro-ecosystems are hotspots for biodiversity conservation, which is why they have been in the attention of scientists for many years [31, 41, 63]. Moreover, the results of scientific investigations developed inside these traditional areas raise the idea of crop erosion, and new approaches have been published to scientifically substantiate the need for crop red listing in Nepal [47]. A historical approach of the crop's species cultivated since some 7,000 years ago proved the loss of at least eight crops' species from the Fertile Crescent [38]. In case of Germany, the need for red listing crop species was based on the phasing out of the diet of important crop species due to a specific crop-oriented trade at the global level with dramatic effects at the national level [99]. Applying such approaches in heterogenous agricultural landscapes may further support at the global level based on the mechanism of the Multilateral System, crop breeding strategies in ensuring food security for the future [7]. Pests, diseases, and the continuous existence of landraces as PGRFA inside traditional agroecosystems will further enrich genetic heterogeneity at the landraces level for future breeding programs [26]. Moreover, the careful integration of certain activities already existing in these types of agroecosystems may be part of future adaptation strategies to climate change [53]. By ensuring connectivity with seed keepers from traditional households through the national Seed Gene Banks, it will improve access to such genetic resources in the future based on the Multilateral System [7, 102]. All these scientific results also underlined the need for an official monitoring system to be in place for making effective functioning of such networks and, furthermore, of crop's red lists. Consequently, the need to create an on-farm conservation network at the national level should be the very first step [7, 70].

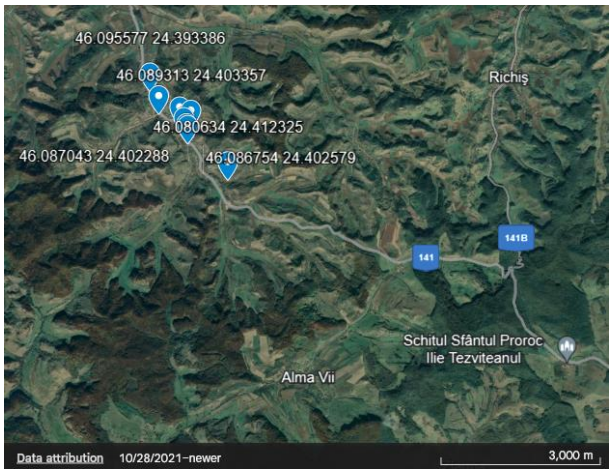
In Romania, heterogeneous agricultural lands exist, especially in hilly mountain areas [64, 85], but they have not yet been evaluated for their relevance in supporting food security in the future. However, part of these subjects, mostly connected with socio-economic features in the former province of Transylvania, have already been investigated by different groups of researchers from Romania and Hungary [14, 40, 73, 74]. Our team was involved in describing home gardens from Sibiu County, Romania, for cultivated species and a potential identification of TK related to landraces and agricultural practices. During more than 20 missions between 2013 and 2019, in more than 12 Saxon-origin villages, we succeeded in identifying potential landraces and defining some indicators for defining traditional Saxon home-gardens [8, 9, 10].

The scope of this article is to study the potential existence of traditional Saxon home gardens and traditional and/or local knowledge related to land use in households

and landraces cultivation in Sibiu County, Romania. The study was conducted in Moșna commune (it includes 3 localities: Moșna, Alma Vii and Nemșa), which is part of the historical Saxon villages founded between the XIII and XIV centuries. Traditional land use inside traditional Saxon households was investigated as part of the local knowledge to understand if there is a potential connectivity to land use outside urban areas, including forests, pastures, grasslands, and creeks. As a result of these surveys, we will present an innovative procedure development related to the local official recognition of landraces and home gardens based on a bottom-up approach with the support of researchers. Such a procedure may be followed by similar communities in our country, Europe, or in communities that may share the same social, political, and economic peculiarities.

MATERIALS AND METHODS

Studied area.In 2019, more than 20 missions were realized in Moșna commune, which includes Moșna, Alma Vii, and Nemșa localities in Sibiu's County, Romania [8, 9, 10]. The geographical coordinates of the sites are as follows: 46°04'39''N, 24°24'31''E (Map 1).



Map 1. Mapping the traditional Saxon households of Moșna commune (i.e., Moșna, Alma Vii, and Nemșa, Sibiu County, Romania)
Source: Made by authors with the support of the free mapping software provided by Google Earth Map [34].
Note: It is relevant the diversity of natural relief of locality for this image.

*Land-use mappingof households*was realized with the support of Google Earth Map [34] and a Bosch GLM 50-22 laser telemeter. The telemeter was used inside and outside the property of householders and general data were compared to the Google Earth Map results. The ratio between households and home gardens land areas was investigated. All in field investigations were conducted during July-September 2019. The free GPS software 3.3.1.2. of Virtual Maze was used for maps creating.

Questionnaire applied. A scientific based questionnaire was applied through direct interviews on local authorities and householders [11]. This questionnaire was developed in the period 2010-2018 based on the experience during field missions in Sibiu County. The purpose of the published questionnaire was to make local authorities aware of the importance of each household or farm's interest in local native genetic resource conservation, such as landraces or animal breeds. Aside from this questionnaire, based on observations related to Saxon home gardens mainly cultivated with vegetables in the region, the idea of studying the ratio between the household coverage area and that of the home garden area only if it has not changed for more than 50 years. Based on the former in situ surveys we noticed that a Saxon household comprises smaller constructed areas (i.e., house and outhouses) and larger green areas (Saxon home garden, orchard, vineyard, and grassland). The borders of these properties are mostly to the forests, pastures, grasslands, or creeks.

Therefore, the questionnaire includes for this study relevant information related to landscape properties, land use inside households, home garden practices, and cultivated species.

Three principles have been defined for the study: 1. investigate only households as landowners that are supported by the local community not to be changed for more than 50 years; 2. protect the owner's identity; and 3. authorities should endorse landowners that they apply traditional agricultural practices, full seed selection systems, seedling cultivation, preservation, and maintenance.

Questionnaire for householders. The main objective of the questionnaire was to provide information based on which the Saxon home gardens to be characterized. A set of questions was released during the on-spot survey: 1) the coverage areas of home gardens and households. This information was relevant to calculating the ratio between household total surface area and home garden related only to vegetable cultivation. The surface of other green areas inside the household was also included in the survey (i.e., orchards, grasslands, vineyards), as well as the vicinity with forests, grasslands, pastures, and creeks; 2) the composition of the cultivated vegetables inside the home gardens. During the survey, we were interested in the reasons why they are cultivating certain species or integrating new crop varieties from the market. Such information was relevant to substantiate the existence of traditional or local knowledge related to crop practices,and 3) the survey includes knowledge related to the cultivation of fruit trees, shrubs, ornamentals, and vineyards in households, as well as knowledge related to species collection from the wild, such as medicinal plants and edible mushrooms. Such information was relevant to substantiate traditional or local knowledge related to wild species.

Questionnaire for authorities. Authorities were surveyed for official public data monitored at the commune level and at the national level with respect to agriculture: agricultural land use and crop production at the species level [8, 9, 10]. They provided owners' addresses to be surveyed as well as a counselor to support our interviews during the surveys.

Survey implementation. In 2019, 20 full days were dedicated to field missions for the surveying of the Evangelic church garden and 15 household owners endorsed by local authorities. In the first part of the survey, each of the household owners provided information related to the history of the property and the surface area dedicated to home gardens for vegetables cultivation. In the second part of the survey, all crops were inventoried inside the home garden and household property (i.e., fruit trees, shrubs, ornamentals, and weeds). The third part of the survey covered only data related to the surface of the home garden in the neighboring houses.

Official procedure development for the recognition of local/traditional knowledge related to agriculture to support food security was discussed at the mayor's level, followed by the main stakeholders in the commune (i.e., non-governmental organizations, local school) and with local Council Members. Thus, it was agreed to first present the results of surveys as tables and, after discussions, to finalize the council decision to be voted on. The principles for capacity building have been applied [78].

Data bases accessing. The official scientific names of plant species are documented based on the International Plant Name Index [43] as well as other related and connected information inside the website.

*Data analysis.*All collected data, based on specific criteria, were introduced, and processed in Excel. Margalef index, a species diversity index, was calculated to characterize the level of landraces richness for surveyed households. Margalef index was automatically generated based on the calculation of the Shannon index and Simpson index.

RESULTS AND DISCUSSIONS

The analysis of the official reports and scientific data revealed that, at a major scale, the landscape units for Moșna commune are defined by natural relief formations such as hills, valleys, and creeks. Forests, pastures, and meadows define the ancestral landscape units of the former spatial planning and occupy almost 50% of the total surface of such types of villages with the highest altitude of 600 m. The territory of the commune is defined by 47.54% of natural and semi-natural landscapes (forests, pastures, meadows, and riparian) that continue with agricultural landscape units such as vineyards, agricultural lands covered with crops, and grasslands fenced mostly by natural vegetation (i.e., 46.31%) [5, 6, 80, 89]. The rest of the land is covered by roads, watercourses, reeds, and the

constructed areas of the three villages (i.e., 6.15%) (Fig. 1).

Today, the whole commune relies on products and services that are provided by agriculture and forest by trying to keep the forest ratio towards the entire agricultural lands, such as pastures, grasslands, and arable lands as this ratio has remained unchanged for more than six centuries based on historical evidence [5, 6, 80, 89].

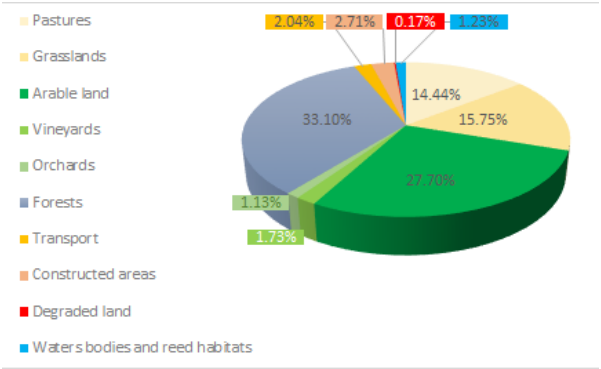


Fig. 1. Land use in Saxon origin Moșna Commune, Sibiu County, Romania.

Source: Made by authors based on open sources official data provided by local authorities during 2019 [80].

Note: It can be observed that there is an obviously equilibrium between forests (i.e., 33.10%), agricultural land (i.e., 27.7% arable land, 1.73% vineyards and 1.17% orchards) and seminatural land (i.e., 15.75 grasslands and 14.44% pastures).

Heterogenous agricultural land not defined up today for Moșna was investigated for land use inside households as well as for the potential landraces cultivated inside home gardens, and the results will be presented below.

1. Traditional land use of Saxon-origin households

120 properties have been investigated with the support of local authorities for land use inside households that are considered traditional by the local community in terms of home garden preservation and household land use. Also, 15 former traditional Saxon home gardens and the Evangelic church garden in Moșna commune were investigated for cultivated crops species. During the survey, we also collected data for vineyards, orchards, ornamentals, and common garden-weeds.

The analysis of land use investigations for 120 properties and considering the preservation of the former land use of the original Saxon population, revealed that at least three main categories of households still exist: 1.1. *traditional Saxon properties* where land use has been preserved for more than 100 years, 1.2. *slightly modified traditional Saxon properties* where land use inside the household has slightly changed over the last 100 years, but where the main characteristics of land use, such as the ratio between the property area coverage and home garden area, have been retained, and 1.3. *profoundly modified properties* where no traditional land use can be observed.

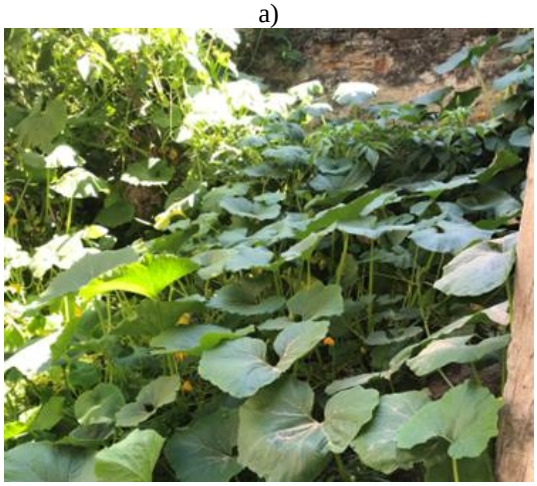
These three categories are further discussed for the traditional land use of households and the continuous use of traditional home gardens in our research.

1.1. Traditional Saxon properties. Two types of traditional Saxon properties were identified based on telemeter measurements and interviews such as: traditional Saxon households from Moșna commune and the Evangelic Church's Garden of Moșna locality (Photo 1).

1.1.1. Traditional Saxon households. Based on measurements realized with the Bosch telemeter at the local level and compared to data provided by Google Earth Map, it can be considered thattraditional Saxon households cover a land area ranging between 6,000 and 2,000 m^2. In the case of traditional Saxon home gardens, they still cover 20,17% from constructed areas at the commune level that means that they include all three localities (i.e., 268 of 1,330 properties and over 3,300 people according to previous reports) [80].The land use of household property inside constructed area of the commune was relevant in this study. In the case of traditional Saxon households, which are older than 100 years, the covered area for house construction was between 80 and 140 m^2 for the investigated households. The built area is covered by different dependencies or outhouses, and the covering area ranges between 1,400 and 300 m^2. We identified that it may be applied a ratio between the house and outhouse terrain of at least 1:3 or higher. Generally, the rest of the land was covered by vegetable gardens or home garden, orchards as well as grasslands and it was identified to be in a ratio of 2:1:2. Vineyard are now usually associated with gardens and/or built houses.A construction peculiarity for these groups of households is

that some of the outhouse buildings are placed at street level (i.e., warehouses for hay) and integrated into the rural landscape of the locality. Such land use was due to the presence of a marshy land area inside the urban area and alongside one of the streets where one of the oldest properties was located. Therefore, the house construction locations in that area were placed at the foot of the hill level, the upper part of the properties behind the outhouse constructions. We mention that the orchard and grassland area were integrated into the upper part of the marshy land, and to the street view are the home garden and vineyard (Map 2.a. and Photo 1). The same land use inside the households was found for all eight properties (Map 2.b).

a)

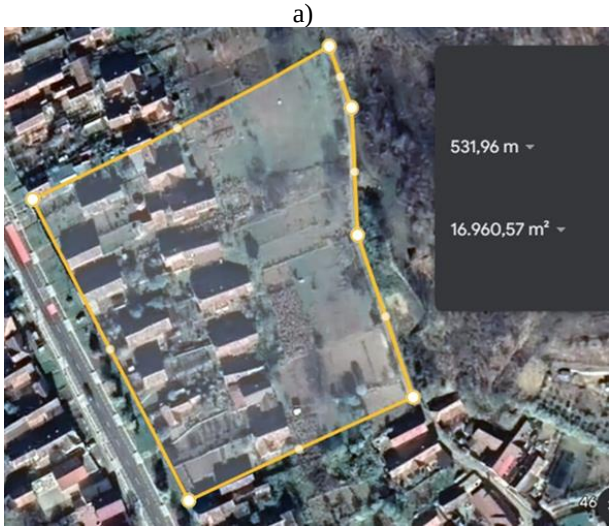


b)

Photo 1. Image of a household where no boundaries exist between urban and outside urban areas (a). The direct connectivity to the grassland and forest can be observed, and the presence of ornamental plants as well (i.e., *Zinnia elegans* L.) in the home garden. In the Evangelic Church Garden mainly species adapted to humidity and shadow are cultivated (i.e., *Cucurbita maxima* Duchesne) (b) (Moșna, Sibiu County, Romania).
Source: Made by authors.

The measurement analysis carried out for all 120 properties claimed that they are applying traditional practices according to local authorities and householders and that they are in the possession of traditional home gardens, which revealed, among others, that roughly 26% of the households are covered by traditional home gardens (Fig.2, upper part of the graph).

a)



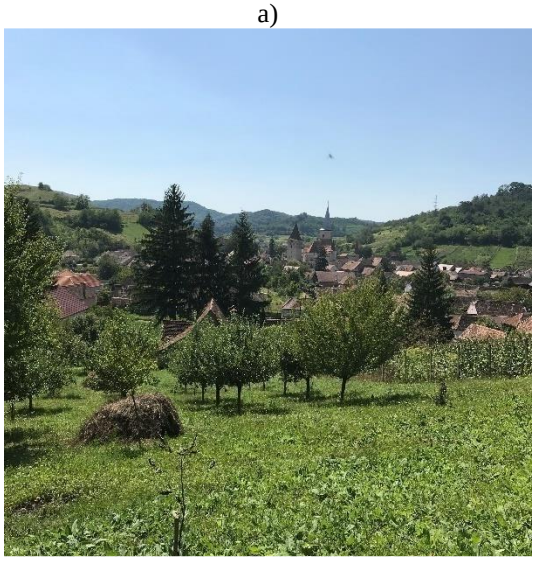
b)

Map 2. Google Earth Map modified: aerial view of Moșna locality. The oldest property of the village, unchanged for more than 100 years (a) as part of a group of households located in the marshy area. In both images, the yellow perimeter follows the household property (a) and the group of households (b). The household has a perimeter of 273.51 m^2 and a total surface area of about 3,000 $m^2$and these can be seen in the black square automatically generated by Google Earth Map. The group of 8 households has a total perimeter of around 532 m and a total surface area of almost 16,960 m^2. In this image the street view can be observed, as well as the hilly area in the remote part of the households towards the forests area.
Source: Made by authors.

Similar traditional Saxon households can be found in Nemșa village, with an average surface area between 5,000 m^2 and less than 1,500 m^2. The two houses involved in our

survey occupied 2,500 m^2 and were covered by less than 1/3 of the constructions, with the rest of the households being covered by gardens, orchards, and grasslands.

a)



b)

Photo 3. General views for the oldest household of the village: the street view (a) and the upper remote part of the household in Moșna locality. (b) Different land use inside the household can be identified: a vegetable garden, a vineyard, a grassland, and an orchard.
Source: Made by authors.

In Alma Vii, the survey of one property considered at the limit of a traditional Saxon household covered some 1,200.00 m^2.

In this respect, the traditional rural landscape was permissive with the place-choosing of the built areas inside the households due to the relief conditions but, at the street level it was compulsory to have a uniform distribution of the property's boundaries (i.e., fences and gates).

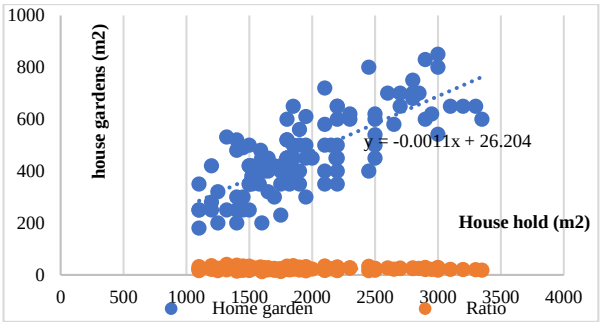
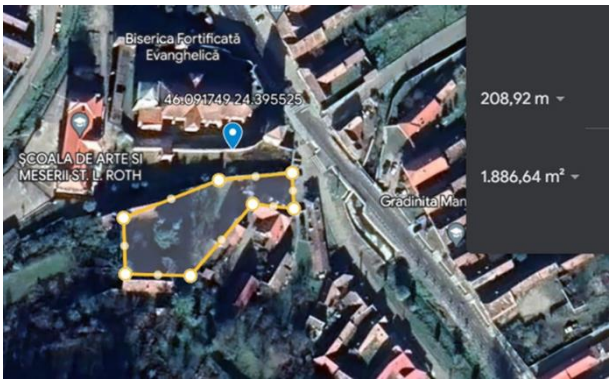


Fig. 2. Traditional Saxon gardening preserves a media range ratio of 26% (y = -0.0011x + 26.204). The survey was realized on 120 households' properties in Moșna, Sibiu County, Romania. The highest density of properties is between 1,500 and 2,000 m^2, with an average of home-gardens of 400 m^2.



Map 3. The aerial view of the Evangelic Church Garden
Source: Made by authors with the support of Google Earth Map. https://www.google.com/maps/d/u/0/ and https://earth.google.com/web/.
Note: The Evangelic Church Garden is located inside the first defense wall (GPS coordinates: 46.091749, 24.395525). The perimeter, as a yellow line, is 208.92 m, covering a surface area of approximately 1,886 m^2.

As a general remark, for agricultural practices, these traditional Saxon home gardens are functioning as integrated parts of households and cover 24% of 3,000 m^2 and less in cases where the property is larger (i.e., in case of 6,000 m^2), whereas a home garden may cover up to 16% and the rest is covered by field crops for the rest of the green areas.

1.1.2. Evangelic Church Garden. The Evangelic Church Gardenis positioned next to

the church, covering around 1,900 m^2 (Map 3), and it is cultivated mainly with plant species that are resistant to shade and high humidity due to the defending brick walls surrounding the church. Thus, most of the cultivated species belong to the shrub group. Today, the surface of the Church Garden is unchanged since the church construction (i.e., XVI century). Upon discussions with the church curator, it appears that for more than 100 years the cultivated species have been almost unchanged, and this should be considered today as a traditional garden too.

1.2. Slightly modified traditional Saxon properties. The second pool of properties in Moșna commune is represented by households that own smaller properties than 1,500 m^2, but they preserve the traditional way of land use inside their property, and especially for traditional home gardens. In this respect, they used to have gardens no larger than 500 m^2 and down to 200 m^2 that were managed in a traditional way (i.e., seeds selection system, preservation, cultivation, use) [see central part of Figure 2. Such households developed more after the Second World War, especially after 1970, when an important part of the Saxon population migrated to Germany and their properties were sold to the Romanian population from the region. Most of the larger properties have been split into two or more. Today, based on the householders' survey, these home gardens are assumed to be enough to cover the needs for 3-4 persons and cover more than 40% of all properties of commune based on authorities' data.

1.3. Profoundly modified properties Today, based on authorities' data a proportion of 38.72% of households are smaller compared to traditional Saxon households in terms of surface area as well as land use in the urban area (see left-down part of Map 4). However, in some of them the traditional way of gardening is still well preserved, but there are also householders not interested in applying traditional agricultural practices. In our analysis we consider only householders that still apply traditional practices. Thus, such a property was surveyed at house no. 254, which covers around 1,100 m^2 and comprises a green area of 800 m^2. In this case, their vegetable garden is not integrated into the household because it is too small, but it is cultivated outside the urban area, in a crop field near the forest area. At the border to the forest, there are only natural fences between gardens facing the field or the forest, and usually the large herbivores such as boars or dears as well as other wild species, including bears, are in constant contact with these gardens. However, the vineyard cultivated into the field and covering 500 m^2 is protected against rodents with a simple crafted fence. In the same area the common peach trees are cultivated based on the self-selecting seeds technology, which takes no longer than 6 or 7 years. In a similar situation, more than 50% of the householders' properties are positioned inside urban areas but oriented and near the forests. We mention that most of these properties are placed in urban areas, and at the limits of the forests, they are fenced towards the forest areas. Mainly, the vegetable gardens positioned inside the field crops are not fenced and cover roughly about 2,000 m^2.

Map 4. The aerial view of the profoundly changed property and preserving the traditional Saxon gardening in the field outside the urban area
Source: Made by authors with Google Earth Map. Moșna Sibiu County Romania.
Note: The garden is represented as a yellow line positioned next to a forest with a perimeter of 236.6 m and covering 2,159.72 m^2. The yellow arrow is indicating the householder location in the village in the included aerial view, who owns a surface area of 1,113.64 m^2 with a perimeter of 157.97 m. In the left figure, the perimeter is also represented by a yellow line.

2. Traditional home gardens: species and traditional knowledge

The survey of household owners as well as of the representatives of authorities revealed that the cultivation of all vegetables is part of their traditional knowledge, as it has been orally

transmitted from their ancestors or at the community level [8, 9, 10]. In this case, we are witnessing the use of agricultural practices that are either part of their traditional knowledge or are newly integrated and it can be considered local knowledge.

2.1. Traditional and local knowledge related to agriculture. It can be considered that the knowledge associated with the selection of crop species for cultivation inside their garden or in the field is part of the traditional knowledge transmitted nowadays as local knowledge. In this case they are cultivating small plots areas in their traditional gardens (i.e., a plot area is of 3- 4 m^2) and the mosaic of cultivated vegetables inside the plot areas is part of the traditional knowledge. Thus, they know that some species should not be cultivated next to others. More than that, they also inherited TK related to shrubs, vineyards, and orchards cultivation and management, and from the beginning, they knew what part of the garden they needed to use for their cultivation, how to graft new varieties, or how to apply maintenance cuts. Some of these results have been published already [8, 9, 10].

As a general feature, in all home gardens, whether they are in the urban area or outside urban areas, the local people cultivate ornamental plant species for the beauty of their flowers that are mainly blooming during summer up to autumn period (i.e., most abundant are *Zinnia elegans var. purpurascens* DC., and *Callistephus chinensis* Nees). Another plant species cultivated among the ornamental plants and not missing from traditional gardens is basil (*Ocimumbasilicum* L.).

We mention that this community is still applying agricultural practices based on the Christian calendar (i.e., either Orthodox, Evangelical, or other confessions). Thus, they stated that all agricultural practices that are traditional follow the religious calendar, and inside the garden, they start working at least one week before St. George (i.e., April 15), and in the field, they start one month later (i.e., May 15).

Traditional knowledge is also associated with weed species management. All these families have the knowledge related to the usefulness of some of the species or for the futility of others, up to being considered as real pests for their gardens.

Among the undesired weed species, we mention: *Ecballium elaterium* (L.) A. Rich. *Agropyron repens* (L.) P. Beauv., *Cirsium arvense* (L.) Scop., *Sonchus arvensis* L.

Some of the weed species are appreciated for being used in their traditional practices (i.e., for cuisine, on farm or for different remedies), which is why they preserve them inside the gardens such as *Melissa officinalis* L., *Geranium robertianum* L., *Portulaca oleracea* L., *Symphytum officinale* L., *Polygonum aviculare* L., *Equisetum arvense* L., *Achillea millefolium* L., *Matricaria chamomilla* L. Collecting, drying, preserving and using the medicinal plants in their home is a continuous process that is enriched all the time, and nowadays it can be considered local knowledge developed based on traditional knowledge.

In the case of wild species, the local community is also in the possession of traditional knowledge related to mushroom collection from the wild (i.e., collecting from the forests or pastures, preserving, and cooking) as well as other wild fruits from the forests. The most appreciated mushrooms are *Macrolepiota procera* (Scop.) Singer, *Armillaria mellea* (Vahl) P. Kumm. *Cantharellus cibarius* Fr., and *Agaricus arvensis* Schaeff. Only six families of 15 admitted that they know, based on traditional knowledge, when and where to find all these food resources. Preserving and preparing are part of local knowledge developed on traditional knowledge too.

The major risks for the community are the invasive alien species spreading inside arable land areas, such as *Erigeron annuus* (L.) Desf. and *Solidago canadensis* L. Both species have been seen in the marginal parts of the arable land, mostly on the paths from the village to the field of crops. In these three villages, the abandonment of the arable land is under 0.1% (i.e., part of the degraded arable land of 0.17%, Figure 1), and these species could not spread too much compared to neighboring villages such as Ațel or Dupuș, also from Sibiu County [7].

2.2. PGRFA listing for their heritage value.

Based on the results of the applied survey and published in 2020 [9,10] we identified for this study 20 PGRFA that are important for locals to be cultivated in their home gardens for more than 100 years (Table 1). These results have been endorsed by local authorities and stakeholders due to their experience.

Table 1. Local PGRFA, which have been used in the traditional home gardens of Moșna commune for more than 100 years, in Sibiu County, Romania.

Crt. no	Scientific name	Household house no. in Moșna localities
1.	*Allium sativum* L.	Alma Vii (182), Moșna (19, 254*, 268, 418) Nemșa (51,111)
2.	*Anethum graveolens* L.	Alma Vii (182), Moșna (268, 418, 420), Nemșa (51,111)
3.	*Apium graveolens* L.	Alma Vii (182), Moșna (254*, 268, 417, 418), Nemșa (51,111)
4.	*Armoracia rusticana*G.Gaertn., B.Mey. & Scherb.	Alma Vii (182), Moșna (420), Nemșa (51,111)
5.	*Artemisia dracunculus* L.	Moșna (417)
6.	*Brassica oleracea* var. capitata L. (Moșna cabbage)	Alma Vii (182), Moșna (1/C, 254*, 268, 418, 402, 461),Nemșa (51,111)
7.	*Petroselinum crispum* (Mill.) Fuss	Moșna (268, 417, 420)
8.	*Phaseolus vulgaris* L. var 'nana'	Alma Vii (182), Moșna (418), Nemșa (51,111)
9.	*Rheum rhabarbarum* L.	Evangelic Church Garden Moșna 530
10.	*Satureja hortensis* L.	Moșna (254*, 206, 420)
11.	*Zea mays* L., (yellow)	Moșna (12)
12.	*Zea mays* L. (red of Moșna)	Moșna (543)
13.	*Cydonia oblonga* Mill.	Moșna (19, 206)
14.	*Prunus armeniaca* L.	Moșna (19, 268)
15.	*Prunus domestica* L.	Alma Vii (182), Moșna (268), Nemșa (51,111)
16.	*Prunus persica* (L.) Batsch	Alma Vii (182), Moșna (254*, 268), Nemșa (51,111)
17.	*Rubus idaeus* L. (Saxon raspberry)	Alma Vii (182), Moșna (19, 417, 530), Nemșa (51,111)
18.	*Vitis vinifera* L. 'Perla negra'	Alma Vii (182), Moșna (254*, 417)
19.	*Vitis vinifera* L. 'Risling'	Moșna (254*), Nemșa (51)
20.	*Vitis vinifera* L. Hybrid	Moșna (417)

*Traditional gardening is located outside the urban area.

Source: Data results based on the home garden survey and locals' statements.

As an exception authorities agreed in the same survey that for animal breeds, they would recognize for the local Bazna Pig as having heritage value. For this, the householder from No. 268 in Moșna was also recognized at local level for its TK related to animal husbandry in line with provisions of the UNESCO Intangible Heritage Convention.

A second set of data covered genetic resources that are recognized by local householders only, and that are slightly different compared to the first list and covers additional 10 crop species (Table 2). In this specific case some of the landraces are cultivated for less than 50 years and therefore they can be considered as creole and have good chances to become landraces.

Table 2. Local PGRFA, which has been used in the traditional home gardens of Moșna commune for more than 50 years in Sibiu County, Romania.

Crt. no	Scientific name	Household house no. in Moșna localities
1.	*Allium cepa* L.	Alma Vii (182), Moșna (254*, 268, 417, 418, 420), Nemșa (51,111).
2.	*Cucumis sativus* L.	Moșna (254*, 268, 417, 418, 420), Nemșa (51,111)
3.	*Cucurbita maxima*Duchesne	Evangelic Church Garden, Moșna (530).
4.	*Lactuca sativa* L.	Alma Vii (182), Moșna (19, 254*, 268, 417, 418, 420), Nemșa (51,111)
5.	*Mentha* L. sp.	Moșna (420)
6.	*Phaseolus vulgaris* L.	Alma Vii (182), Moșna (19, 418, 417, 420), Nemșa (51,111)
7.	*Solanum lycopersicum*L.	Alma Vii (182), Moșna (19, 206, 254*, 268, 420, 417, 418), Nemșa (51,111), Evangelic Church Garden
8.	*Solanum tuberosum L.* (white potatoes)	Moșna (417)
9.	*Spinacia oleracea* L.	Moșna (417)
10.	*Zea mays* L., Turda 200	Moșna (254*)

*Traditional gardening is located outside the urban area.

Source: Data results based on the survey and the locals' statements.

Very important for seed selection systems and agricultural practices are the species with two years per life cycle, such as onions or cabbage. The cultivation of such species implies the knowledge required for seed selection, seedling cultivation, crop maintenance, and use in the future. These skills are essential for applying the best agricultural practices in these traditional villages. By analyzing Tables 1 and 2 it became obvious that householders are integrating new crops into their gardening or field crops today. We mention 'Turda 200', an old Romanian maize cultivar that entered the market in 1976 and is considered by locals to be relevant for cultivation in this region. For the same reason the vineyard cultivars are considered as important for community [7, 9].

There is also the case of 'apple'-pepper variety especially cultivated by the Hungarian population, which is very much appreciated in this region and integrated into their gardens as well as yellow raspberry variety without thorns in one case [9]. In addition, to understand the landraces abundance all data were statistically interpreted for calculating the following indexes: Shannon index, Simpson index and Margalef index. Based on the results of these analysis the richness in landraces reflect a medium value for Margalef index (i.e., low bellow 2, medium between 2 and 6, and high over 6) (Table 3).

Table 3. The statistical analysis of landrace abundance is expressed based on the Shannon index and Simpson index as well as on the Margalef index calculations

Landraces as crops species	No of investigated home gardens	Shannon index	Simpson index	Margalef index
20	16	2.509138	0.096217	4.461375

Source: Own calculation.

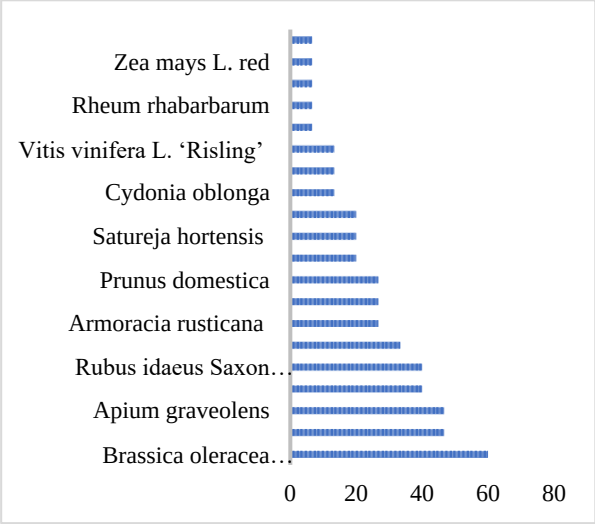


Fig. 3. Most popular species as landraces cultivated in surveyed home gardens as crops, shrubs, and fruit trees Moșna, Sibiu County, Romania
Source: Own design and results.

3. Traditional home gardens recognition for their heritage value at local level. Upon the analysis of the composition of home gardens, it was established based on the proven knowledge, including seed selection systems and agricultural practices, for at least 15 householders as families their continuing implementation during their lives of the same agricultural practices (i.e., seed selecting system, cultivation, storage, and use) as they were transmitted and inherited from their ancestors (Table 4).

We mention that all surveyed locals proved to be able to test and introduce new species and keep co-existence for different cultivars (e.g., Saxon raspberry and without thorns raspberry, new peppers varieties, 'apple' pepper and other classic cultivars, tomato cherry versus old landraces of tomato) [8, 9, 10].

Table 4. Traditional Saxon home gardens in Moșna commune, Sibiu County, Romania, recognized by local authorities.

Crt. No	Household no. in Moșna localities	Landraces and animal bred in home gardens of heritage values
1.	Moșna 254*	Garlic, onion, tomatoes, Moșna cabbage, thyme, yellow maize with 8 rows cobs, celery.
2.	Moșna 418	Moșna cabbage, tomatoes, dwarf beans, thyme, celery.
3.	Nemșa 111	Onion, garlic, plum-trees, thyme, celery, Saxon raspberry.
4.	Moșna 206	Thyme, celery, horseradish.
5.	Moșna 268	Salad, tomatoes, Moșna cabbage, dill, cucumbers, Bazna pig.
6.	Moșna 12	yellow maize with 8 rows cobs, thyme, celery.
7.	Alma Vii 182	Garlic, onion, Moșna cabbage, eggplants, Saxon raspberry.
8.	Moșna 420	Tomatoes, thyme, beans, parsley, dill.
9.	Moșna 417	Vine Nova, beans, potatoes, Saxon raspberry, thyme, celery
10.	Moșna 19	Saxon raspberry, quince, apricot, thyme, celery.
11.	Moșna 530	Pumpkin for pies, tomatoes, Saxon raspberry, rhubarb, thyme, celery.
12.	Nemșa 51	Garlic, onion, Saxon raspberry, plum-trees, thyme, celery.
13.	Moșna 461	Moșna cabbage, thyme, celery.
14.	Moșna 1/C	Moșna cabbage producer for selling, thyme, celery.
15.	Moșna 402	Moșna cabbage, thyme, celery.

* Traditional gardening is located outside the urban area.

Source: Information collected from local authorities.

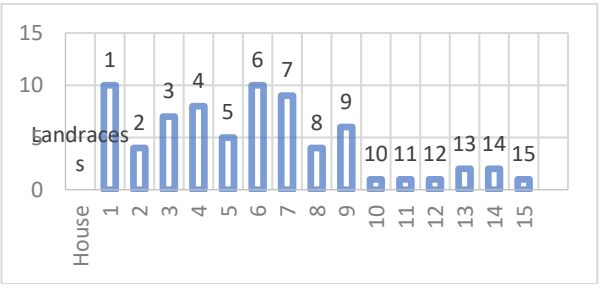


Fig. 4. The abundance of landraces in the 15 surveyed traditional Saxon house gardens.
Source: Own design and results.

Note: It can be observed that 9 householders are cultivating most of the surveyed landraces.

The most cultivated landrace is Moșna cabbage, followed by garlic. In the fifth position is the Saxon raspberry, which has been cultivated for more than six centuries in the region (Figure 3). A maximum of ten landraces per home garden were recognized (Figure 4). During these discussions, all lists suffered slight changes. upon which all agreed to be part of the future local Council Decision.

4. The historical context of traditional land use of Saxon-origin households. The evolution of human civilization in the past 100 years has created tremendous changes at the interface between humans and the environment, associated nowadays with huge costs over nature restoration and conservation [27, 90]. The quest for accessing new natural resources as well as for developing or maintaining polluting technologies for the past two centuries is paid today with the tremendous loss of biodiversity at the global level [13, 26, 79, 83]. Among the major threats to the future of our civilization at the global level, we may cite the decreasing access to nutritional food [30, 53, 71, 102] and potable water [103] as the groundwork for our continuity [17]. However, human civilization is today facing additional challenges such as those generated by biodiversity loss [7, 20, 53, 70], shook effects of climate change, and desertification [42, 46]. Of particular interest in our future development are the appropriate measures to be implemented for agriculture under the sustainable development goals [92], where a focus should be on soil fertility preservation and improvement [94]. On the other hand, by recognizing the values of intangible cultural heritage, rural communities become once again the subject of such types of analysis at the global level [23, 50]. Moșna locality has been historically documented since 1280 as a Saxon village with a fortified church called "Mäschn" in German, or sparrow. Saxons are ethnics of German origin that were settled in Southeast Transylvania, mainly during the XII century. Today, the commune includes the villages Nemșa (original German name is "Nymps") first historically documented in 1359, and Alma Vii (whose original German name is "Almasium"), mentioned in 1356 all three of which were originally inhabited by Saxons. Other at least 11 similar communes exist, located especially in the northeast of Sibiu County, and all of them have been constructed based on rigorous village spatial planning dominated by fortified churches for creating independent, resilient communities that prove their success during history [3, 5]. During the XIX century, these localities started accepting Romanians ethnics, and after 1970, the ratio changed for Romanians [69, 89]. Nowadays, the above authors have identified and defined a strong local cultural identity for these communities of Saxon origin.The general spatial planning and land use management, including agricultural land, of the commune were well preserved and included in the current spatial planning, mostly due to the relief peculiarities not supporting intensive agricultural practices. The main access roads are towards Mediaș (i.e., 10 km), being at least in the 19th century the main producer of high wine quality in the region. As the distance towards Sibiu was high (i.e., 66 km) and the location was off the national roads, these localities remained archaic or remote compared to others in terms of implementing intensive agriculture practices [5, 69, 89]. As a result, we are embracing nowadays a high nature value of biodiversity in this village and in similar Saxon origin villages as well [3, 5, 69, 93].

The commune Moșna is also located in a hilly area covered for 43.38% of its territory by the ROSPA0099 Podișul Hârtibaciului, the most extensive SPA in the interior of Romania, and 0.01% by ROSCI0227 Sighişoara–Târnava Mare [54, 66].

In this case, by starting survey research for landraces in Moșna commune on several occasions after 2013 up to 2019, new subjects became of high interest for us. Thus, the interviews with local authorities and householders revealed new subjects of high interest, such as the discovery of TK related to agricultural practices. Moreover, it was underlined once again the relevance of these villages for nature conservation as a whole and related to the heterogeneous landscape.

Thus, in our attempt to define specific home gardens we discovered that up until today no study was realized in Romania on this subject. However, certain studies revealed the relevance of farming positive impact on nature conservation [24, 69]. Therefore, based on our observations, several indicators were already defined for home gardens survey and assessment, among which we may mention the following: 1) the historical topography inside the households; 2) the continuous cultivation of old landraces; 3) the integration of wild genetic resources into the household needs; 4) risks and vulnerabilities for traditional and local knowledge erosion; and 5) capacity building at the local level [9]. However, the topography for traditional land use inside the households was not studied yet in Romania. Such studies have been realized also in different countries being recognized the lack of academic studies that may further substantiate the spatial planning for the sustainable use of natural resources [68]. In this respect we mention the results of similar studies in China [104], Ghana [2], or Ecuador [72]. In Europe, similar studies have been published for Spain [36], Greece, and others [49], but not too many for the Eastern European countries.

The major attribute of these Saxon origin villages is their position in natural fragmented landscapes due to the relief properties, having access to major natural resources, and ensuring all communities' needs to survive as fortified churches [3, 89]. As mentioned above, during the XIXth century, these villages were occupied mostly by the Saxon population but slowly also integrated Romanians [89]. The transfer of traditional knowledge related to agriculture was ensured at the community level and transmitted up to nowadays, based on similar principles already identified in different indigenous communities [96]. Our results supported the idea that in these remote villages, it was possible to be further preserved customs and knowledge related to agriculture, such as seeds selecting systems, crop cultivation, traditional land-use inside the household, and sustainable access to natural resources.

As a general peculiarity we mention that for home gardens of Saxon origin, the heterogeneity of agricultural land is in direct connectivity to forests, pastures, creeks, and grasslands (Photo 1a) which is in line with previous studies [5, 80, 89]. However, the mosaic appearance of arable land provides excellent conditions for the richness of biodiversity in direct connectivity to wildlife. Under these conditions, which are also imposed by relief, arable land plots can be found both inside and outside urban areas [80]. Each agricultural plot outside the urban areas is cultivated with different crops on less 10 ha, most of them less than 1 ha and larger plots areas are integrated into the semi-natural landscape.

The main characteristics of these households belonging to the three Saxon origin villages that can support further sustainable rural development ideas for circular economies under the Green Deal [82] in the regions and are relevant for this study are as follows: 1) general land use inside households is similar (i.e., constructed areas are occupying less than 1/3 of green areas); 2) traditional home gardens (i.e., for vegetable cultivation), orchards, vineyards, and grasslands are mostly located inside the household in the urban area; and 3) the intimate contact of households and home gardens with forests, pastures, meadows, and creeks ensures the long term wild-life contact with agro-ecosystems and further support the status of these heterogenous agricultural lands as hotspots of biodiversity conservation.

The fact that traditional Saxon-type home gardens still exist in localities such as Moșna, Alma Vii, Nemșa entrusts us to consider that future spatial planning in rural areas in Romania needs to refer to such households to ensure the resilience of rural communities for the future [77].

Based on these study results, three different types of land-use households exist today in these villages: 1) traditional Saxon properties; 2) slightly modified traditional Saxon properties; and 3) profoundly modified properties. Also, we mention that generally, the alteration of the traditional land-use of household is not so profound, and it is

relevant for the future that urban spatial planning be realized according to the principles of ensuring sustainable access to resources. These principles may further support the development of strong, resilient rural communities facing the dramatic effects of climate change while also ensuring the integration of new agricultural technologies based on existing local knowledge [96].

Investigating home gardens for crop diversity, we are able to underline that they are occupying a central role inside the household. The position of the home garden is not changing often due to the orchard and vineyard's locations. However, the location of cultivated vegetables inside the home garden is changed annually, and all 15 owners proved to have knowledge related to seed selection systems, seedling cultivation, preservation, and use of these PGRFA. The best place of construction area is chosen to be in the upper part of the household. Therefore, the home garden can be positioned with the best sun orientation and access to water. The dimensions of the home garden cover the food needs of the owners for a one-year period in the case of traditional Saxon home gardens. The rest of the investigated home gardens cover the same needs, but there are changes in household land use. Having these, the home gardens can be considered traditional if they are applying the same principles for crop cultivation, seed selection systems, seedling cultivation, preservation, and use, ensuring the resilience of the householders. A similar situation was already described in Spain [82]. In our case the reference household is that of the group of eight houses that was build up in 1785 and the household land use remained unchanged for more than 100 years. And more, these communities proved to be resilient over time, like others [77].

4.2. Home gardens and PGRFA with heritage value. The official *listing* process upon the PGRFA listing of identified landraces and discussions with all involved stakeholders, a list of legal reasons why such lists should be recognized at the local level as having cultural heritage value for their communities was presented. The major question raised was: Who can certify that these genetic resources are unique? This is a pertinent question. However, the need to identify their existence as specific landraces is imposed due to the risks of genetic erosion [7]. Thus, if there is TK already transmitted through generations in their families or in their community, the process itself should be preserved, which will further ensure the access of local communities that are well trained in the cultivation of specific PGRFA [7]. Consequently, the discussion of paradigm certified- versus self-recognized seeds, gained local authorities' interest in the second in similar cases, like in Amazonia [88]. And way? Because of proving the existence of erosion processes in terms of the social dimension of the local community for more than 30 years [7]. In this case, 12 owners are over 70 years old, proving that there is a major vulnerability to continuing the process of local and traditional knowledge transmission through generations. These remark in line with official reports data [5].

In this case, old families are cultivating traditional gardens with traditional genetic resources, and such recognition should support the promotion of these values in all communities furthermore supporting food security for the future.

Aside from such discussions, the traditional and local management of heterogenous agricultural lands was recognized as becoming more complex under the shock events of climate change as well as food insecurity at the local rural level. Consequently, the very first measure should be the securing of all resources (i.e., tangible and intangible) [75]. Among these resources, we underline that local knowledge securing need for direct connectivity with agriculture management [86]. Moreover, if this activity is associated with local pride, the future implementation of innovative agricultural practices is ensured for the long term [16, 65].

Two European directives were mentioned as reasoning for local council decision issuing and approval [7]: 1) Commission Directive 2008/62/EC of 20 June 2008 providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion

and for marketing of seed and seed potatoes of those landraces and varieties; and 2) Commission Directive 2009/145/EC of 26 November 2009 providing for certain derogations, for acceptance of vegetable landraces and varieties which have been traditionally grown in particular localities and regions and are threatened by genetic erosion and of vegetable varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions and for marketing of seed of those landraces and varieties.

In terms of capacity building, the list of reasoning refers to the national regulatory framework on the subject and for administration, as well as the European regulatory framework on the subject of the local decision to prove that it is in line with the EU legal framework [7].

The text of the local decision recognizes the provisions of 10 articles that are including among others the heritage value of the following items: 1) The list of crop plant species cultivated in Moșna commune according to the AGR 2A form (the current data sheet form for collecting data related to agriculture production and land use) [8, 9, 10]. 2) The list of cultivated plant species cultivated for more than 50 years [8, 9, 10]. 3) The list of local populations cultivated for more than 100 years. 4) The list of ancient animal breeds. 5) The list of families owning local varieties with heritage value. 6) The list of traditional home gardens.

The text of this decision stated that *future development strategies for agriculture will take into account the conservation and sustainable use of local varieties and ancient breeds of animals, as well as the promotion of families that own such resources.*

The local council decision was approved by the Commune Council on 29.11.2019.

We mention that it was the first decision on this subject taken at the local level in Romania. The promotion of pride at the local level related to agriculture, which is among their daily life activities, may support rural communities to further ensure food security for the future and to increase their resilience. Such an approach was needed to be exercised in our country, as Romania does not yet have a national strategy adopted for the conservation and sustainable use of PGRFA under the Plant Treaty [7, 9]. Certain constraints of the process should also be underlined. Communication with the householders was not possible without the support of local authorities and stakeholders. Local communities are not open to foreigners. However, once they open their homes, they instantly offer all the needed information for this type of survey. Another constraint is coming from the authorities as well. They are also not very open to discussing this with universities without the support of local stakeholders. Our support was ensured by local stakeholders after more than 10 years of working together. This might be a long process of building trust between science, authorities, and local communities. With this, we consider that it was a real success to have the very first official local council decision related to the recognition of landraces as having heritage values for their communities. This approach will further support capacity building at the authority's level in charge of the conservation of genetic resources as a basis for new breeding programs all over the country. The Multilateral System may provide access for crop breeding laboratories working on different plant species in a broader genetic pool, including from on-farm, officially recognized gene banks [55].

CONCLUSIONS

A major role in a households' life aretraditional home gardens preservation and a specific land-use pattern inside the household for supporting the needs of their family in Moșna commune, Romania. Today, about 26% of the current household land use is covered by Saxon origin home gardens and 20.17% of households are still preserving the original traditional land use for more than two centuries. In these households, a mix of traditional and modern agricultural practices are applied, from seed selection system to, preservation, cultivation, and further use. 20 landraces have already been recognized as being of heritage value at the local level.

Aside from these, creole landraces have been recognized for their heritage value, including an old Romanian maize cultivar 'Turda 200' placed on the market in 1976. The existing continuity between these heterogenous agricultural lands and forests, pastures, grasslands, meadows, and creeks further contributes to biodiversity conservation and may be reference models as functional agro-ecosystems. The value of Margalef index supports the richness in landraces for these home gardens. TK related to wild species collection, preservation, and use further supports biodiversity conservation. These Saxon origin households provide us with historical reference and traditional land use cover, to better understand what a resilient rural community should be. This would respond to current sustainable rural development policies for supporting a circular economy, low costs of energy under the Green Deal, and fast connectivity to breeders through the Multilateral System based on seeds gene banks.

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