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THE POTENTIAL OF PRESERVING CROP AGROBIODIVERSITY TO ENHANCE FOOD SOVEREIGNTY IN ROMANIA

Master Thesis

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Résumé: Le problème étudié dans ce Mémoire de Master est lié au potentiel de préserver l'agrobiodiversité végétale pour développer la souveraineté alimentaire en Roumanie. Afin d'englober le plus possible l'étude, les principales questions de recherche ont été focalisées sur la découverte de l'actuelle situation des semences traditionnelles en Roumanie, et de l'utilisation de ces semences dans les marchés locaux et les chaines courtes alimentaires. Des sondages liés à l'utilisation de ces semences et à l'opinion des fermiers ont été créés et des études de marché ont été réalisées. Une étude de durabilité a aidé à évaluer les systèmes paysans de production impliqués dans ces chaines. Les résultats montrent que de nombreux fermiers utilisent ces semences dans les marchés locaux et les chaines étudiés (95% respectivement 87.5%). De plus il y a une présence importante de produits provenant de ces semences. En général les paysans des marchés ont une opinion positive sur les bénéfices obtenus en utilisant ces semences. D'un autre côté les fermiers des chaines alimentaires courtes ont des visions et des objectifs différents en utilisant ces semences. Néanmoins leurs fermes sont durables en ce qui concerne les dimensions socio-culturelle et environnementale. En conclusion préserver l'agrobiodiversité végétale a le potentiel d'améliorer la souveraineté alimentaire, si la durabilité économique des fermes est optimisée en vendant par des réseaux alimentaires alternatifs, créés avec des paysans et consommateurs qui comprennent et apprécient les bénéfices obtenus en utilisant les semences traditionnelles.

Abstract: The main problem studied in this MSc Thesis is related to the potential of preserving crop agrobiodiversity to enhance food sovereignty in Romania. In order to cover as much as possible this study, the main research questions were focused on revealing the actual situation of traditional seeds in Romania, and whether traditional seeds are used in local food markets and short circuit supply chains. Surveys focused on traditional seeds use and farmers' opinions about these seeds were created and market studies were conducted. Further on a sustainability assessment helped to evaluate the peasant production systems involved in the same short chains. Results point out that many farmers use traditional seeds in the local food markets and short circuit supply chains investigated (95% respectively 87.5%). In addition there is a strong presence of products made using traditional seeds. Overall peasants from food markets have a positive opinion about the benefits obtained from using traditional seeds. On the other hand the farmers from short chains have different visions and objectives while using these seeds. Nevertheless their farms are sustainable regarding the sociocultural and environmental dimensions. To conclude, preserving crop agrobiodiversity has potential to enhance food sovereignty in Romania, if the economic sustainability of farms is improved by selling through alternative food networks, created with peasants and consumers that understand and appreciate the benefits obtained from using traditional seeds.

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Host institution: Eco Ruralis

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List of abbreviations/acronyms

ASAT: Asociatia pentru Sustinerea Agriculturii Taranesti (Association for Supporting Peasant Agriculture)

BRGV: Banca de Resourse Genetice Vegetale Suceava (Bank of Genetic Vegetal Resources of Suceava)

CAP: Common Agricultural Policy

CSA: Community Supported Agriculture

ECPGR: European Cooperative Program for Plant Genetic Resources

ECVC: European Coordination La Via Campesina

MESMIS: Marco para la Evaluacion de Sistemas de Manejo de Recursos Naturales Incorporando Indicadores de Sustentabilidad (Indicator-based Sustainability Assessment Framework)

NGO: Non-Governmental Organization

SAVE: Safeguard for Agricultural Varieties in Europe Foundation

SEEDNet: South East European Development Network on Plant Genetic Resources

SPSS: Statistical Package for the Social Sciences

SWOT: Strengths, Weaknesses, Opportunities and Threats

USAMV: University of Agricultural Sciences and Veterinary Medicine

WWOOF: World-Wide Opportunities on Organic Farms

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1. Introduction

1.1. The Romanian agroecosystem context

Romania is an Eastern European country with a long history in peasant agriculture which can be traced back more than 2000 years ago, and with unfortunate historical episodes, being dominated by neighboring empires and more recently by communists until 1989 (Knight 2010). Nevertheless the peasant culture and knowledge have subsisted until today, and nowadays Romania has the highest percentage of population working in the agricultural sector in the European Union (i.e. 30% in 2008). Even though this percentage is almost five times higher than the EU average, concerning the average size of the farm holdings, Romania is placed on the opposite side, with around 3.3 ha per farm. Nonetheless Romanian agriculture is represented mainly by two opposite types of agroecosystems: subsistence agriculture (with 2.6 million of farms under 1 ha in 2008) and industrial agriculture (with 9600 farms over 100 ha in 2008). The middle-sized farms (between 10 and 100 ha) represent only 12% of the agricultural surface, therefore this type of agriculture is under-developed (Luca and Ghinea 2009). Being integrated in the EU and in the Common Agricultural Policy (CAP) since 2007, Romania had to comply with the agricultural reforms and receive subventions based on farm surfaces. Since 2007, the payments were gradually increased from 25% of the amount received by UE-15, up to 90% in 2015. Moreover the Romanian Government decided that farms with a surface under 1 ha could not apply for European subventions, meaning that 2.6 million of farms don't receive any payments. Consequently subventions are mostly received by agro-industrial farms. Indeed as an example, 1% of the farms (those over 100 ha) received 51% of the CAP subventions allocated to Romania in 2008 (Luca and Ghinea 2009).

Nevertheless, Romanian agriculture is nowadays "plagued by many problems" such as: "the lack of vision behind policies", "the persistence of poverty and aging in the Romanian countryside, a lack of quality rural development" and "regional differences within Romania" among others (Knight 2010, p. 5). Indeed, having been dominated by a communist system during 40 years, and having a particular topography with one third of Romania's surface being covered by the Carpathian Mountains (WWF 2014), Romanian agriculture is weakened by the low productivity and the lack of farmers' organization as a result of the communist collectivization trauma. Even though a large central part of Romania has been preserved from collectivization due to the lack of interest of the communist system in mountain areas (Webster et al. 2001), there is a persistence of poverty in the Romanian countryside and an important lack of rural development (Knight 2010). However studies have shown that integrating rural development and biodiversity conservation in central Romania, which is "characterized by an exceptionally high level of farmland biodiversity" (Mikulcak et al. 2013, p. 129), could be achieved if EU rural development policies would be more adjusted to fit local conditions and if cooperation among stakeholders would increase. It is

certain that “rural development goals cannot be pursued in isolation from social and ecological goals” (Mikulcak et al. 2013, p. 135), therefore the new CAP needs to be adapted to the local environment.

And yet, since 2015 a new CAP has been established, with the latest National Rural Development Program (Government of Romania 2015). The new plans of the Ministry of Agriculture and Rural Development seem to be very promising and are meant to support in a sustainable way the socio-economic development of rural areas. For this reason an evaluation study of the socio-economic potential of rural areas has been realized last year, in order to prioritize municipalities according to their financial needs under the measure 7.2 “Investments for the creation and modernization of the basic infrastructure at a small-scale” (PNDR 2014). Furthermore an evaluation and a classification of the agricultural production potential has been elaborated for all the municipalities concerning cereals, several field crops (e.g. soya, rape, potatoes, sugar beet, leguminous plants), grasslands, vegetables, medicinal plants, grapevines and rice production (Government of Romania 2015). Moreover specific national strategies for a sustainable development of the disadvantaged mountain areas have been elaborated (MADR 2014). Their objectives are, on the one hand, to increase the economic competitiveness and the attractiveness of these mountain areas, and on the other hand, to improve biodiversity conservation and natural resources conservation. Future evaluations of these strategies will assess whether these governmental plans have helped towards a sustainable development of these rural areas and disadvantaged mountain areas.

Nonetheless, Romania’s agriculture has “enormous potential, but faces robust challenges to improving performance” (Rowe 2012, p. 2). Main challenges identified are related to poor capital access and “semi-subsistence farmers’ inability to sell to large market chains” (Rowe 2012, p. 2). As a fact, studies have revealed that Romanian retail sector has rapidly evolved over the past years, especially since Romania became a member of the EU (Prada 2008). Indeed, research studies in retail “reveal the evolution of new types of commerce in the detriment of those represented by traditional commerce” (Prada 2008, p. 169). However the author indicated that small local retailers could survive to large market chains if they propose new and diverse range of products adapted to their clientele, and if they promote their own brands. One interesting idea would also be to promote Romanian traditional products which are being largely produced in the countryside (Tudor et al. 2013). It is acknowledged that there is an increasing demand for high quality products and traditional products. These local, traditional products are produced, processed and sold directly by farmers, which results in the creation of “the shortest marketing chain” (Tudor et al. 2013, p. 249) and of a solution of rural sustainable development.

Even so, it is important to suggest that a part of the solution towards the sustainable development of the Romanian agroecosystem could be related to the development of the organic farming sector. Studies have revealed that the main organic crops in Romania are obtained from cereals and oilseeds. As a fact, the “surfaces of cereals under organic systems increased four times, in the period 2006-2010” (Ion 2012, p. 452). Yet, the organic sector is still insignificant in the agro-food system since it represents between 1 to 4% of total agricultural area (Ion 2012), and with 40 farms registered in the Romanian

World Wide Opportunities on Organic and Traditional Farms (WWOOF 2015), the network of organic farms is still under development but on the increase.

1.2. The state of the art

Conserving crop agrobiodiversity in Romania was already an important concern starting 25 years ago. Indeed the National Bank of Genetic Vegetal Resources of Suceava (BRGV 2015) was established as a public institution in 1990. The goals of this gene bank are to conserve ex situ genetic vegetal resources that are important for Romanian agriculture and to use those resources in order to benefit the environment and the society. The gene bank is responsible of inventorying and collecting genetic vegetal resources, characterizing the genetic material conserved, multiplying seeds and testing seeds viability, and participating in several national and international collaborations and research projects.

An important milestone for Romanian agrobiodiversity was achieved in 1999 when a key event was organized in Suceava (SAVE Workshop-Report 1999), by SAVE (Safeguard for Agricultural Varieties in Europe) Foundation (SAVE Foundation 2015) in cooperation with the National Bank of Genetic Vegetal Resources of Suceava. The workshop gathered together several Carpathian countries (Poland, Romania, Slovakia, and Ukraine) in order to discuss about rare breeds and plant varieties monitoring and conservation strategies in the Carpathian Mountains. At the time, it was stated that in Romania there were many vegetables endangered (especially perennial vegetables) but there was no data available in 1999. Only a couple of vegetables (Curcubitaceae family and onions) and several field crops (common wheat (*Triticum aestivum*), einkorn wheat (*Triticum monococcum*), common oat (*Avena sativa*), mountain perennial rye (*Secale montanum*), two-rowed barley (*Hordeum distichon*), buckwheat (*Fagopyrum esculentum*), maize, and potatoes landraces) were listed as endangered plants in Romania. The conclusions of the workshop concerning vegetables and crops were that local gene banks should secure the collection of seeds, and that a "systematic inventory of existing local varieties in the Carpathians Mountains" and a "database on existing resources in situ and ex situ" should be organized (SAVE Workshop-Report 1999, p. 25).

Furthermore, since 1993 the Gene Bank of Suceava is a partner of the European Cooperative Program for Plant Genetic Resources (ECPGR 2015), of the South East European Development Network on Plant Genetic Resources (SEEDNet) (Sustar-Vozlic et al. 2011), and collaborates in several research projects. This Gene Bank is also the chair of the Cereals and Maize Working Group within SEEDNet (Sustar-Vozlic et al. 2011) and contributes to the European ex situ Plant Genetic Resources Web Catalogue (EURISCO 2015). Over recent years, the Gene Bank of Suceava has contributed to several important research projects (Table 1). Therefore this Gene Bank represents an essential pillar in preserving crop agrobiodiversity in Romania.

Table 1. Important research projects for the National Gene Bank of Suceava

Research projects	References
The inventory of local populations of maize in the Carpathian Mountains (2000-2002)	BRGV 2015
The inventory of genetic diversity of traditional varieties in Romanian peasant farms (2002-2003)	BRGV 2015
The inventory and collection of traditional varieties of cereals in Apuseni Mountains in Romania (2007-2008)	BRGV 2015
The collection of local landraces of maize and cereals in South Eastern Europe (2009-2010)	Simeonovska et al. 2013
The characterization of European *Avena* genetic resources (2007-2011)	Murariu et al. 2013
The collection of plant genetic resources important for Chinese and Romanian agriculture (2013-2014)	BRGV 2015

Another major actor in crop agrobiodiversity research in Romania is USAMV Cluj-Napoca (University of Agricultural Sciences and Veterinary Medicine). Over the past years, Prof. Dr. Maxim and his team of researchers from USAMV Cluj-Napoca have performed several important research studies concerning local crop agrobiodiversity (Table 2). Only between 2007-2010, "290 peasant vegetable cultivars (tomatoes, cucumbers, carrots, parsley, lettuce)" (Maxim et al. 2011, p. 93) have been studied at USAMV Cluj-Napoca "for their characterization, seed production and seed conservation in gene banks" (Maxim et al. 2009, p. 148). It is important to emphasize that all these different local authentic varieties identified and characterized by USAMV Cluj-Napoca over the past years have been introduced in the National Bank of Genetic Vegetal Resources of Suceava.

Table 2. Important research studies about crop agrobiodiversity at USAMV Cluj-Napoca

Research topics	Important results	References
The collection and preservation of genetic diversity of local vegetable varieties	57 carrot, 63 parsley and 70 lettuce varieties collected	Maxim et al. 2007a
The study of seed quality of local Romanian vegetable varieties	59 carrot, 60 parsley and 68 salad varieties studied	Maxim et al. 2007b
The study of genetic diversity of carrot *(Daucus carota)*	27 local authentic varieties proved	Maxim et al. 2008
The conservation of genetic diversity of parsley (*Petroselinum crispum* MILL.)	54 local authentic varieties proved	Maxim et al. 2009
The conservation of genetic diversity of cucumber (*Cucumis sativus* L. Mill)	12 local authentic varieties proved	Maxim et al. 2011
The conservation of Romanian landraces of tomatoes	28 authentic landraces proved	Maxim et al. 2012

Nonetheless, conserving crop agrobiodiversity has become an important battle also for Romanian civil society over the last years. Eco Ruralis (which was the host association of this MSc Thesis) (Eco Ruralis 2015) is a Non-Governmental Organization (NGO) registered under the Romanian legislation, with 1800 actual members on the increase. These comprise many family farmers whom are mostly peasants, small organic farmers including from World-Wide Opportunities on Organic Farms (WWOOF), urban and rural gardeners as well as agricultural activists. This diverse group of people serves as a strong unified voice that advocates for non-industrial, small-scale traditional agriculture. This NGO is member of the European Coordination La Via Campesina (ECVC), of ECVC Seed Working Group, and is connected to national and international networks that work on many agriculture-related issues. The organization actively supports a movement of young farmers that preserve traditional farming practices and assert their control over food production and land rights. The concepts of agroecology and food sovereignty are central pillars of Eco Ruralis. This NGO has a main focus upon maintaining traditional seeds via its Agrobiodiversity Campaign. "Romania is facing the loss of traditional seeds due to intensive farming methods with the use of industrially-made seeds promoted by large multi-national corporations like Pioneer and Monsanto" (Eco Ruralis 2015). Therefore Eco Ruralis works on this issue because traditional seeds allow small-scale peasants and family farmers to practice sustainable and environmentally-friendly agriculture which can feed the world (La Via Campesina 2010, Vredeseilanden 2008a). Eco Ruralis collects traditional seeds from Romanian peasant farmers and other European countries. This NGO works in one local organic garden in Cluj-Napoca where traditional seeds are multiplied and collected, and also collaborates with local seed guardians (farmers which contribute to seed production and exchange) and with Prof. Dr. Maxim from USAMV Cluj-Napoca to analyze and describe the characteristics of the varieties. Annually, the association designs a seed catalog, organizes a free national distribution of traditional seeds and holds traditional seed exchanges so that many people can have access to traditional seeds across the country.

On the other hand, food sovereignty, promoted by La Via Campesina and its association members, "prioritizes local food production and consumption. It gives a country the right to protect its local producers from cheap imports and to control production. It ensures that the rights to use and manage lands, territories, water, seeds, livestock and biodiversity are in the hands of those who produce food and not of the corporate sector" (La Via Campesina 2015). It is a necessity to find the best way to promote food sovereignty in the Romanian agroecosystem context, since this country has an important agricultural potential with 62% of its total surface being agricultural land (Pana 2011). Family and peasant farmers are "perfectly capable of providing sufficient food for the entire world" (Vredeseilanden 2008b, p. 1). Moreover since Romanian population living in the rural areas represents the highest percentage in Europe (43.6 %) (Popa 2015), there is a high potential in producing local food in those rural areas. However it is acknowledged that farmers are "trapped between suppliers and customers" (Vredeseilanden 2008b, p. 1), and that their position makes it difficult to elaborate a sustainable food chain. Nevertheless, an important MSc thesis research hosted by Eco Ruralis has revealed that functional alternative food networks exist in

Cluj-Napoca (Smeds 2014). These alternative networks, based on community supported agriculture (CSA) and direct selling box schemes, involve "close producer-consumer connections and an emphasis on local and organic produce" (Smeds 2014, p. 2). The alternative food networks studied were ASAT - Asociatia pentru Sustinerea Agriculturii Taranesti (Association for Supporting Peasant Agriculture), established in 2008 (ASAT 2015) and Cutia Taranului (Peasant's Box), established in 2012 (Cutia Taranului 2015). It was assessed that these networks contribute to a sustainable food chain by promoting agroecology and peasant farming. However the question arises whether these alternative networks can also contribute to the conservation of crop agrobiodiversity and to the promotion of food sovereignty within the Romanian agroecosystem context.

1.3. Scope and relevance of the Master's thesis

The main scope of this Master's thesis is to study the potential of preserving crop agrobiodiversity to enhance food sovereignty in the Romanian agroecosystem context. One the one hand, this Master thesis is important because protecting agrobiodiversity and enhancing food sovereignty are interconnected and represent essential objectives in agroecology. Indeed, encouraging farmers to work with traditional seeds that are adapted to the local environment, and promoting local food production, commercialization and consumption are key solutions that can trigger on the long-term environmentally and socio-economically sustainable agriculture. On the other hand, this Master thesis is important because it will provide new knowledge about the potential of preserving crop agrobiodiversity to enhance food sovereignty in Romania. In this thesis crop agrobiodiversity is related to traditional seed diversity (also called landraces) from different crops such as vegetables, aromatic and/or medicinal plants and cereals (e.g. maize), which provide the staple food in Romania. I expect that the results of this master thesis will provide a viable solution to enhance food sovereignty, by proposing a model of environmentally and socio-economically sustainable short supply chain for traditional small-scale peasant farmers producing food with traditional seed varieties.

1.4. Problem studied and research questions

Following the scope and relevance of this MSc thesis, and acknowledging the complexity of the Romanian agroecosystem context, the main problem in this thesis is related to studying the potential of preserving traditional seeds to enhance food sovereignty in Romania. In order to have an overall study of this problem, I formulate my research questions and hypothesis for this thesis as follows:

1. *Are traditional seeds still being widely used in Romania? Are there enough networks of traditional seed savers, and are they meeting the demand of producers? What positively and negatively affects the future growth of traditional seed propagation?*

My hypothesis is that traditional seeds are not widely used, mainly because there are not enough networks of traditional seed savers, and they cannot provide the demand of all small-scale producers. My assumption is that the European and Romanian Legislation on seeds are negatively affecting the traditional seed propagation because of strict regulations and high taxes to register varieties on an official catalogue. On the other hand, the improvement of traditional seed savers networks and of public awareness can positively affect the future growth of traditional seed propagation.

2. *Is protecting crop agrobiodiversity a strong priority of the actual Romanian local food markets? Is there a strong presence of products made using local traditional seeds?*

My hypothesis is that for the moment protecting crop agrobiodiversity is not a priority in the actual Romanian local food markets. My assumption is that local food markets include very few products issued from traditional seeds, and this is assumed to be due to the fact that the actual Romanian Market Law (145/2014) restricts small-scale farmers to sell their products in the local food markets, unless they can comply with the formalities and pay high taxes for obtaining a producer attestation, a commercialization notebook and a place to be able to be present in the local food markets.

3. *Is protecting crop agrobiodiversity a driver in short circuit supply chains (direct selling, other alternative food networks including organic WWOOF farms network) in Romania?*

My hypothesis is that direct selling and other alternative food networks favor crop agrobiodiversity and this is assumed to be due to the fact that many small-scale farmers involved in such short circuit supply chains conserve their seeds over the years and/or that they are involved in local seed exchange practices with other farmers and/or with local farmers organizations.

4. *Is protecting crop agrobiodiversity a solution towards environmentally and socio-economically sustainable agriculture in Romania?*

My hypothesis is that small-scale farms working with traditional seeds (by producing their own seeds and/or by exchanging seeds) can be environmentally and socio-economically sustainable provided that their products are integrated in short circuit supply chains (using direct selling or other alternative food networks). The consensual definition which is today commonly accepted to qualify sustainable agriculture is: “A sustainable agriculture is one that, over the long term, enhances the environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole” (Francis and Youngberg 1990).

2. Methodology

2.1. Literature review about traditional seeds: use and networks

In order to be able to answer the first research question, it is essential to elaborate a short literature review about traditional seeds use and traditional seed savers networks in Romania. This review helps to evaluate the actual use of traditional seeds in Romanian agriculture, as well as to evaluate the actual situation of the local traditional seed savers networks and their ability to reach the demand of local producers. In the end the review provides the positive and negative aspects that can affect the future growth of traditional seed propagation in Romania. The literature review is related to academic literature (articles and reports), journal articles, personal experience in Eco Ruralis' Agrobiodiversity Campaign as well as Romanian and European legislations.

2.2. Market studies focused on traditional seeds use

2.2.1. Market study of local food markets

In order to answer the second research question, the methodology consists at first in designing a specific survey (using a Likert-type scale with five-level Likert items) for producers in local food markets (Appendix 1), and in conducting a market study focused on traditional seeds use. The local food markets used for this study are: Marasti, IRA and Gheorgheni food markets in Cluj-Napoca. Both IRA and Gheorgheni are public food markets, with the difference that IRA is opened daily, whereas Gheorgheni is opened only on Thursdays, from June until December. Marasti is a private food market opened daily. A preliminary interview with the Manager of the Public Markets from Cluj-Napoca City Hall was necessary, in order to obtain the permission to conduct the market studies. The data collection was performed in person. The results of the survey assist in evaluating whether protecting crop agrobiodiversity is a strong priority of the actual Romanian local food markets, and whether there is a strong presence of products made using local traditional seeds. The results of the survey are analyzed using IBM SPSS Statistics 20 software, based on a statistical technique called Exploratory Factor Analysis, using Principal Component Analysis (PCA) extraction method. This technique is used to identify and construct different attributes that are important in the mind of farmers interviewed for building their opinions on traditional seeds. The attributes identified are used to create perceptual maps where producers' perceptions are visually displayed in some factors related to traditional seeds. Further on the presence of traditional seeds in the local food markets is evaluated using SWOT analysis, and a "Fact Sheet" presenting this evaluation for Eco Ruralis is elaborated in the Appendix 4.

2.2.2. Market study of local short circuit supply chains

In order to answer the third research question, the methodology is similar to the one used for the previous market study. The methodology consists at first in designing a similar survey, but for producers involved in local short circuit supply chains (Appendix 2), and in conducting a market study focused on traditional seeds use. The local short circuit supply chains used for this study are: Cutia Taranului, ASAT, WWOOF Romanian network and Eco Ruralis members (those concerned by direct farm selling or selling through alternative food networks). The data collection was performed for some in person, but mostly by email using Qualtrics Survey Software (available at: https://wur.az1.qualtrics.com). The results of the survey assist in evaluating whether protecting crop agrobiodiversity is a driver in the actual Romanian short circuit supply chains. The results of the survey are analyzed using the same methodology (i.e. Exploratory Factor Analysis) as explained above. Further on the presence of traditional seeds in the local short supply chains is evaluated using SWOT analysis, and a "Fact Sheet" presenting this evaluation for Eco Ruralis is elaborated in the Appendix 5.

2.3. Sustainability assessment of peasant production systems involved in short circuit supply chains

In order to answer to the last research question, the methodology consists in designing a survey for peasant producers working with traditional seeds and involved in local short circuit supply chains (Appendix 3), and in performing an assessment of the sustainability performance of their small-scale peasant production systems. The local short circuit supply chains used for this study are: Cutia Taranului, ASAT and WWOOF Romanian network. The data collection was performed for some in person, but mostly by email using Qualtrics Survey Software. In this analysis it was decided with Eco Ruralis to perform the data collection while performing the market study of the local short circuit supply chains, and to choose afterwards the most representative peasant production systems that work with traditional seeds. An agricultural activity is sustainable if it is profitable, environmental friendly and socially acceptable. The results of the survey assist in evaluating the environmental and socio-economical sustainability of the peasant farming systems investigated. A comparison is realized between the results obtained from the survey and data collected from average organic crop production systems in The Netherlands. There is also a comparison between the different peasant production systems investigated. The sustainability assessment of the production systems chosen is performed using MESMIS analysis, which is a framework to evaluate the sustainability of natural resource management systems by using a cycle of six steps, in three dimensions: ecology-environmental (EE), sociocultural (SC), and economic productive (PE) (Lopez-Ridaura et al. 2002, Astier et al. 2012).

3. Results

3.1. Literature review about traditional seeds: use and networks

The actual use of traditional seeds in Romanian agriculture is difficult to evaluate in precise terms since there is no data about these specific seeds within the Ministry of Agriculture. It would be very useful to establish a national inventory program of the local traditional varieties; however the interests of seed companies, which have the monopole over seed commercialization, are prioritized by the Romanian Government (Platon 2011). It is acknowledged that Romania represents an important genetic pool of landraces, however the most critical factors responsible for genetic erosion of traditional plant resources are "the aging population in rural areas, the increasing areas of uncultivated land, the fact that most farmers prefer modern varieties and the lack of organization of small traditional seed producers like those in EU's old countries" (Platon 2011, p. 7). Nevertheless, field investigations of the Gene Bank of Suceava have revealed that many Romanian farmers are implicated in conserving in situ/on-farm traditional plant resources. Between 2000 and 2008, the Gene Bank inventoried 47 major crop species with their landraces distributions across Romania. Three areas of interest were identified as presenting the highest concentrations of local varieties: Apuseni Mountains, Suceava County and Maramures region (Figure 1). These regions were not collectivized during the communist period and were protected from modern technologies due to their specific topography. "The data reveal that in almost all major species landraces are continuously cultivated" (Strajeru et al. 2009, p. 139), but the richest genetic diversity conserved on-farm in Romania is represented by beans, maize and potatoes (Strajeru et al. 2009, Platon 2011).

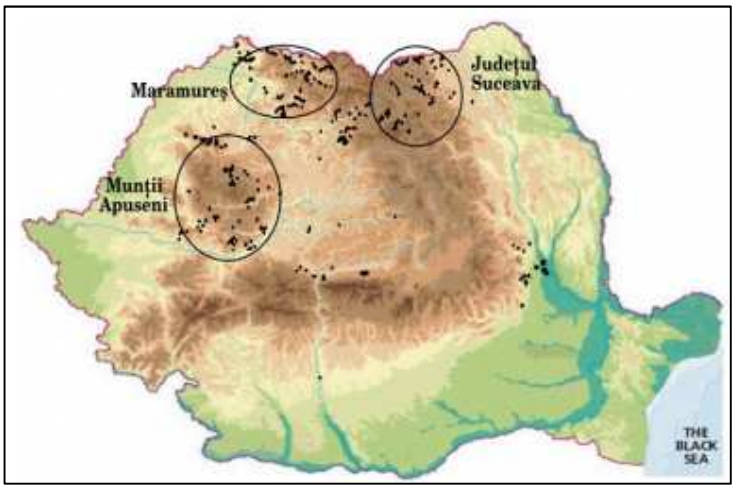


Figure 1. Areas of interest with local varieties in Romania (Strajeru et al. 2009, Platon 2011)

The actual situation of local traditional seed savers networks can be evaluated throughout a literature review about these networks and their ability to reach the demand of local producers. First of all, one of the most important local traditional seed savers is Eco Ruralis association (Eco Ruralis 2015). This NGO has started an annual free national distribution in 2013, based on a traditional seed catalog designed according to the seeds that they multiply and collect from their garden, and also according to the seeds saved by some involved members of Eco Ruralis. A scientific review of their first distribution has revealed that 128 beneficiaries received seeds in 2013 (Marcus 2014). During the latest distribution which

took place in February 2015, over 1300 beneficiaries all over Romania received seeds, which reveals just how successful this distribution was and how the Romanian society is increasingly interested in traditional crop agrobiodiversity. Eco Ruralis is participating as well in traditional seed exchange events and occasional distributions which happen throughout the year at local events and festivals (e.g. Free Seeds Market on February 1, 2015 in Cluj-Napoca, and Moara Veche event on May 16, 2015 in Hosman village, Sibiu). The NGO works with two involved families which save seeds for Eco Ruralis' distribution and also sell them throughout specialized websites (Cucu 2015, Lalu 2015). Nevertheless, Eco Ruralis wishes to expand their network of seed savers in Romania and as a result, establish a network of seed guardians. Currently the NGO is sending traditional seeds to some farmers so that they can contribute to Eco Ruralis' traditional seed distribution starting with 2016. On 25-26th of July took place in Cluj-Napoca the first workshop on traditional seeds with 20 (future) seed guardians. Moreover it is important to emphasize that Eco Ruralis' seed database was built over the years starting with 2011, with the contribution of the Gene Bank of Suceava, European organizations (e.g. Kokopelli and Le Biau Germe from France, Peliti from Greece, Arche Noah from Austria, Irish Seed Savers from Ireland) and Romanian individuals "who accepted to share their heritage" (Marcus 2014, p. 4). Currently, the seed database is an imposing collection of 998 traditional plant varieties including about 51% of varieties collected from Romania. The database is organized as an Excel document with several sheets regrouping species and varieties depending on the family name or the common names of the plants (Table 3). Furthermore, it is essential to understand that Eco Ruralis' Sopor garden is functioning as an ecological farming system specialized in on-farm conservation (i.e. traditional seeds multiplication and saving) (Figure 2). Nevertheless, it is important to indicate that starting with 2015 Eco Ruralis' garden was extended, reaching about 1000 m². In consequence their ability to distribute seeds and to reach the demand of local producers will inevitably increase. Eco Ruralis is estimating that their next annual free national distribution of traditional seeds in February 2016 will reach over 2000 beneficiaries.

Table 3. Summary of Eco Ruralis' traditional seed database

Excel sheet name	Species common names	Number of Romanian varieties	Number of other varieties	Total
Aromatics	Anise, Chervil, Greater burdock, Basil, Scallion, Thyme, Coriander, Fennel, Lemongrass, Lovage, Dill, Mustard, Parsley, Pepper, Salvia, Safflower, Celery	54	34	88
Amaryllidaceae	Onion, Leak, Garlic	9	7	16
Cereals	Amaranth, Wheat, Buckwheat, Flax, Rice, Barley, Oat, Quinoa, Rye, Sorghum	4	37	41
Corn	Corn	24	11	35
Curcubitaceae	Cucumber, Melon, Watermelon	14	22	37
Pumpkin	Pumpkin	27	6	33
Squash	Squash	15	28	43
Sunflower	Sunflower	10	8	18
Flowers/ Medicinal plants	Cornflower, Zinnia, Cosmos, Marigold, Woad, Echinacea, Phacelia, Strawflower, Garden	29	24	53

	marigold, Hyssop, Broadleaf plantain, Maltese cross, Columbine, Morning glory, Borage, others			
Gombo/okra	Gombo/okra	0	1	1
Beans	Beans	82	19	101
Leguminous	Lentil, Lupine, Pea, Chickpea, Luzerne, Sainfoin, Soy	2	19	21
Rooty plants	Carrot, Turnip, Parsnip, Radish, Beetroot	12	36	48
Salads	Artichoke, Goatsbeard, Chicory, Cauliflower, Cresson, Kale, Sorrel, Chard, Rucola, Lettuce, Scorzonera, Spinach, Patience dock, others	30	79	109
Cabbage	Cabbage	4	20	24
Mountain spinach	Mountain spinach	16	1	17
Peppers	Peppers	47	23	70
Tomatoes	Tomatoes	121	105	226
Other Solanaceae	Potato, Physalis, Tobacco, Eggplants	8	10	18
TOTAL VARIETIES		**508**	**490**	**998**

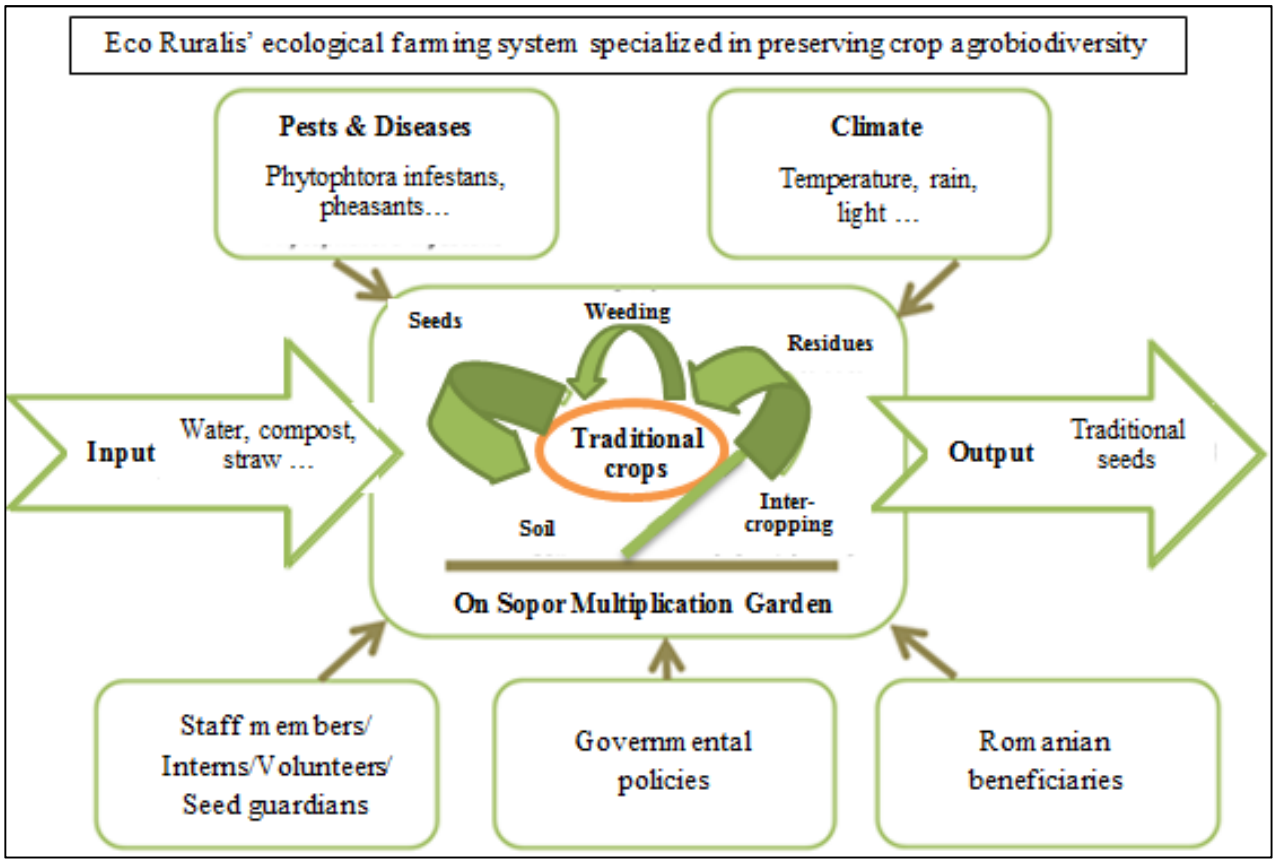


Figure 2. Farming system diagram for Eco Ruralis' Sopor garden

Another very important local traditional seed saver is the National Bank of Genetic Vegetal Resources of Suceava (BRGV 2015). This Gene Bank has currently an impressive collection including 2246 plant varieties collected from Romania (including cereals, vegetables, flowers, aromatic and medicinal plants) (Table 4). In total 2336 plant varieties can be found in the Gene Bank's database, from

which 96% are Romanian. On their website it is possible to make an order to receive some seed samples in spring and autumn, however the stocks are limited and the distribution is free, therefore the amount sent can be a maximum of 5 varieties and 25 seeds per variety. Nevertheless the distribution of seeds to the society and their ability to reach the demand of local producers are restricted by the incapacity to multiply new seeds collected or seeds already conserved, due to financial and technical constraints, as well as due to the lack of technical and specialized employees (BRGV Activity Report 2013).

Table 4. Genetic vegetal resources from Romania conserved at the National Gene Bank of Suceava (adapted from BRGV 2015)

Species (Latin/common names)	Number of varieties	Species (Latin/common names)	Number of varieties
Allium cepa / Onion	4	*Lupinus polyphyllus* / Garden lupine	1
Allium porrum / Leak	1	*Lychnis coronaria* / Rose Campion	1
Amaranthus cruentus / Amaranth	2	*Lycopersicon esculentum* / Tomato	75
Anethum graveolens / Dill	1	*Nicotiana rustica* / Tobacco	1
Apium graveolens / Celery	1	*Nigella damascena* / Ragged lady	1
Atriplex hortensis / Mountain spinach	1	*Ocimum basilicum* / Basil	1
Avena sativa / Oats	94	*Papaver somniferum* / Opium poppy	18
Beta vulgaris var. rubra / Red beet	2	*Petroselinum crispum* / Parsley	6
Beta vulgaris var. saccharifera / Sugar beet	1	*Phaseolus vulgaris* / Beans	55
Brassica napus / Rape	2	*Phleum pretense* / Timothy grass	6
Brassica oleracea / Cabbage	6	*Pisum sativum* / Peas	21
Brassica rapa subsp. Oleifera / Turnip rape	1	*Plantago lanceolata* / Broadleaf plantain	1
Calendula officinalis / Garden marigold	1	*Raphanus sativus* / Radish	1
Cannabis sativa / Cannabis	2	*Ruta graveolens* / Rue	1
Capsicum annuum / Pepper	34	*Secale cereale* / Rye	15
Capsicum baccatum var. umbilicatum / Chili pepper	1	*Sinapis alba* / White mustard	1
Capsicum frutescens / Chili pepper	1	*Solanum melongena* / Eggplant	1
Carthamus tinctorius / Safflower	2	*Sorghum bicolor(vulgare)* / Sorghum	4
Cucumis melo / Muskmelon	1	*Tagetes sp.* / Marigold	1
Cucumis sativus / Cucumber	74	*Trigonella caerulea* / Blue fenugreek	1
Curcubita pepo / Squash, pumpkins	14	*Trigonella foenum-graecum*/ Fenugreek	2
Daucus carota / Carrot	3	*Triticale sp.* / Triticale	3
Dianthys barbatus / Sweet William	1	*Triticum aestivum* / Common wheat	125
Dracocephalum moldavica / Moldavian dragonhead	1	*Triticum dicoccon* / Emmer wheat	2
Fagopyrum sagittatum / Buckwheat	1	*Triticum durum* / Durum wheat	1
Helianthus annuus / Sunflower	15	*Triticum monococcum* / Einkorn wheat	28
Hordeum vulgare / Barley	39	*Vicia faba* / Broad beans	30
Lactuca sativa / Lettuce	93	*Vicia hirsute* / Hairy vetch	2
Lens culinaris / Lentils	1	*Vigna sinensis* / Cowpea	1
Linum usitatissimum / Flax	22	*Zea mays* / Maize	1416
Lupinus perennis / Blue lupine	1	**TOTAL Romanian varieties**	**2246**

Another major actor in the local network of traditional seed savers is USAMV Cluj-Napoca. Besides contributing via Prof. Dr. Maxim to Eco Ruralis' Agrobiodiversity Campaign by characterizing and evaluating each year the varieties grown in their garden, USAMV Cluj-Napoca built a modern Gene Microbank which was inaugurated in 2012 (Maxim 2008, USAMV Cluj-Napoca Gene Bank 2015). Around one thousand varieties of plants collected from Romania are stored in this Gene Microbank. USAMV Gene Bank actually exists since 1962, but in 2012 modern technologies were installed (e.g. liquid nitrogen facility) that allow to conserve crop agrobiodiversity on longer periods of time (Prodan 2012). This specific facility is useful for all the horticultural laboratories at USAMV, and as well for Eco Ruralis' collection which can be stored in ideal conditions for long-term preservation.

Last but not least, Seminte Libere (meaning "Free Seeds") plays also a role in the local network of traditional seed savers (Seminte Libere 2015). This initiative is organized by Adina Moise as Facebook dynamic group (which contains over 9,000 members from all around the country) where people can exchange seeds, knowledge and advices. Adina Moise also organizes and participates in occasional seed exchange events across Romania (e.g. Free Seeds Market on February 1, 2015 in Cluj-Napoca), with the seeds she gathers within the Seminte Libere group.

In order to evaluate the aspects that can affect the future growth of traditional seed propagation in Romania, it seems relevant to relate these aspects to Romanian and European legislations, and to the possible improvements of traditional seed savers networks and of public awareness.

On the one hand, Romanian legislations indicate very strict procedures for producing, processing, controlling and certifying the quality and commercializing seeds (Romanian Law 266/2002-republished in 2014, Romanian Order 1366/2005). These legislations suggest that all seed producers should only work with tested and registered varieties in the Official National Catalogue. This Catalogue is available each year through the National Institute for testing and registering varieties (ISTIS 2015). However the fees applied for testing and registering varieties are extremely high (e.g. for one corn variety the fees sum up to 700 €) therefore only large seed companies can comply with these regulations. By extension, these legislations are forbidding the commercialization of traditional varieties of seeds. Furthermore the European directives concerning the commercialization of seeds in the EU are also very strict and suggest only the marketing of seeds that are registered on the Common Catalogue of varieties of agricultural plant and vegetable species (European directives 98/95/EC, 2002/53/EC, and 2002/55/EC). Moreover, a recent Romanian market legislation which is being applied since May 2015 (Romanian Law 145/2014) is establishing regulation measures for marketing products from the agricultural sector. This new legislation is restricting small-scale farmers to sell their products on the local market, unless they can comply with the formalities and pay high taxes for obtaining a producer attestation, a commercialization notebook and reserve a place on the local market. As a consequence, many Romanian peasant farmers are being currently thrown away from the local food markets, and their products - often made from traditional seeds - can no longer be sold (Dragomir 2015a). Therefore both these several Romanian and European

legislations are negatively affecting the traditional seed propagation because of strict regulations and bureaucratic burdens.

On the other hand, the improvement of traditional seed savers networks and of public awareness can positively affect the future growth of traditional seed propagation. Indeed as seen with Eco Ruralis' experience in seed distributions, the public awareness about traditional seeds is increasing gradually and therefore the society will be more demanding each year. Moreover it is a fact that the collaboration between Eco Ruralis and the major local seed savers, USAMV Cluj-Napoca and the Gene Bank of Suceava, has already made possible the multiplication of the number of beneficiaries of their annual distribution by 10 in only 3 years. Therefore further collaborations between the different actors involved in the local seed savers networks, and further improvements of their relations will definitely enhance the future growth of traditional seed propagation in Romania.

3.2. Market studies focused on traditional seeds use

3.2.1. Market study of local food markets

The first part of the market study results consists in 40 surveys answered by farmers interviewed in Marasti private food market (15 farmers interviewed), IRA daily public food market (9 farmers interviewed) and Gheorgheni weekly food market (16 farmers interviewed) local food markets in Cluj-Napoca (Figure 3).

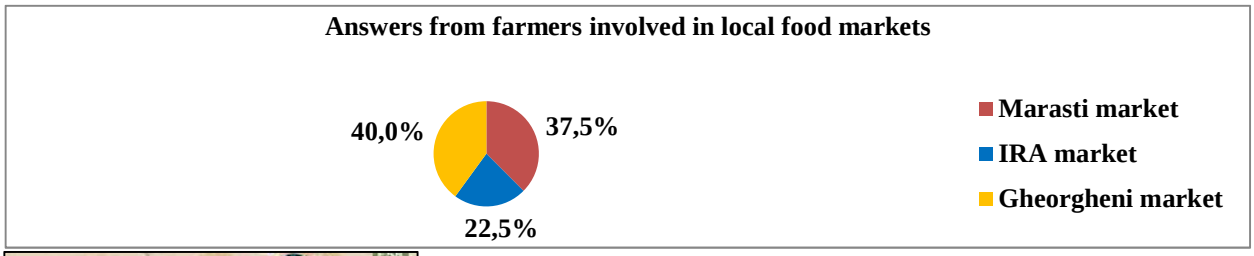
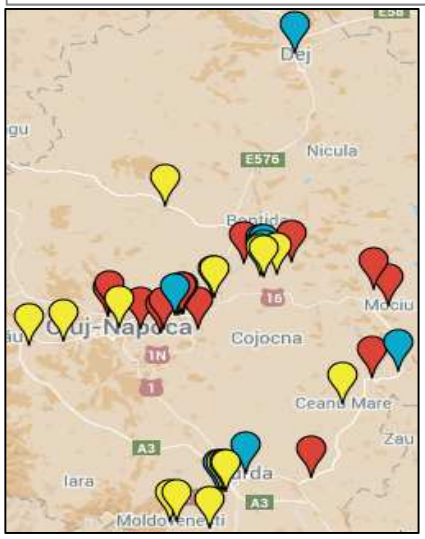


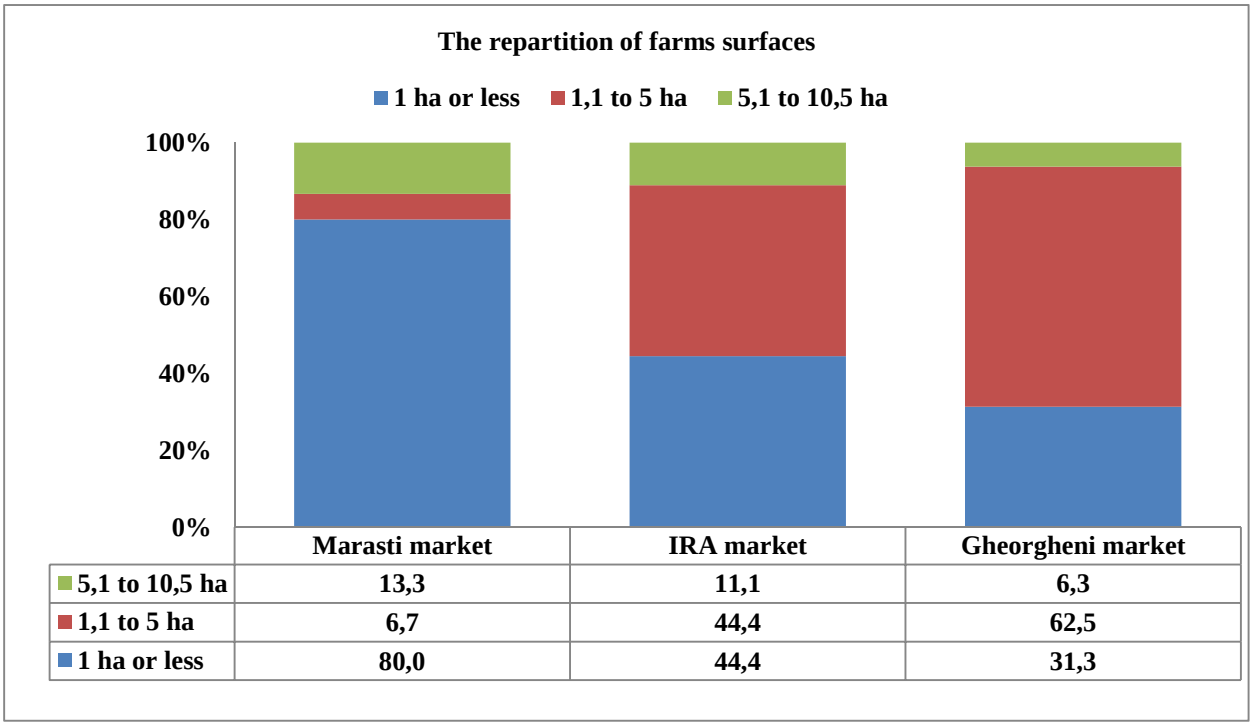
Figure 3. The involvement of the farmers interviewed in the local food markets



All the farmers interviewed own farms in Cluj county (Figure 4). All producers interviewed at Marasti, IRA and Gheorgheni local food markets travel less than 44 km until the markets.

Figure 4. Map of the peasant production systems involved in the local food markets in Cluj-Napoca. Marasti market: red dots; IRA market: blue dots; Gheorgheni market: yellow dots. (Available at: www.google.com/maps/d/edit?mid=zkhLaViZdqTo.kfhFmWYKk93s&usp=sharing)

The average surface of a farm is 2.3 ha (Std. Deviation = 2.8), and the surfaces vary between 0.07 ha and 10.5 ha (Figure 5). Overall 52.5% of the farms have surfaces of 1 ha or less, 37.5% have surfaces between 1.1 and 5 ha, and only 4 farms (10%) have surfaces over 5 ha.

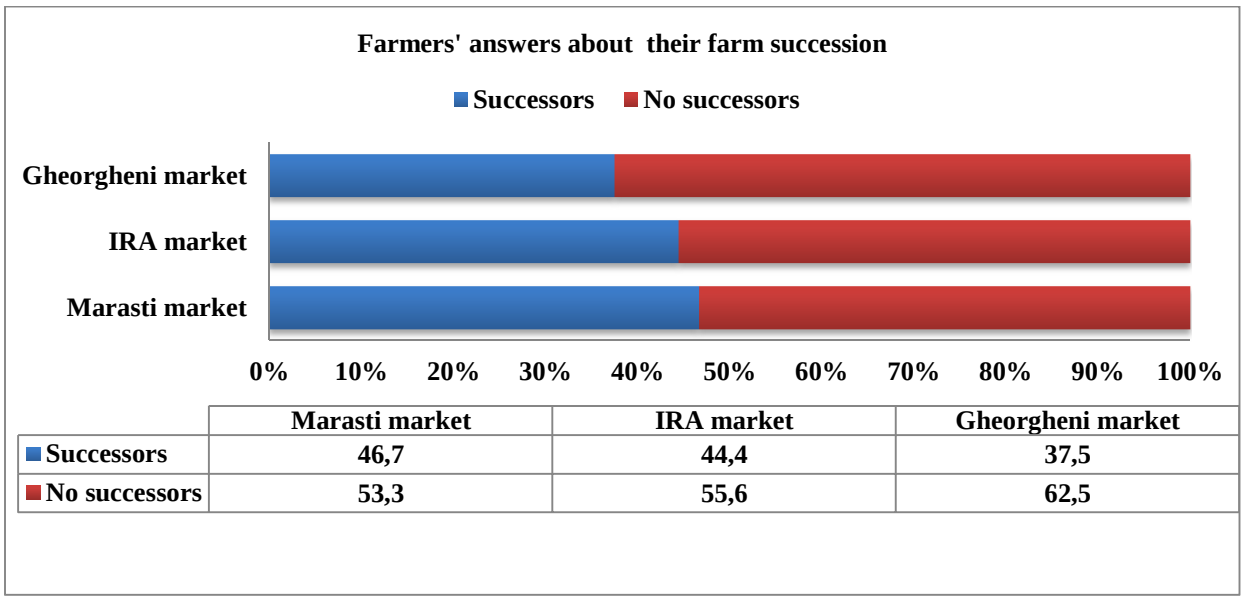


	Marasti market	IRA market	Gheorgheni market
5,1 to 10,5 ha	13,3	11,1	6,3
1,1 to 5 ha	6,7	44,4	62,5
1 ha or less	80,0	44,4	31,3

Figure 5. The surfaces of the farms involved in the local food markets in Cluj-Napoca

Overall 55% of the farmers interviewed were male, but variations exist within the local food markets investigated. More female from Marasti market answered the survey (60%), whereas more male from IRA market (66.7%) and Gheorgheni market (62.5%) answered the survey.

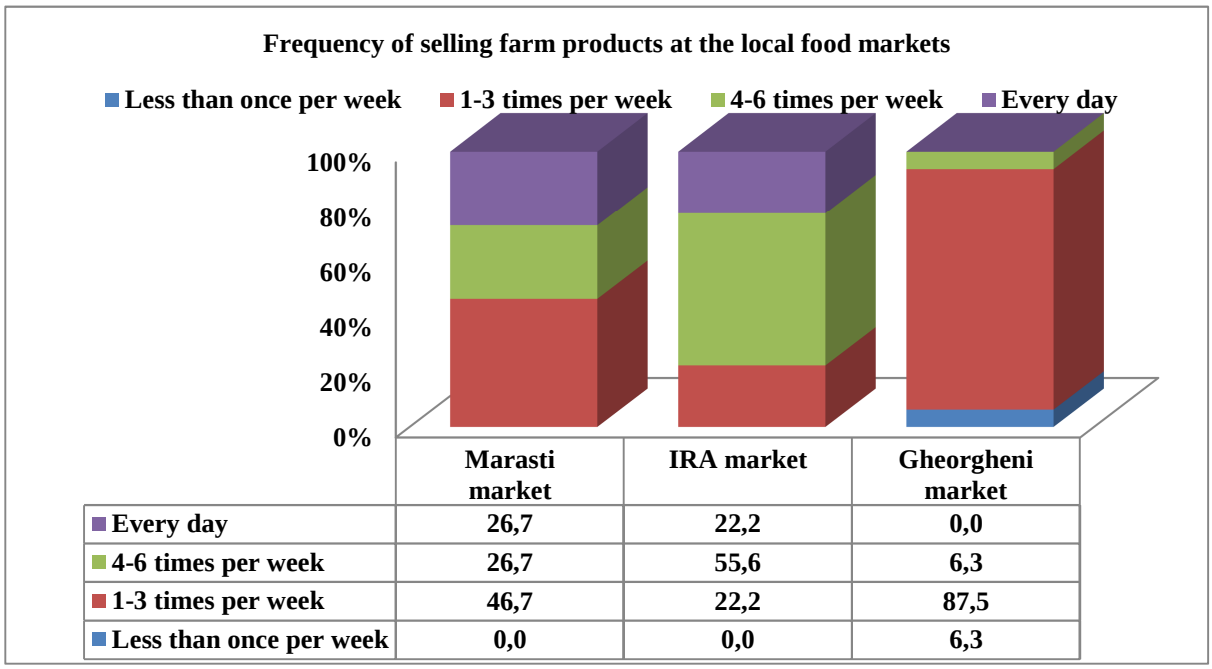
Overall 42.5% of farmers interviewed in the local food markets have farm successors (Figure 6).



	Marasti market	IRA market	Gheorgheni market
Successors	46,7	44,4	37,5
No successors	53,3	55,6	62,5

Figure 6. Farmers' succession depending on the local food market attended in Cluj-Napoca

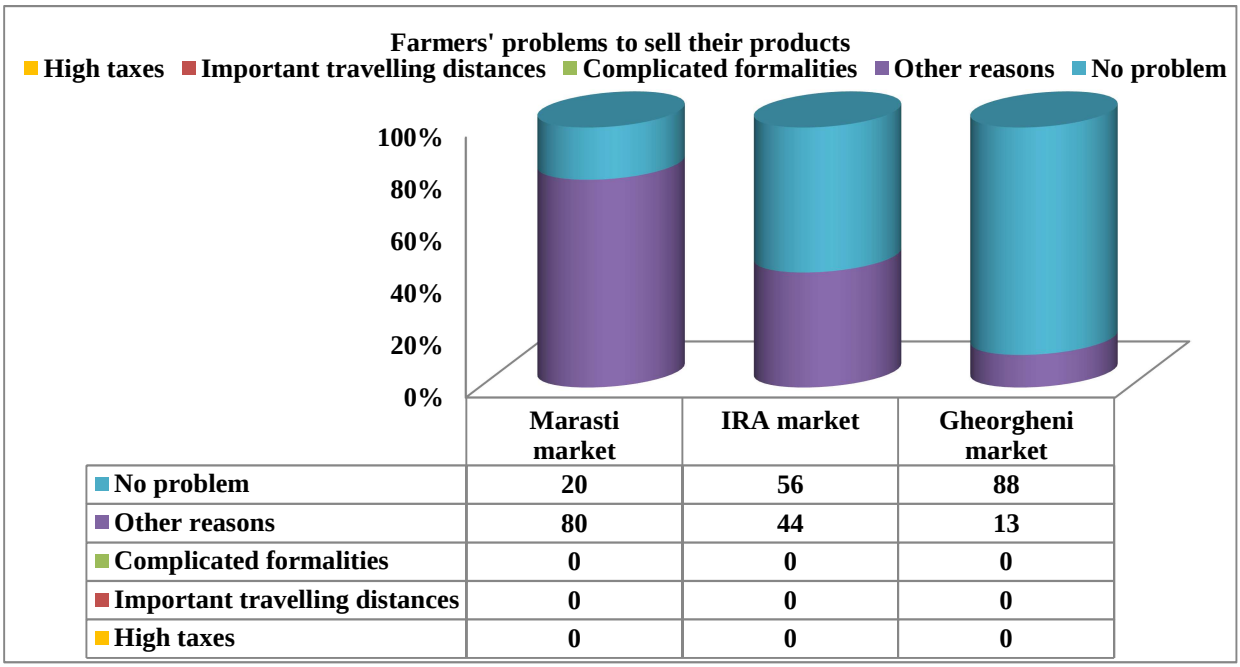
Concerning the frequency of selling farm products at the local food markets, only one farmer (2.5%) from Gheorgheni market sells less than once per week, whereas 57.5% of the farmers sell 1 to 3 times per week, 25% sell 4 to 6 times per week and 15% sell their farm products every day (Figure 7).



	Marasti market	IRA market	Gheorgheni market
Every day	26,7	22,2	0,0
4-6 times per week	26,7	55,6	6,3
1-3 times per week	46,7	22,2	87,5
Less than once per week	0,0	0,0	6,3

Figure 7. Frequency of selling farm products at the local food markets

All together 55% of the farmers interviewed do not encounter problems to sell their products at the local food markets, whereas 45% of them give "other reasons". The reasons evoked are: both complicated formalities and variable taxes related to the new Market Law 145; complicated notebook to fill in; competition with intermediaries; and lack of consumers, of consumers' interest and of governmental support (Figure 8).



	Marasti market	IRA market	Gheorgheni market
No problem	20	56	88
Other reasons	80	44	13
Complicated formalities	0	0	0
Important travelling distances	0	0	0
High taxes	0	0	0

Figure 8. Problems encountered to sell products at the local food markets

Concerning the utilization and/or conservation of traditional seeds on-farm, 95% out of all the farmers interviewed apply this practice on their farm (Figure 9). Only two farmers (one from Marasti market and one from Gheorgheni market) do not use traditional seeds in his farm, which was explained to be due to the fact that they prefer to buy hybrid seeds or already grown seedlings.

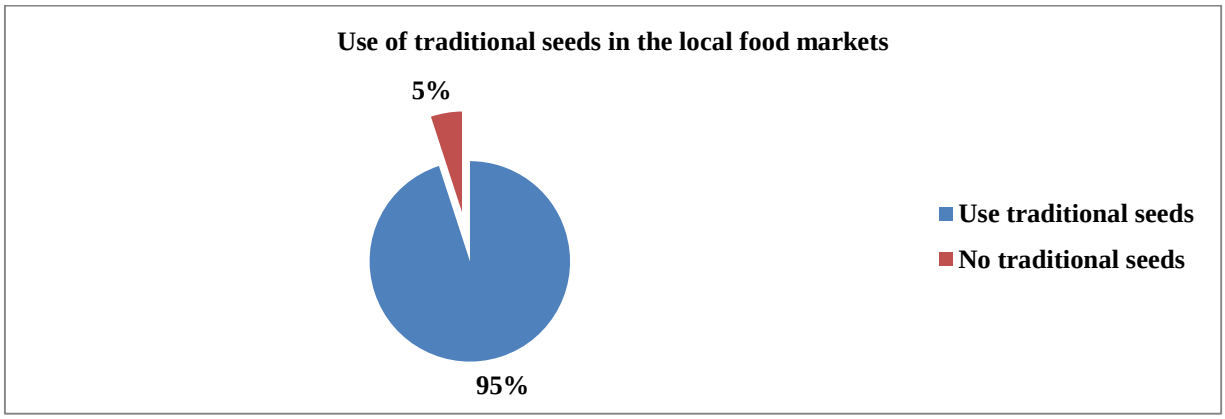
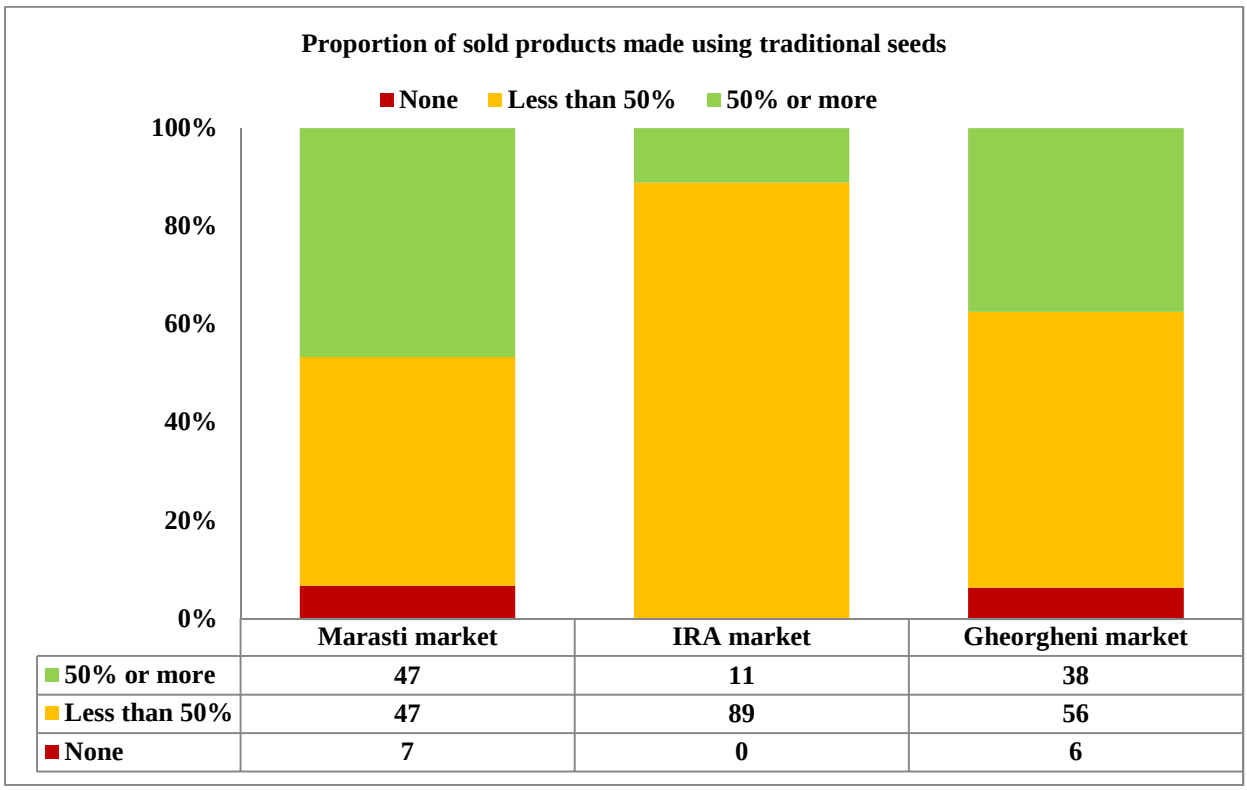


Figure 9. Use of traditional seeds among the farmers interviewed in the local food markets

The proportion of sold products made using traditional seeds is variable among the farmers interviewed. Only 5% of the farmers interviewed (one farmer from Marasti market and one from Gheorgheni market) do not sell products made with traditional seeds, whereas 60% of farmers sell less than 50% of products made with traditional seeds, and 35% of farmers sell less more than 50% of products made with traditional seeds (Figure 10).



	Marasti market	IRA market	Gheorgheni market
50% or more	47	11	38
Less than 50%	47	89	56
None	7	0	6

Figure 10. Proportion of sold products made using traditional seeds depending on the local food markets in Cluj-Napoca

3.2.2. Market study of local short circuit supply chains

The market study results consist in 40 answered surveys filled in by farmers involved in the different local short circuit supply chains, i.e. Cutia Taranului (5 farmers interviewed), ASAT (8 farmers interviewed), WWOOF (18 farmers interviewed) and Eco Ruralis members (9 farmers interviewed, those concerned by direct farm selling or selling through alternative food networks) (Figure 11).

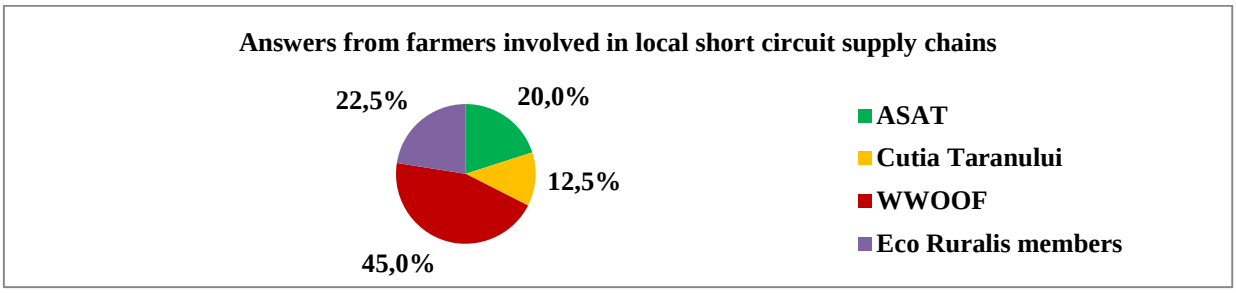


Figure 11. The involvement of the farmers interviewed in the local short circuit supply chains

The farmers interviewed own farms in various counties of Romania (Figure 12) but most of the answers came from Transylvania region.

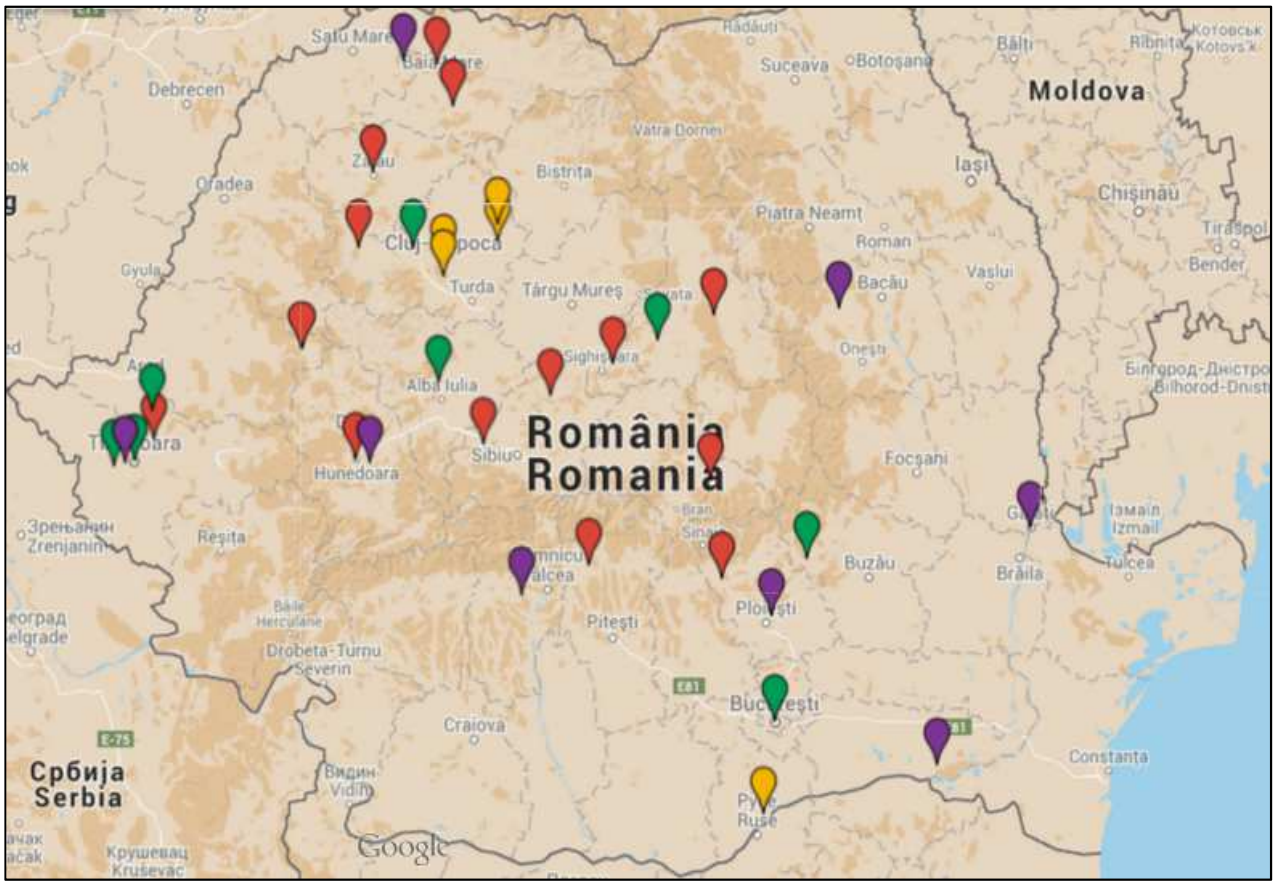
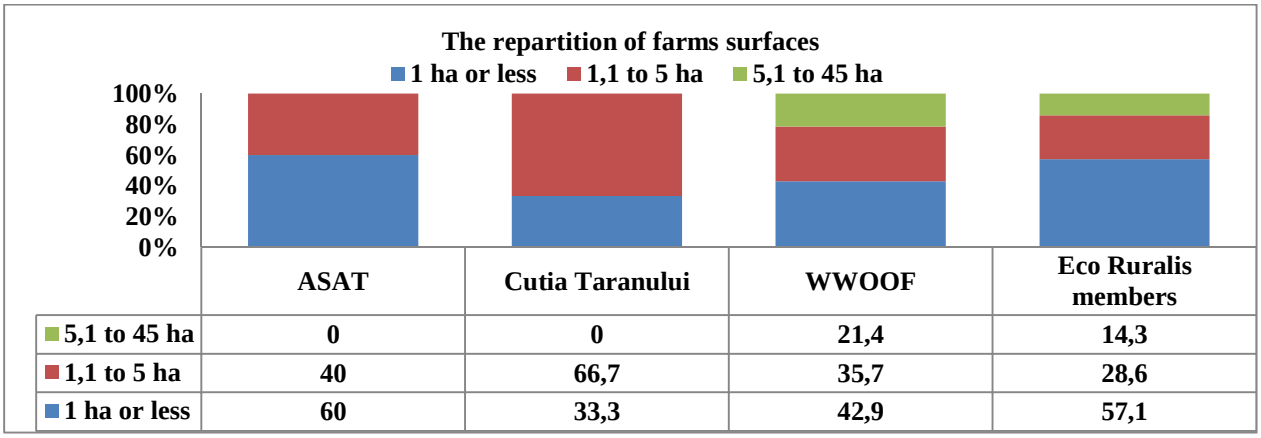


Figure 12. Map of the peasant production systems involved in local short circuit supply chains. ASAT: green dots; Cutia Taranului: yellow dots; WWOOF: red dots; Eco Ruralis: purple dots. (Available at: www.google.com/maps/d/edit?mid=zkhLaViZdqTo.kt3DXplz5MRo&usp=sharing)

The average surface of a farm is 4.7 ha (Std. Deviation = 9.8), and the surfaces vary between 0.08 ha and 45 ha and between the different short supply chains (Figure 13). Overall 48.3% of the farms have surfaces of 1 ha or less, 37.9% have surfaces between 1.1 and 5 ha, and only 4 farms (13.8%) have surfaces over 5 ha.

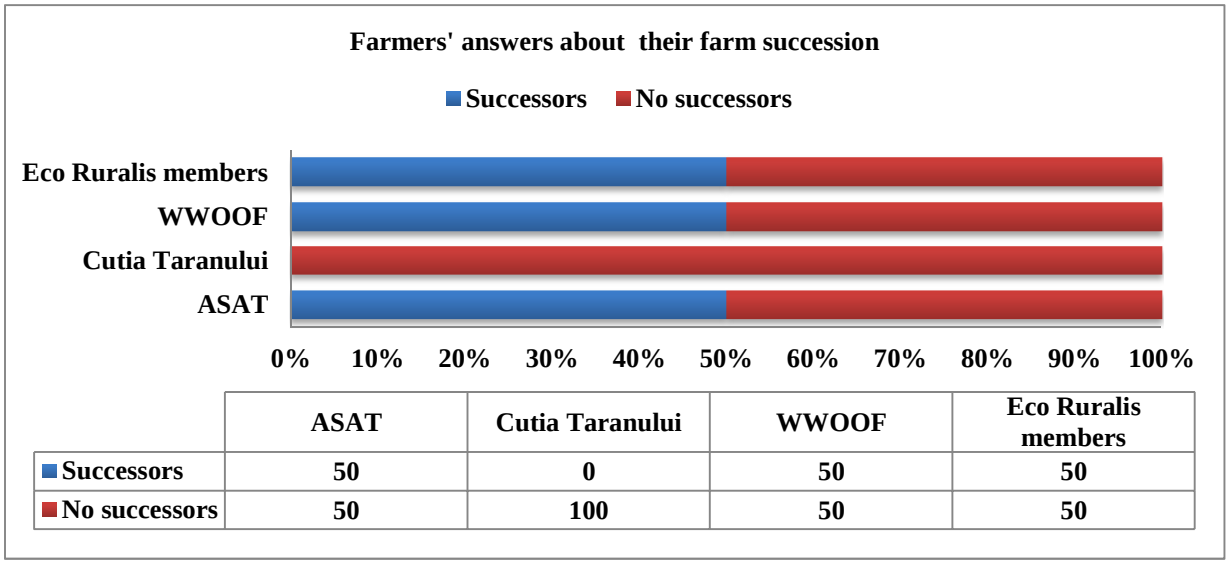


	ASAT	Cutia Taranului	WWOOF	Eco Ruralis members
5,1 to 45 ha	0	0	21,4	14,3
1,1 to 5 ha	40	66,7	35,7	28,6
1 ha or less	60	33,3	42,9	57,1

Figure 13. The surfaces of the farms involved in local short circuit supply chains

Overall 57.6% of the farmers interviewed were male, but variations exist within the local short circuit supply chains in which they were involved. More female from ASAT network answered the survey (66.7%), proportions were equal for WWOOF farms, only male answered the survey from Cutia Taranului network, and more male from Eco Ruralis members answered (62.5%).

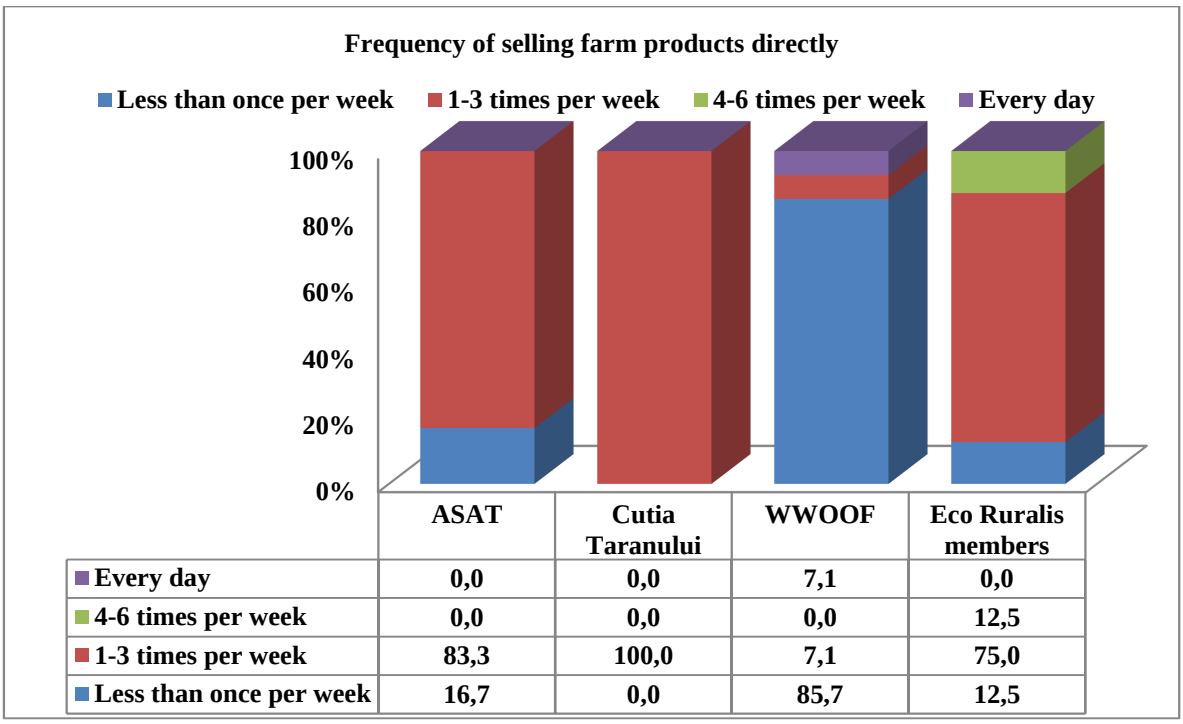
The farmers' answers about their farm succession differ depending on the short supply chain in which they are involved, but overall 42.4% of all farmers interviewed have farm successors (Figure 14).



	ASAT	Cutia Taranului	WWOOF	Eco Ruralis members
Successors	50	0	50	50
No successors	50	100	50	50

Figure 14. Farmers' succession depending on their involvement in short circuit supply chains

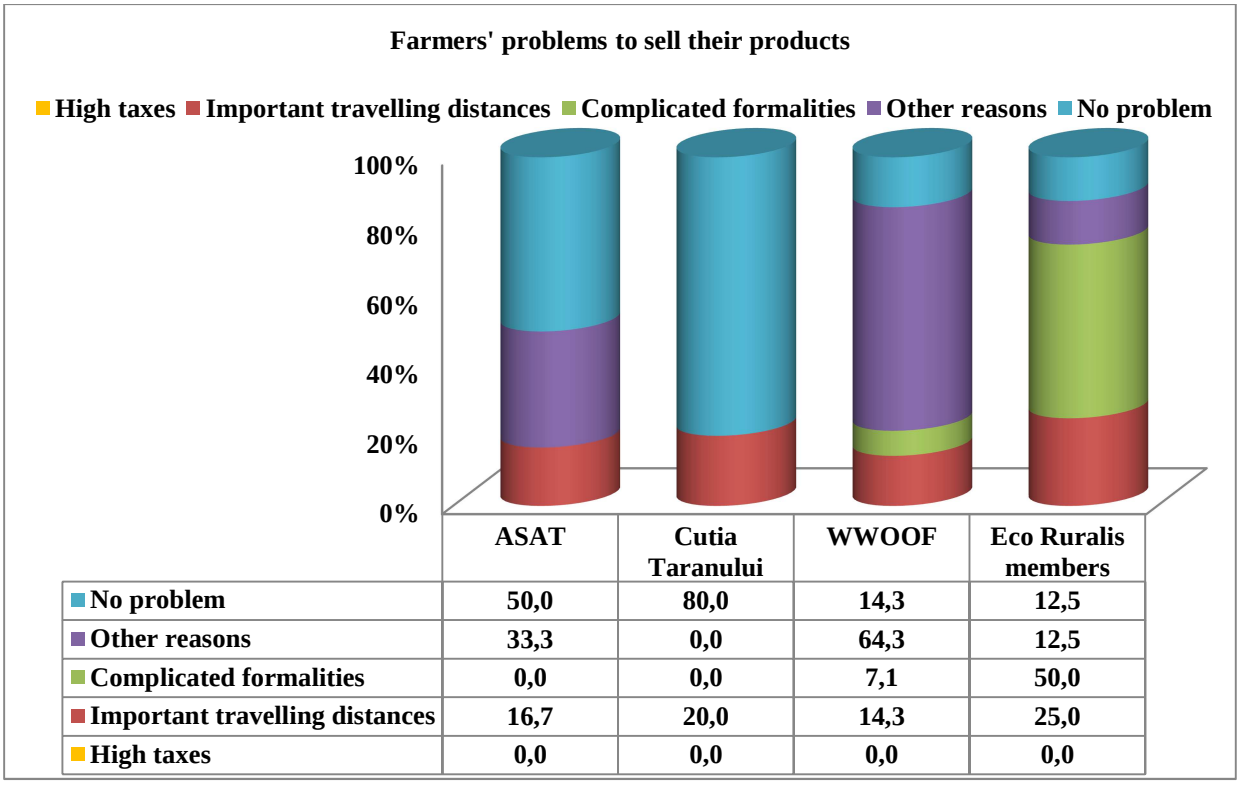
Concerning the frequency of selling farm products directly via the short supply chains, 42.4% of all farmers sell less than once per week, whereas 51.5% sell 1 to 3 times per week. One Eco Ruralis member sells 4 to 6 times per week, and one WWOOF farmer sells his products every day (Figure 15).



	ASAT	Cutia Taranului	WWOOF	Eco Ruralis members
Every day	0,0	0,0	7,1	0,0
4-6 times per week	0,0	0,0	0,0	12,5
1-3 times per week	83,3	100,0	7,1	75,0
Less than once per week	16,7	0,0	85,7	12,5

Figure 15. Frequency of selling farm products directly via the short circuit supply chains

Many farmers encounter several problems to sell their products directly. Nevertheless 30.3% of farmers do not encounter any problem. All together 18.2% of farmers have important distances to travel; 15.2% of farmers encounter complicated formalities; and the other 36.4% of farmers give “other reasons” without specifying exactly the problems encountered (Figure 16).



	ASAT	Cutia Taranului	WWOOF	Eco Ruralis members
No problem	50,0	80,0	14,3	12,5
Other reasons	33,3	0,0	64,3	12,5
Complicated formalities	0,0	0,0	7,1	50,0
Important travelling distances	16,7	20,0	14,3	25,0
High taxes	0,0	0,0	0,0	0,0

Figure 16. Problems encountered to sell products directly via the short circuit supply chains

Concerning the utilization and/or conservation of traditional seeds on-farm, 87.5% out of all the farmers interviewed apply this practice on their farm (Figure 17). Only 5 farmers (2 from ASAT and 3 from WWOOF) do not use traditional seeds in their farms. Two farmers (one from each short chain) explained that organic farming regulations do not allow the usage of traditional seeds.

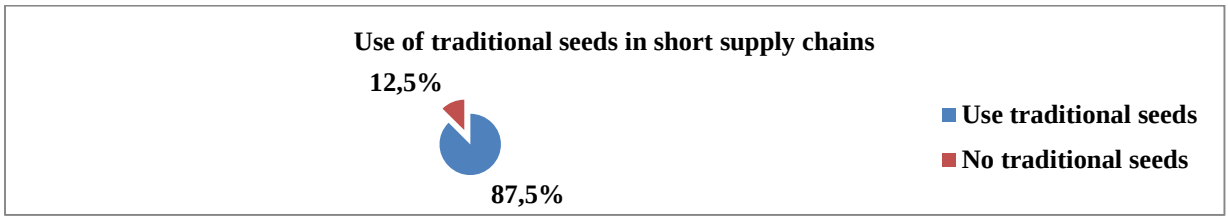


Figure 17. Use of traditional seeds among the farmers interviewed in the short circuit supply chains

The farmers' answers about their grade of seed self-reliance differ depending on the short supply chain in which they are involved. Overall in average 48.7% (Std. Deviation = 23.4) of seeds used are traditional out of all the seeds used on-farm in the short circuit supply chains investigated (Figure 18).

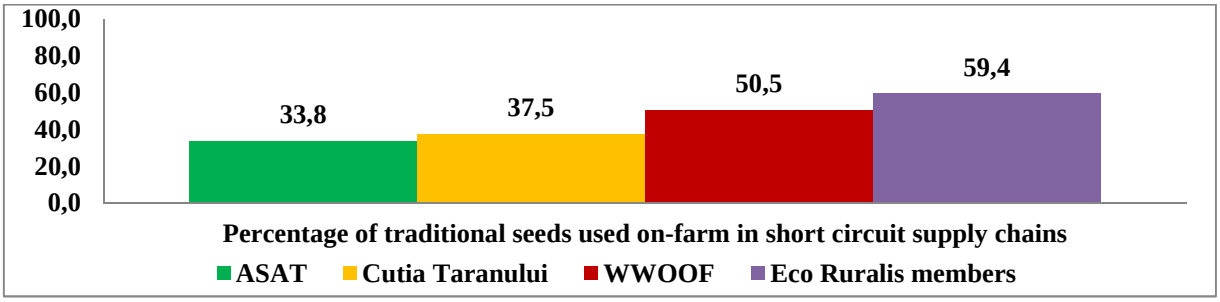
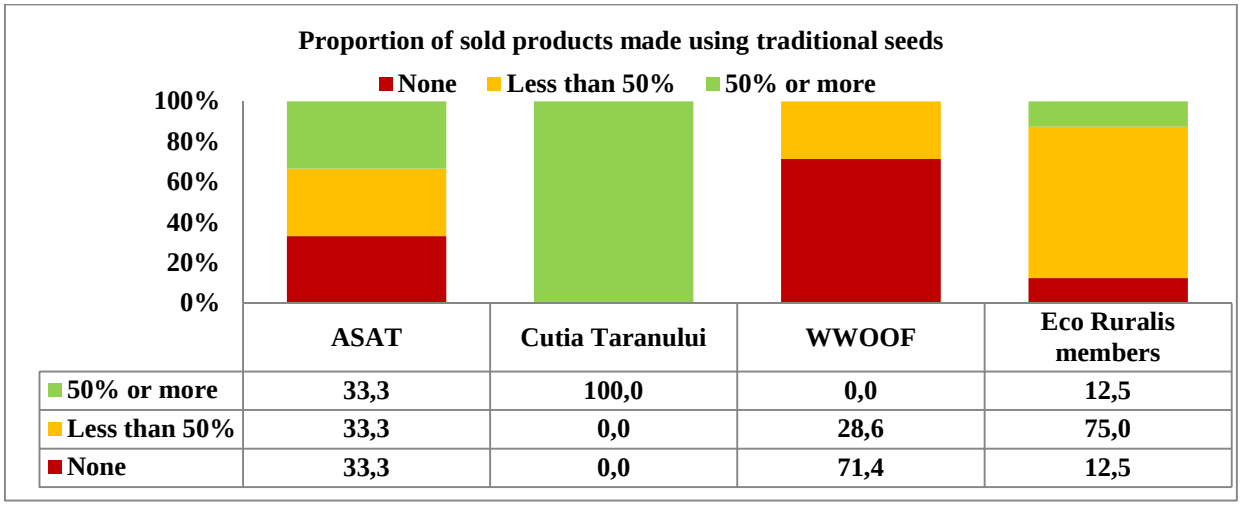


Figure 18. Grade of seed self-reliance in the short circuit supply chains

The proportion of sold products made using traditional seeds is variable depending on the short supply chain investigated. Overall 39.4% of all farmers interviewed sell no products made with traditional seeds; whereas 36.4% of the farmers sell less than 50% of products made with traditional seeds, and 24.2% of the farmers sell less more than 50% of products made with traditional seeds (Figure 19).



	ASAT	Cutia Taranului	WWOOF	Eco Ruralis members
50% or more	33,3	100,0	0,0	12,5
Less than 50%	33,3	0,0	28,6	75,0
None	33,3	0,0	71,4	12,5

Figure 19. Proportion of sold products made using traditional seeds in the short supply chains

3.2.3. Farmers' opinions about traditional seeds

In order to understand what farmers' opinions are about traditional seeds, data from the surveys which is related to this topic was selected to conduct a statistical analysis. Exploratory Factor Analysis is a statistical method (available in IBM SPSS Statistics 20 software) used in data reduction to identify a small number of factors that explain most of the variances observed in a large number of variables within the dataset. Factor Analysis can only be achieved on variables that use Likert-type scale, which measures the level of satisfaction on the same scale (e.g. 1 represents the least agreement and 5 represents the highest agreement). Therefore 12 variables were selected from the surveys (Appendices 1 and 2), which are related to farmers' opinions about traditional seeds (Table 5).

Table 5. Variables selected from the surveys (Appendices 1 and 2) to conduct the Factor Analysis on farmers' opinions about traditional seeds

Questions on their opinion about traditional seeds being environmentally friendly (questions 3-7-10-11)	• if traditional seeds are good for the environment • if they are more adapted to the local environment than conventional ones • if plants grown from these seeds are more resistant to pests and/or diseases than conventional ones • if plants grown from these seeds are more resistant to drought than conventional ones
Questions on their opinion about traditional seeds being helpful for their farm economics (questions 1-2-8-9)	• if they improve the profit of their farm • if the production costs are lower than for conventional seeds • if products made using these seeds can be conserved longer than conventional products • if the harvest if higher than for conventional seeds
Questions on their opinion about traditional seeds being socially friendly (questions 4-5-6-12)	• if the products made using these seeds are safe to eat • if the products made using these seeds are healthy • if the products made using these seeds are tasty • if using these seeds improves the work conditions on their farm

In order to be able to conduct the Factor Analysis, a preliminary analysis of the dataset needs to be performed to check the suitability of the Factor Analysis (Field 2009): the determinant of the Correlation Matrix has to be different from 0.00001; the p-value of Bartlett's Test of Sphericity has to be significant (so lower than 0.05); the Measure of Sampling Adequacy Kaiser–Meyer–Olkin (KMO) has to be greater than 0.5 (preferably greater than 0.7), and less than 50% of the non-redundant residuals in the Reproduced Correlations Matrix have to have absolute values greater than 0.05.

A Principal Component Analysis (PCA) was conducted on the 12 items selected with oblique rotation (Oblimin). The determinant of the Correlation Matrix is 0.002. The KMO measure verifies the sampling adequacy for the analysis. KMO is 0.711 which is 'good', and all KMO values for individual items in the Anti-image Matrices are greater than 0.558, which is above the acceptable limit of 0.5. Bartlett's Test of Sphericity is significant with χ^2 (66) = 448.816 and p-value = 0, which indicates that

correlations between items are sufficiently large for PCA. Moreover 45% (which is less than 50%) of the non-redundant residuals in the Reproduced Correlations Matrix have absolute values greater than 0.05. Therefore the dataset is suitable for the Exploratory Factor Analysis (Field 2009).

An initial analysis was run to obtain eigenvalues for each component, keeping oblique rotation since the Component Correlation Matrix contains some values over 0.3. Four components have eigenvalues over Kaiser's criterion of 1, and all together they explain 72.012% of the variance. Given the sample size (N = 77), the number of variables being less than 30 and the average of the communalities (0.720) exceeding 0.7, the Kaiser's criterion is accurate (Field 2009). Therefore four components were retained in the final analysis. According to the internal consistency reliability analysis, both the first and the third subscales have 'acceptable' reliabilities with Cronbach's $\alpha = 0.752$, respectively 0.768. The second subscale has 'good' reliability with Cronbach's $\alpha = 0.845$. The last subscale has 'excellent' reliability with Cronbach's $\alpha = 0.916$ (Table 6).

Table 6. Summary of the Exploratory Factor Analysis using PCA extraction method and oblique rotation method for the surveys about traditional seeds use

	Factor 1	Factor 2	Factor 3	Factor 4
Initial eigenvalues	4.732	1.614	1.216	1.080
% of variance	39.431%	13.453%	10.130%	8.997%
Cronbach's alpha	0.752	0.845	0.768	0.916
Reliability	acceptable	good	acceptable	excellent

The oblique rotation results in factor loadings being displayed in one pattern matrix (Figure 20) and one structure matrix (Figure 21). The pattern matrix is much easier to interpret because it provides information only about the contribution of variables to factors, and not about the relationships or correlations between the factors that are given in the structure matrix.

Pattern Matrix[a]

	Component			
	1	2	3	4
Trad_seed_profit	,769			
Trad_seed_costs	,696			
Trad_seed_work_conditions	,681			
Trad_seed_conservation	,586			
Trad_seed_harvest	,577			
Trad_seeds_willingness		-,904		
Trad_seed_safety		-,647		
Trad_seed_pest_disease			-,886	
Trad_seed_drought			-,762	
Trad_seed_adaptation			-,635	
Trad_seed_health				-,908
Trad_seed_taste				-,893

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 10 iterations.

Figure 20. Pattern Matrix obtained with PCA Factor Analysis, representing the regression coefficients for each variable on each factor

Structure Matrix

	Component			
	1	2	3	4
Trad_seed_profit	,758			
Trad_seed_work_conditions	,751			
Trad_seed_costs	,727			
Trad_seed_conservation	,647			
Trad_seed_harvest	,640			
Trad_seeds_willingness		-,922		
Trad_seed_safety		-,760		-,607
Trad_seed_pest_disease			-,883	
Trad_seed_drought			-,847	
Trad_seed_adaptation			-,674	
Trad_seed_health				-,942
Trad_seed_taste				-,933

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Figure 21. Structure Matrix obtained with PCA Factor Analysis, representing the correlation coefficients between each variable and factor

The items that cluster on the same components suggest that component 1 represents socio-economic benefits from traditional seeds, component 2 represents the willingness to use traditional seeds, component 3 represents agronomic benefits from traditional seeds and component 4 represents social benefits from traditional seeds. These 4 components obtained display an overview of the different factors that influence farmers' opinions about traditional seeds. Further on the conception of perceptual maps using the factor scores averages can help to visualize the perceptions of the farmers interviewed (from the different local short circuit supply chains and local food markets) related to traditional seeds.

According to this perceptual map (Figure 22), it appears that farmers from WWOOF Romanian network are not really willing to use (more) traditional seeds on their farms, compared to the other farmers from the short circuit supply chains and especially those from the local food markets investigated. On the other hand, farmers from WWOOF and especially ASAT networks perceive less socio-economic benefits that they could obtain from using traditional seeds than the other farmers interviewed.

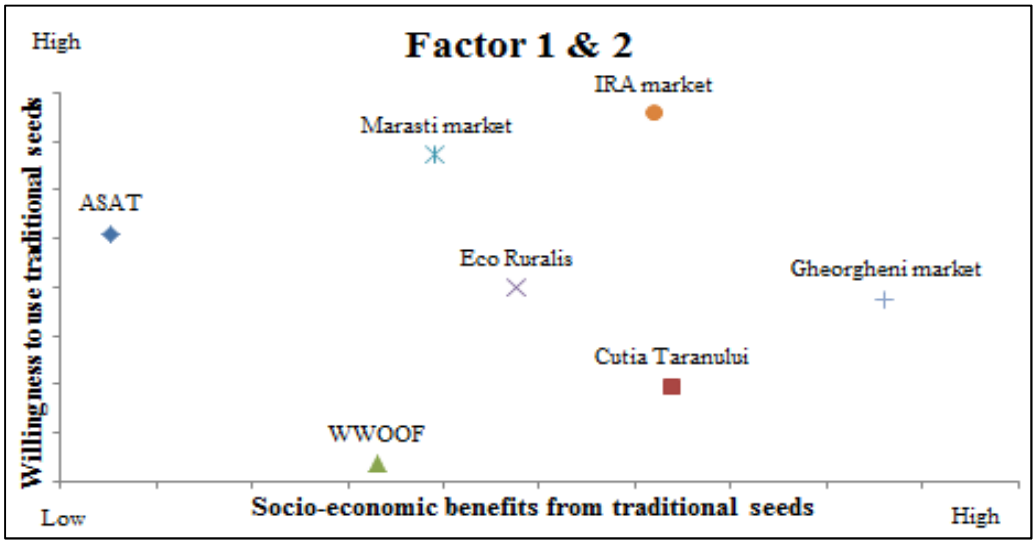


Figure 22. Perceptual map displaying the perceptions of farmers about socio-economic benefits from traditional seeds and willingness to use traditional seeds

According to this perceptual map (Figure 23), it seems that WWOOF farmers perceive less agronomic benefits from using traditional seeds compared to the other farmers interviewed. In contrast ASAT farmers have the best vision of these agronomic benefits even though they perceive the lowest amount of socio-economic benefits from using traditional seeds.

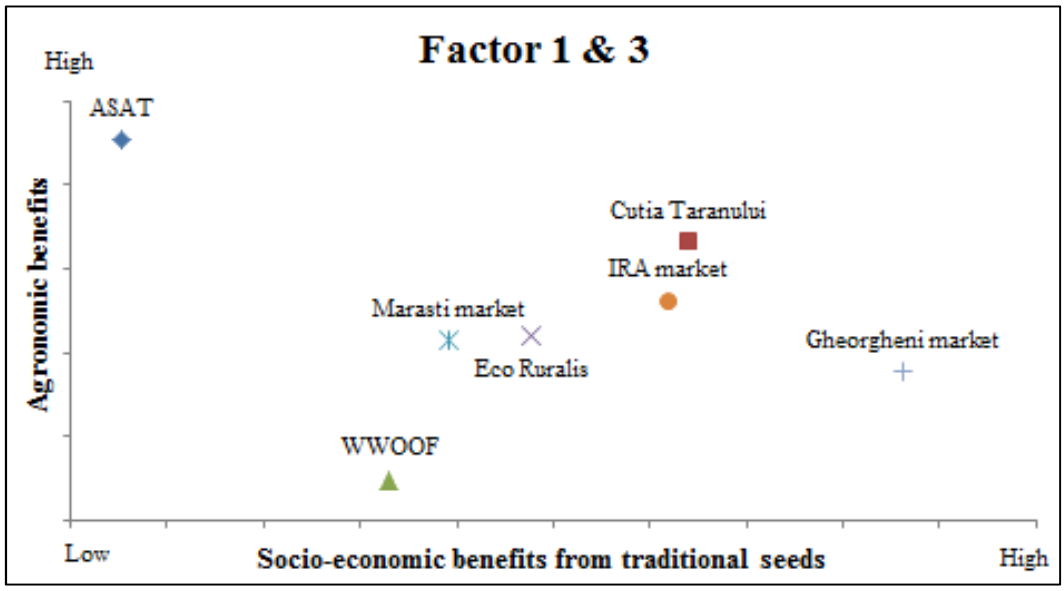


Figure 23. Perceptual map displaying the perceptions of farmers about socio-economic and agronomic benefits from traditional seeds

According to this perceptual map (Figure 24), it appears that farmers in Cutia Taranului perceive the least social benefits from using traditional seeds compared to the other farmers interviewed. In contrast ASAT farmers have the best vision of these social benefits even though they perceive the least socio-economic benefits from using traditional seeds.

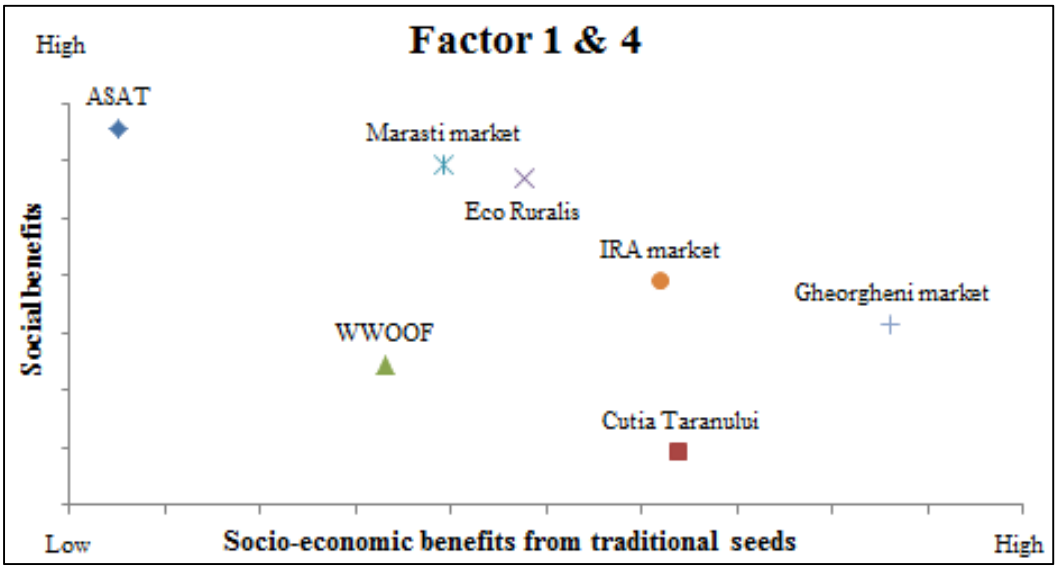


Figure 24. Perceptual map displaying the perceptions of farmers about socio-economic and social benefits from traditional seeds

According to this perceptual map (Figure 25), it appears that WWOOF farmers perceive the least agronomic benefits from using traditional seeds and they are not willing to use them, compared to the other farmers interviewed. On the other hand farmers from the food markets are the most willing to use traditional seeds. Overall farmers interviewed from the short circuit supply chains have a better vision of the agronomic benefits they could get from using traditional seeds than the other farmers.

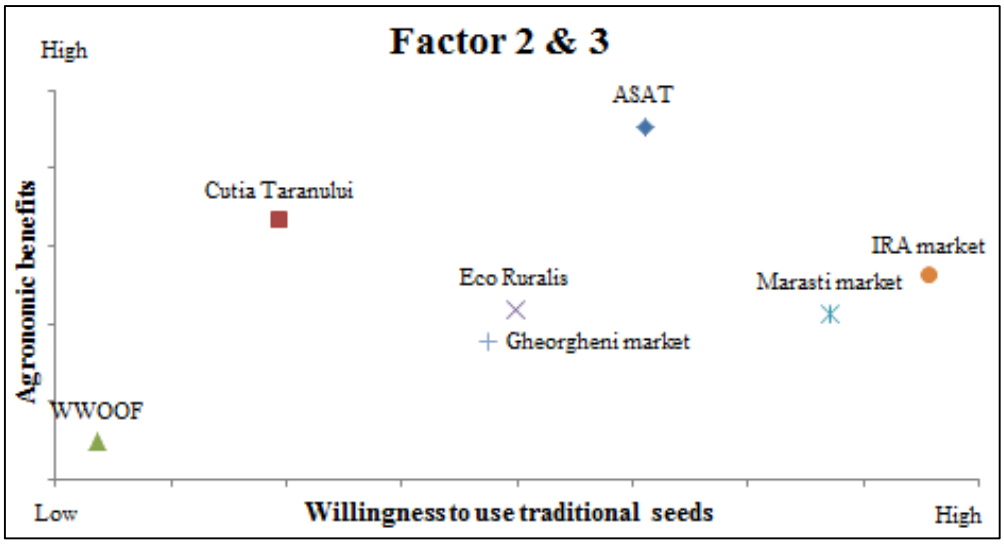


Figure 25. Perceptual map displaying the perceptions of farmers about the willingness to use traditional seeds and agronomic benefits from traditional seeds

According to this perceptual map (Figure 26), it seems that WWOOF and Cutia Taranului farmers perceive the least social benefits from using traditional seeds and they are not willing to use them, compared to the other farmers interviewed. On the other hand the other farmers interviewed have a better perception of the social benefits they could get from using traditional seeds.

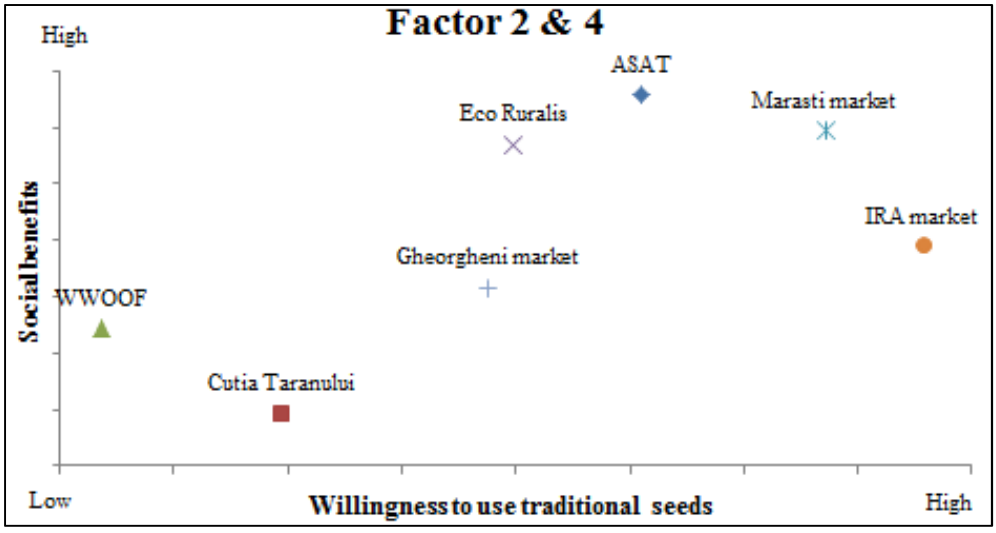


Figure 26. Perceptual map displaying the perceptions of farmers about the willingness to use traditional seeds and social benefits from traditional seeds

According to this perceptual map (Figure 27), it seems that Cutia Taranului farmers perceive the least social benefits from using traditional seeds, even though they have a good vision of their agronomic benefits. On the other hand it appears that the other farmers interviewed (except for WWOOF and ASAT farmers which have extreme and opposite opinions) have also a good perception of the agronomic benefits they could get from using traditional seeds.

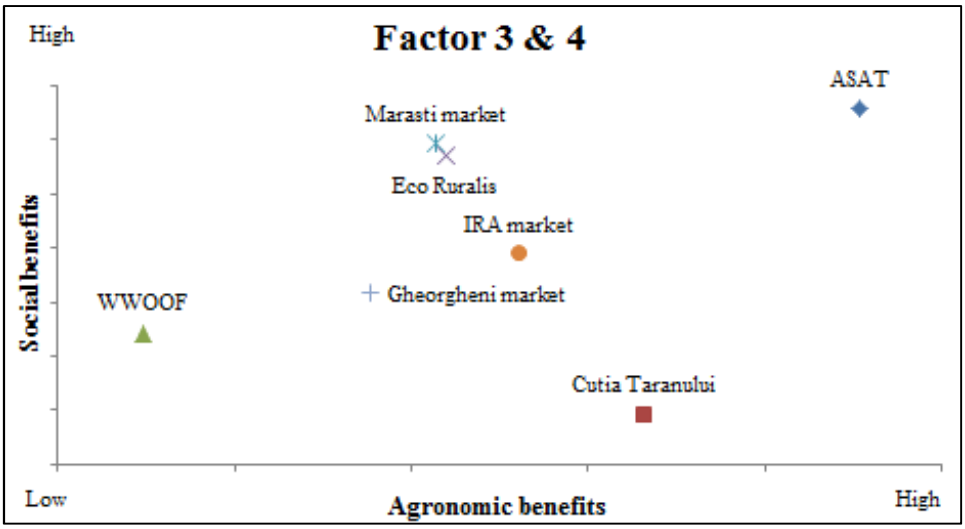


Figure 27. Perceptual map displaying the perceptions of farmers about agronomic and social benefits from traditional seeds

3.2.4. SWOT analysis: evaluation of the presence of traditional seeds in local food markets and short circuit supply chains

In order to evaluate the presence of traditional seeds in the local food markets and in the local short circuit supply chains, SWOT analysis were conducted for each one of these marketing options. The presence of traditional seeds in the local food markets is important since 95% of the farmers interviewed use and/or conserve this type of seeds. Moreover there is a strong presence of products made using traditional seeds, since 60% of the farmers sell less than 50% of these products, and 35% of the farmers sell more than 50% of these products. To come back to the second research question, the results of this survey indicate that protecting crop agrobiodiversity is currently a priority in the local food markets investigated. The fact that Romania is still a peasant country is a strength, because on the one hand peasants conserve crop agrobiodiversity, and on the other hand peasant farming maintains ancestral agroecological practices (e.g. low input farming). The fact that producers and consumers are becoming more interested in traditional seeds in the recent years is an opportunity, and this is linked to the added value of products made using traditional seeds including their taste, nutritional and healthy qualities. Nevertheless, the under-developed situation of agriculture in this country is a weakness. Both the producers and the consumers have a negative vision about peasant farming, and the low yields are

detrimental for peasants. Moreover, the competition between peasants and supermarkets is currently very high, which is a real threat for crop agrobiodiversity. On the one hand, consumers are actually searching for cheap products so there is a lack of support from their side. On the other hand the government also does not support peasant farming, as it can be seen with the new Market Law 145/2014. This SWOT analysis evaluating the presence of traditional seeds in the local food markets was summarized (Table 7), and a "Fact Sheet" presenting this evaluation for Eco Ruralis was elaborated (Appendix 4).

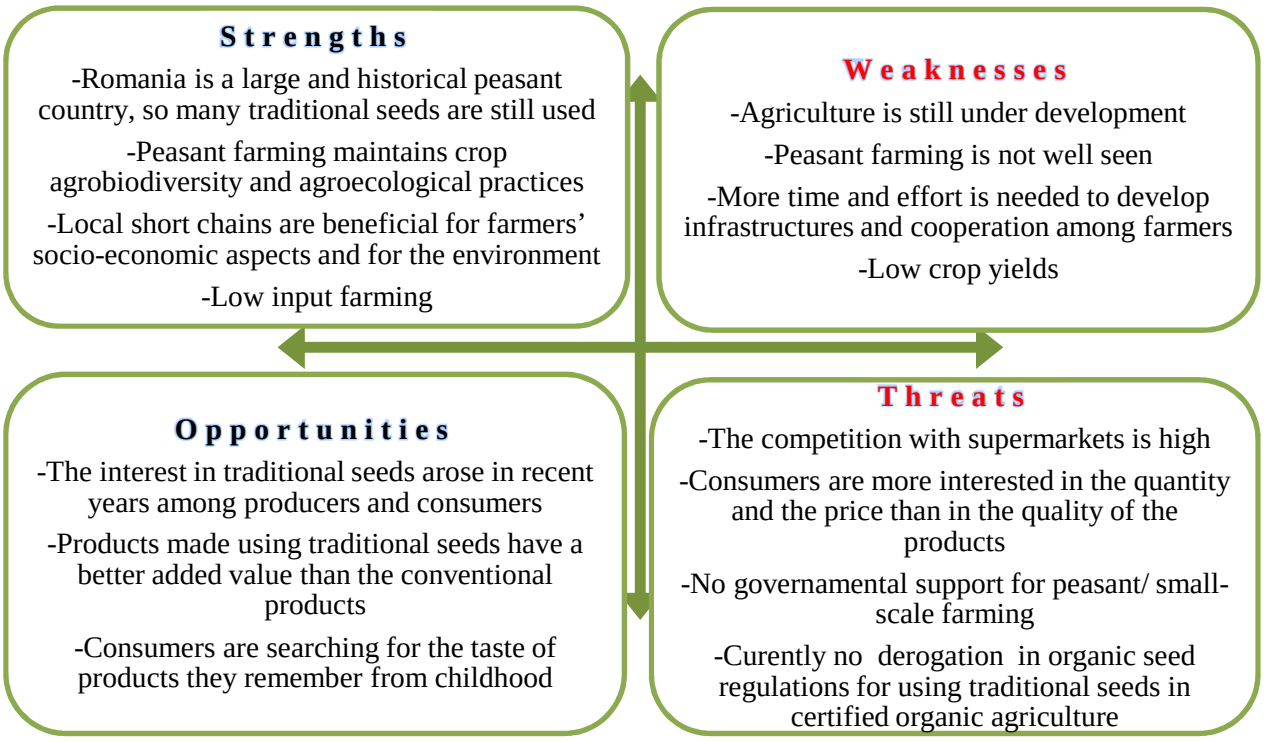
Table 7. SWOT analysis: evaluation of the presence of traditional seeds in the local food markets

Strengths	Weaknesses
-Romania is a large and historical peasant country, so many traditional seeds are still used -Peasant farming maintains crop agrobiodiversity and agroecological practices -Low input farming -Cheap labor cost	-Agriculture is still under development -Peasant farming is not well seen -More time and effort is needed to develop infrastructures and cooperation among farmers -Low crop yields
Opportunities	**Threats**
-The interest in traditional seeds arose in recent years among producers and consumers -Products made using traditional seeds have a better added value than the conventional products -Consumers are searching for the taste of products they remember from childhood	-The competition with supermarkets and intermediaries is high -Consumers are more interested in the quantity and the price rather than in the quality of the products -No support for peasant farming from the government

The presence of traditional seeds in the local short circuit supply chains is also important since 87.5% of the farmers interviewed use and/or conserve this type of seeds. Moreover there is a significant presence of products made using traditional seeds, since 36.4% of the farmers sell less than 50% of these products, and 24.2% of the farmers sell less more than 50% of these products. To come back to the third research question, the results of the survey point out that protecting crop agrobiodiversity is a driver in the short circuit supply chains studied. In the same way as for the previous SWOT analysis, it is a strength that Romania is still a peasant country, because peasants conserve crop agrobiodiversity, and ancestral agroecological practices are preserved by practicing peasant farming (e.g. using organic fertilizers). Moreover being involved in short circuit chains is beneficial for farmers' social and economic aspects (e.g. fair prices for farmers) and for the environment (e.g. low transportation distances). It is an opportunity that producers and consumers are interested in traditional seeds, because of the taste, nutritional and healthy qualities of products made using traditional seeds. However, in this country the actual situation of agriculture is a weakness. Both the producers and the consumers have a negative vision about peasant farming, and the low yields obtained are detrimental for peasants. Furthermore, the competition between peasants and supermarkets is very high, and currently there is no derogation in organic agriculture regulations for traditional seeds, which represent threats for crop agrobiodiversity.

Further on, consumers want cheap products therefore there is a lack of support from their side. Finally the government also does not support small-scale farming (e.g. no possibility to get subventions for farms under 1 ha). This SWOT analysis evaluating the presence of traditional seeds in the local short supply chains was summarized (Table 8), and a "Fact Sheet" presenting this evaluation for Eco Ruralis and all the farmers from the short chains investigated was elaborated (Appendix 5).

Table 8. SWOT analysis: evaluation of the presence of traditional seeds in the local short circuit supply chains



3.3. Sustainability assessment of peasant production systems involved in short circuit supply chains

The MESMIS sustainability analysis is a framework using a cycle of six steps, in three dimensions: economic productive (PE), ecology-environmental (EE) and sociocultural (SC) (Lopez-Ridaura et al. 2002, Astier et al. 2012). The 7 main attributes of sustainable management systems are productivity (for PE dimension), stability-resilience-reliability (for EE dimension) and adaptability-equity-self-reliance (for SC dimension).

Step 1: Definition of the evaluation object: In this analysis the performance of the Romanian peasant crop production systems studied in the survey (Appendix 3) will be compared to organic crop production systems in The Netherlands. There will also be a comparison between representative peasant crop production systems from each one of the short circuit supply chains investigated.

Step 2: Determination of the critical points: These points are the main features which threaten or strengthen the system sustainability. Concerning the productivity attribute, this analysis is focused on the efficiency and the profitability of the production system, which are characterized by two critical points: low productivity and high production costs. The stability/resilience/reliability attributes can be related to the diversity (which has a critical point upon the agrobiodiversity found in the fields), and to the crop damages (which has a critical point upon vulnerability of the production). The adaptability and equity attributes are characterized by the participation, the control and the organization. The critical point can be defined by the indebtedness of local farmers. Finally the self-reliance attribute can be related to the costs and benefits distribution, which has a critical point upon the limited basic grain supply.

Step 3: Selection of indicators: In order to characterize low productivity and high production costs critical points, the indicators chosen are the crop yield (i.e. tomato was the most frequent crop encountered in the survey results) and the economic return to labor (i.e. the wage per day). The agrobiodiversity critical point can be defined by evaluating the number of plant species grown within the production systems. The vulnerability of the production can be evaluated by assessing the incidence of weeds (i.e. the number of weed species observed in the farming system). Concerning the indebtedness of local farmers, it could be relevant to zoom on the grade of external input dependence (i.e. the organic fertilizer, specifically the manure consumption). Finally the limited basic grain supply can be defined by evaluating the grade of seed self-reliance (i.e. the percentage of traditional seeds used and/or saved out of all seeds used in the farming system) (Table 9).

Table 9. Selection of indicators to assess the sustainability of the peasant production systems involved in short circuit supply chains

Attributes	Diagnostic criteria	Critical points	Indicators
Productivity	Efficiency Profitability	Low productivity High production costs	Crop yield Economic return to labor
Stability **Resilience** **Reliability**	Diversity Crop damages	Agrobiodiversity Vulnerability of production	Number of plant species grown Incidence of weeds
Adaptability **Equity** **Self-reliance**	Participation, control and organization Costs and benefits distribution	Indebtedness of local farmers Limited basic grain supply	Grade of external input dependence Grade of seed self-reliance

Step 4: Measurement and monitoring of indicators: The data shown in Table 10 and Table 11 was collected from different sources for each indicator in order to assess the sustainability of the different crop production systems.

The data for the peasant production system was collected from peasant farmers (involved in ASAT, Cutia Taranului or WWOOF local short circuit supply chains) who answered the survey (Appendix 3). The indicator values for the peasant production system in Table 10 are calculated averages of the values collected from the survey results.

The data for the Dutch organic crop production system was collected from literature and the references are specified for each value. Dutch organic greenhouses, owned by Wageningen University, were taken as example for the tomato yield (Vermeulen 2010) and the organic fertilizer consumption (Gravel et al. 2010). The Dutch organic farm Minderhoudhoeve, owned by Wageningen University, was taken as example for the number of plant species grown (Mertens 1998) and the average number of weed species observed in the farming system (Mertens 2002).

The threshold is the maximum value (also called reference or baseline value) that can be reached for each indicator. The threshold data was collected from academic literature, and the references are specified for each value.

The indicator values for the Table 11 were collected during farm visits and/or direct interviews, from 3 representative farms, one from each short circuit supply chain studied. ASAT_1 was interviewed in person on 28th May, CT_2 was interviewed in person on 11th June and WWOOF_7 was visited and interviewed on 12-13th June.

Table 10. Indicators data collected for the sustainability assessment of the peasant production systems compared to average organic crop production systems in The Netherlands

Indicators	Peasant production system	Organic system	Threshold
Tomato yield (PE)	24 t/ha	500 t/ha (Vermeulen 2010)	585 t/ha (Vermeulen 2010)
	4.1%	85.5%	100%
Economic return to labor (PE)	19.5 €/day	50 €/day (adapted from CAO 2014)	60.4 €/day (adapted from WageIndicator 2015)
	32.3%	82.9%	100%
Number of plant species grown (EE)	36 species	13 species (Mertens 1998)	87 species (Papp et al. 2013)
	41.4%	14.9%	100%
Incidence of weeds (EE)	32 species	14 species (Mertens 2002)	100 species (Roschewitz et al. 2005)
	32.1 %	14%	100%
Grade of external input	9.3 t/ha	27.3 t/ha (Gravel et al. 2010)	109.3 t/ha (Gravel et al. 2010)

dependence (SC)	8.5%	25.0%	100%
Grade of seed self-reliance (SC)	43.9%	1% (Serpolay et al. 2011)	100% (Galluzzi et al. 2010)

Table 11. Indicators data collected for the sustainability assessment of the different peasant production systems involved in short circuit supply chains

Indicators	ASAT farm (ASAT_1)	Cutia Țăranului farm (CT_2)	WWOOF farm (WWOOF_7)	Threshold
Tomato yield (PE)	35 t/ha	30 t/ha	30 t/ha	585 t/ha (Vermeulen 2010)
	6.0%	5.1%	5.1%	100%
Economic return to labor (PE)	13.3 €/day	16.7 €/day	11.1 €/day	60.4 €/day (WageIndicator 2015)
	22.1%	27.6%	18.4%	100%
Number of plant species grown (EE)	25 species	38 species	20 species	87 species (Papp et al. 2013)
	28.7%	43.7%	23%	100%
Incidence of weeds (EE)	25 species	7 species	25 species	100 species (Roschewitz et al. 2005)
	25%	7%	25%	100%
Grade of external input dependence (SC)	23 t/ha	50 t/ha	12.5 t/ha	109.3 t/ha (Gravel et al. 2010)
	21%	45.7%	11.4%	100%
Grade of seed self-reliance (SC)	50%	50%	20%	100% (Galluzzi et al. 2010)

Step 5: Presentation of results: The results can be presented as AMOEBA-type diagrams which represent in qualitative terms, a comparison of advantages and limitations between the small-scale peasant production systems under evaluation and organic crop production systems in the Netherlands (Figure 28), as well as a comparison between the different peasant production systems involved in different short circuit supply chains (Figure 29).

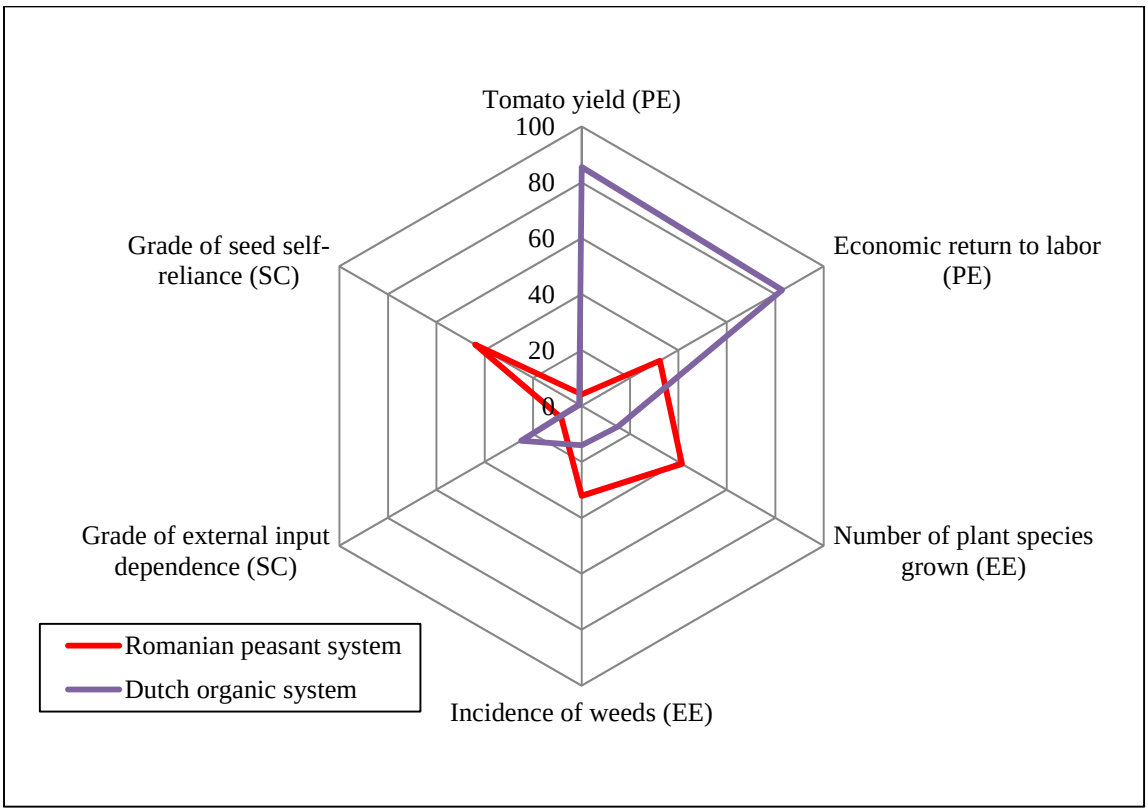


Figure 28. AMOEBA-type diagram representing the comparison between the Romanian peasant production system and the Dutch organic production system

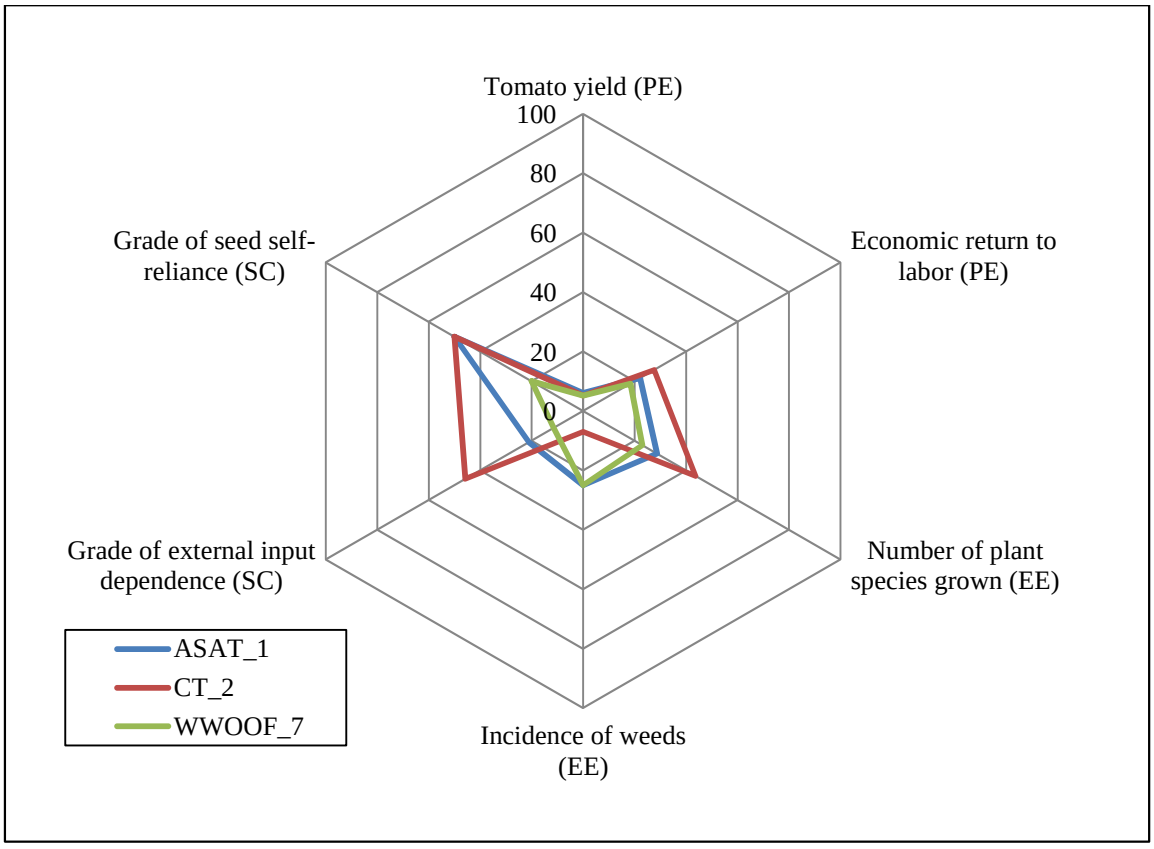


Figure 29. AMOEBA-type diagram representing the comparison between representative peasant production systems from each one of the short circuit supply chains investigated

Step 6: Conclusions and recommendations:

According to the first AMOEBA-type diagram obtained (Figure 28), the Romanian peasant production systems compared to the Dutch organic production systems have both advantages and limitations. Indeed concerning the productivity attribute, the tomato yield is a limitation since peasant systems obtain low yields. The economic return to labor is also a limitation for peasant systems. Even though the minimum wage in Romania is 6 times lower than in The Netherlands (i.e. 250€ compared to 1500€ per month), overall Romanian peasant systems are not sustainable regarding the economic productive dimension. The ecology-environmental dimension is described by more agrobiodiversity in peasant systems than in organic systems, indeed the amounts of crop and weed species are higher. Therefore peasant systems are more environmentally friendly, and more sustainable regarding the ecology-environmental dimension. Concerning the sociocultural dimension, the grade of external input dependence is 3 times lower and the grade of seed self-reliance is much higher for peasant systems compared to organic systems. Therefore the indebtedness of farmers and the limited basic grain supply are not critical points for peasant systems, which results in high sociocultural sustainability.

According to the second AMOEBA-type diagram obtained (Figure 29), the three peasant systems compared have few differences. Concerning the productivity attribute, the tomato yield is a general limitation since all three peasant systems obtain low yields. The economic return to labor is also a general limitation for these peasant systems. However it is important to emphasize that all three peasant systems contribute to the community by providing work for people in their village. Overall these peasant systems are not sustainable regarding the economic productive dimension. Concerning the ecology-environmental dimension, the most environmentally sustainable peasant system is CT_2 (with the highest amount of crop species and the least amount of weed species), followed by ASAT_1 and WWOOF_7. Concerning the sociocultural dimension, the grade of external input dependence is higher for CT_2 than for the other two systems. However overall the manure consumption is low and the grade of seed self-reliance is high, therefore all three peasant systems compared are highly sociocultural sustainable.

Following these results, future improvements of Romanian peasant production systems should focus on enhancing the economic productive dimension. The production of multiple outputs (crops and often animal products) in peasant systems could theoretically allow an improvement of the productivity attribute. As for example farm WWOOF_7 produces besides various crops, teas with medicinal plants, syrups, canned vegetables, dairy products, broiler meat and eggs. Besides the farmer uses only home-made manure, and feed for the cows from his own pastures and hay production which is very sustainable. As a consequence this farmer is able to sell directly at his farm, deliver dairy products 3 times per week to local clients, and deliver food products once per week to a cooperative in the city. Therefore farmers should be encouraged to diversify their outputs. Moreover farmers should be advised on the possibilities available to sell their products, with an emphasis on improving the knowledge on alternative selling methods (e.g. direct farm selling, cooperatives, and CSA schemes). ASAT and Cutia Taranului are very

good models of alternative marketing methods which allow farmers to diversify the boxes depending on the harvest, and to gain 40 lei (around 9€) per box for 1-2 people. CT_2 farmer manages (with his 2.67 ha) a delivery of 70 boxes per week in Cluj-Napoca, which represents a significant income for his farm, compared to the income he was earning when he was selling at local food markets.

All in all, for improving the sustainability of peasant farming systems in Romania, it is essential to develop local short circuit supply chains between peasant farmers and involved consumers, and to use a large diversity of landraces on-farm. These changes would allow farmers to benefit from preserving crop agrobiodiversity and from offering a large choice of food products to their clients.

4. Discussion

4.1. Literature review about traditional seeds: use and networks

In the first part of the results, the evaluation of the actual traditional seeds use in Romania found in the literature, as well as the local traditional seed savers networks, and the positive and negative aspects that can affect the future growth of traditional crop agrobiodiversity propagation in Romania were studied within a short literature review.

On the one hand, these results reveal that three specific hotspots exist in Romania, namely Maramures region, Suceava County, and Apuseni Mountains, where peasants conserve crop agrobiodiversity on-farm, and where the highest amounts of traditional seed varieties can be found (Strajeru et al. 2009, Platon 2011). Even though there is no such evaluation made by a public authority (e.g. Ministry of Agriculture), this evaluation made by the Suceava Gene Bank is trustworthy. These results imply that preserving crop agrobiodiversity is currently still being realized on-farm in Romania for almost all 47 major species with their landraces investigated in this research. To relate these results to the first research question, it appears that traditional seeds are not widely used in Romania. However in these specific hotspots identified, the highest concentrations of landraces were found, therefore these regions are contributing greatly to the preservation of crop agrobiodiversity in Romania. To relate these results to the main problem studied and the initial scope of this MSc Thesis, it is difficult to elaborate already an opinion about the potential of preserving crop agrobiodiversity to enhance food sovereignty, without knowing if those farms investigated produce food for selling it locally or not. Nevertheless it is beneficial to know that these hotspots exist, and that peasants in these regions are highly involved in conserving crop agrobiodiversity in situ, and in using traditional seeds in their farms at least for their own consumption. Nonetheless, the main limits of these results are related to the fact that there is a lack of this kind of evaluation done by authoritative and trustworthy stakeholders. Moreover the Suceava Gene Bank

has very little financial and human resources, which limits their ability to do exhaustive investigations in the whole country to evaluate the use of traditional seeds. Finally this research was done from 2000 to 2008, and since 7 years the situation may have evolved, therefore new similar researches are necessary to update the actual situation about the preservation of crop agrobiodiversity on-farm in Romania.

On the other hand, the results in the literature review indicate that the local traditional seed savers networks are underdeveloped. Eco Ruralis NGO, Suceava Gene Bank and USAMV Cluj-Napoca are currently the most developed networks for preserving crop agrobiodiversity in Romania. To come back to the first research question, these results imply that there are not enough networks of traditional seed savers, and that they cannot meet the demand of producers or reach a large amount of people to propagate their seeds and their knowledge. To relate these results to the main problem studied and the initial scope of this Thesis, these networks need to collaborate and to expand their outreach in order to be able to enhance food sovereignty. Nevertheless the main limits of these results are related to the fact that currently these networks are not being supported by the national or international policies. As it was seen with the different national and European legislations, traditional seeds are actually in a sort of shadow zone, which affects negatively the future growth of crop agrobiodiversity propagation in Romania. Moreover national legislations for food markets are continuously changing in the detriment of peasant producers that use traditional seeds; hence they have more and more difficulties to sell their products (Eco Ruralis 2014, Dragomir 2015a). Nonetheless, the improvement of the collaboration between traditional seed savers networks doing in situ and ex situ conservation, as well as the improvement of public awareness about this issue can have a positive impact on the growth of landraces propagation. Finally in the future this could hopefully have an impact on changing the policies related to traditional seeds.

4.2. Market studies focused on traditional seeds use

In the second part of the results, market studies focused on traditional seeds use were conducted in local food markets in Cluj-Napoca and in local short circuit supply chains in Romania. The main purpose was to evaluate the actual traditional seeds use by peasant farmers that provide food products locally, and to find out if protecting crop agrobiodiversity is a practice used by the peasants selling through these marketing methods.

At first, the results point out that in the local food markets investigated, 95% of the producers interviewed use and conserve traditional seeds on-farm. Moreover the results show that among the farmers interviewed, 60% sell less than 50% of products made with traditional seeds, and 35% sell less more than 50% of products made with traditional seeds. Only two farmers do not sell any product made with traditional seeds. Furthermore, all farmers interviewed own farms in Cluj county, and it is a fortunate coincidence that Cluj-Napoca, the city where the food market studies were conducted, is situated very

close to Apuseni Mountains, one of the three hotspots of crop agrobiodiversity identified by Suceava Gene Bank (Strajeru et al. 2009). To relate these results to the second research question, this implies that protecting crop agrobiodiversity is currently a strong priority for the peasant producers in the local food markets investigated, and that there is a strong presence of products made using local traditional seeds. To come back to the main problem studied and the initial scope of this Thesis, preserving crop agrobiodiversity on-farm allows the peasants interviewed to offer a large variety of food products that they sell locally. Moreover overall they have a positive opinion about the benefits they can have from using traditional seeds. Therefore this agroecological practice has some potential to enhance food sovereignty. Nevertheless, the main limits of these results are related to the fact that a small sample size does not allow to generalize about the potential of preserving crop agrobiodiversity to enhance food sovereignty in the whole country. Besides the results indicate that only 42.5% of the farmers interviewed have farm successors, hence a loss of knowledge and of traditional seeds is going on currently. To back up this idea, a survey realized by Eco Ruralis in 2010 with 134 rural peasant farmers revealed that 70.9% of the farmers grow vegetables therefore a large amount of seeds is used. However 43% of the farmers have no source of information about seeds, whereas 24% go to the shop or the phytopharmacy to buy hybrid seeds and to get information. Consequently there is a clear loss of ancient knowledge about traditional seeds that cannot longer by transmitted.

Further on, the results suggest that in the local short circuit supply chains investigated, 87.5% of the peasants interviewed use and conserve traditional seeds on-farm. Besides the results pinpoint that among the farmers interviewed, 39.4% sell no products made with traditional seeds, whereas 36.4% sell less than 50% of products made with traditional seeds, and 24.2% sell less more than 50% of products made with traditional seeds. Moreover it is a lucky coincidence that 11 peasants interviewed own farms close to Apuseni Mountains and 3 farmers are from Maramures region, two of the three hotspots of crop agrobiodiversity identified by Suceava Gene Bank (Strajeru et al. 2009). In addition farmers involved in short circuit supply chains have different visions and objectives while using traditional seeds on their farms. To relate these results to the third research question, this implies that protecting crop agrobiodiversity is currently a driver in the local short circuit supply chains investigated, and that there is a strong presence of products made using local traditional seeds. Coming back to the main problem and the initial scope of this Thesis, in the same way as for the food markets study, preserving crop agrobiodiversity on-farm is beneficial for the farmers interviewed since they can produce a large variety of food products sold locally. For this reason this agroecological practice has some potential to enhance food sovereignty. Nonetheless, the main limits of these results are related to the fact that a small sample size was used for this market study. Further on, the results reveal that 42.4% of the farmers interviewed have farm successors, which implies that there is a loss of knowledge about traditional seeds. Finally another limitation is that within the WWOOF network, farmers have an overall negative opinion about traditional seeds, which can be linked to that fact that many of them use certified organic seeds and/or produce food mainly for their families and volunteers.

4.3. Sustainability assessment of peasant production systems involved in short circuit supply chains

In the last part of the results, a sustainability assessment was conducted using MESMIS analysis in order to evaluate the sustainability of peasant production systems involved in the local short circuit supply chains investigated during the market studies.

Results point out that in the local short circuit supply chains investigated, peasant crop production systems are environmentally and socio-culturally sustainable. However the economic productive dimension is not sustainable compared to the Dutch organic crop production systems chosen. To relate these results to the last research question, this implies that protecting crop agrobiodiversity can be a solution towards environmentally and socio-culturally sustainable agriculture in Romania. Concerning the main problem studied and the initial scope of this MSc Thesis, preserving crop agrobiodiversity on-farm has potential to enhance food sovereignty in Romania. Nevertheless, the main limits of these results are linked to the fact that not all the farmers interviewed for the market studies managed to answer the survey for the sustainability assessment. Notwithstanding, improvements in the economic productive dimension could enhance the sustainability of these peasant production systems. Indeed, focusing on producing multiple outputs, improving the knowledge on the marketing methods available, developing successful alternative food networks (e.g. CSA schemes such as ASAT and Cutia Taranului, Romanian cooperatives (Dragomir 2015b), direct farm selling), and selling products made using traditional seeds by promoting an improved image (e.g. with their taste and healthy qualities), could help to develop the economic sustainability of peasant production systems in Romania.

4.4. Potential of preserving crop agrobiodiversity to enhance food sovereignty in Romania

Coming back to the main scope of this MSc Thesis, results indicate that preserving crop agrobiodiversity on-farm has potential to enhance food sovereignty in the Romanian agroecosystem context, for peasants selling on local food markets as well as for peasants selling directly through local short circuit supply chains. Further on as specified at the beginning of this Thesis, it was expected that the results would provide a viable solution to enhance food sovereignty, by proposing a model of environmentally and socio-economically sustainable short circuit supply chain for peasant producers. All in all, this model could be a short circuit supply chain integrated in a CSA scheme, with traditional small-scale peasant farmers producing food with traditional seed varieties, and involved and informed consumers that respect the work of peasants and that understand the value of the food products and of

traditional seeds. Actually it is essential that both farmers and consumers understand the value of food products made using traditional seeds related to their benefits (e.g. their taste and healthy qualities), and the value of traditional seeds linked to their benefits i.e. social benefits, agronomic benefits such as the fact that they are adapted to the environment, and socio-economic benefits such as improving the grade of seed self-reliance and spent less money for producing food.

Conclusions

All in all, the results gathered indicate both positive and negative aspects that can contribute to some solutions for the problematic area of this MSc Thesis, which is related to the evaluation of the potential of preserving crop agrobiodiversity to enhance food sovereignty in Romania.

Results from the literature review show that traditional seeds are maybe not being widely used; however specific hotspots of crop agrobiodiversity exist in Romania where farmers contribute largely to preserve landraces on-farm. Further on, results indicate that the networks of traditional seed savers are underdeveloped and they have hard times meeting the demand of producers. Nevertheless improving the collaboration between these networks that conserve crop agrobiodiversity in situ and ex situ can positively affect the future growth of traditional seed propagation. Also the national and European legislations are currently being detrimental for crop agrobiodiversity, however improving the public awareness and developing the traditional seed savers networks may have positive impacts on the national policies and legislations related to seeds on the long term.

What is more, results from the market studies have indicated that protecting crop agrobiodiversity is a strong priority in the local food markets chosen in Cluj-Napoca. In addition there is a strong presence of products made using local traditional seeds in the food markets investigated. Moreover the farmers interviewed in the local food markets have an overall positive opinion about traditional seeds and their benefits. In a similar vein, protecting crop agrobiodiversity is a driver in the short circuit supply chains chosen in Romania. Besides in these chains the presence of products made using local traditional seeds is also important. However the farmers interviewed in the short chains have different visions of the benefits obtained from using traditional seeds and different objectives while using these seeds.

Finally results pinpoint that protecting crop agrobiodiversity can be a viable solution towards environmentally and socio-culturally sustainable agriculture. Nevertheless in order to obtain a type of agriculture that is also economically sustainable, improvements need to be made. Models of sustainable local short circuit supply chains integrated in alternative food networks need to be developed together with peasant farmers and involved and interested consumers.

To conclude, preserving crop agrobiodiversity has potential to enhance food sovereignty, if food products are sold locally mainly through direct selling within alternative food networks, where both consumers and producers understand and appreciate the value of these products and the benefits obtained from using traditional seeds. On the long term, new studies need to be realized by trustworthy authorities including the Ministry of Agriculture and national agricultural research institutes, in order to update the evaluation of the traditional seeds use in the food markets and the short circuit supply chains in the Romanian agroecosystem context. In the end, for the sake of the future of crop agrobiodiversity, civil society, peasants and consumers will have to make their voice heard in order to change national and international policies about traditional seeds.

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Appendices

Appendix 1: Market study survey aimed at the producers in local food markets

Eco Ruralis is a Non-Governmental Organization (NGO) and a peasant association in Romania, which supports small-scale traditional agriculture and peasant farming. Currently we conduct a research on the presence of food products made using traditional seeds in the local food markets. "Traditional seeds" or "local seeds" refer to old seeds inherited from the elders, which were not bought from shops in at least the last 30 years. From traditional seeds are obtained local, traditional or peasant varieties.

In order to achieve this, we would like you to take a few minutes to answer our questions. The goal of this survey is to collect your opinions about traditional seeds. There are no wrong answers, so please help us with your honest opinion! Please indicate your opinion about each question by choosing the appropriate answer. Number 1 of the response scale indicates you 'extremely disagree' with the statement, and number 5 indicates you 'extremely agree'. The higher the number that you choose, the more you think the statement is true.

0	**Do you use or conserve traditional seeds in your farm?**		Yes				No
1	**Using traditional seeds improves the profit of your farm:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
2	**When using traditional seeds, production costs are lower than for conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
3	**You are willing to use more traditional seeds if they are good for the environment:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
4	**It is safe to eat products made using traditional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
5	**Products made using traditional seeds are healthy:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
6	**Products made using traditional seeds are tasty:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
7	**Traditional seeds are more adapted to the local environment than conventional ones:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
8	**Products made using traditional seeds can be conserved longer than products made using conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
9	**Traditional seeds produce a higher harvest than conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
10	**Plants grown from traditional seeds are more resistant to pests and/or diseases than plants grown from conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
11	**Plants grown from traditional seeds are more resistant to drought than plants grown from conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
12	**Using traditional seeds improves the work conditions on your farm:**						
	Extremely disagree	1	2	3	4	5	Extremely agree

Finally, we would like to ask you some personal characteristics.
Please remember that all your answers are confidential and anonymous.

13. Are you ☐male / ☐female ?

14. On average, what proportion of products made using traditional seeds do you sell?
    ☐None
    ☐Less than 50%
    ☐50% or more

15. On average, how often do you sell products on the market?
    ☐ Less than once per week
    ☐1-3 times per week
    ☐4-6 times per week
    ☐ Every day

16. Do you face difficulties to sell on the market because of…?
    ☐High taxes
    ☐Important travelling distances
    ☐Complicated formalities
    ☐Other reasons (detail below)
    ☐No

17. Do you have any successors that will take over your farm?

18. What are the location and the surface of your farm?

19. If you have any remarks related to this questionnaire, please write them down below.

Appendix 2: Market study survey aimed at the producers involved in local short circuit supply chains

Eco Ruralis is a Non-Governmental Organization (NGO) and a peasant association in Romania, which supports small-scale traditional agriculture and peasant farming. Currently we conduct a research on the presence of food products made using traditional seeds in the local short circuit supply chains (ASAT, Cutia Țăranului and WWOOF). “Traditional seeds” or “local seeds” refer to old seeds inherited from the elders, which were not bought from shops in at least the last 30 years. From traditional seeds are obtained local, traditional or peasant varieties.

In order to achieve this, we would like you to take a few minutes to answer our questions. The goal of this survey is to collect your opinions about traditional seeds. There are no wrong answers, so please help us with your honest opinion! Please indicate your opinion about each question by choosing the appropriate answer. Number 1 of the response scale indicates you ‘extremely disagree’ with the statement, and number 5 indicates you ‘extremely agree’. The higher the number that you choose, the more you think the statement is true.

00	**In what short chain is your farm involved?**			ASAT	Cutia Țăranului		WWOOF
0	**Do you use or conserve traditional seeds in your farm?**			Yes			No
1	**Using traditional seeds improves the profit of your farm:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
2	**When using traditional seeds, production costs are lower than for conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
3	**You are willing to use more traditional seeds if they are good for the environment:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
4	**It is safe to eat products made using traditional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
5	**Products made using traditional seeds are healthy:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
6	**Products made using traditional seeds are tasty:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
7	**Traditional seeds are more adapted to the local environment than conventional ones:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
8	**Products made using traditional seeds can be conserved longer than products made using conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
9	**Traditional seeds produce a higher harvest than conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
10	**Plants grown from traditional seeds are more resistant to pests and/or diseases than plants grown from conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
11	**Plants grown from traditional seeds are more resistant to drought than plants grown from conventional seeds:**						
	Extremely disagree	1	2	3	4	5	Extremely agree
12	**Using traditional seeds improves the work conditions on your farm:**						
	Extremely disagree	1	2	3	4	5	Extremely agree

Finally, we would like to ask you some personal characteristics.
Please remember that all your answers are confidential and anonymous.

13. Are you ☐male / ☐female ?

14. On average, what proportion of products made using traditional seeds do you sell?
    ☐None
    ☐Less than 50%
    ☐50% or more

15. On average, how often do you sell products directly (via ASAT, Cutia Țăranului or WWOOF)?
    ☐ Less than once per week
    ☐1-3 times per week
    ☐4-6 times per week
    ☐ Every day

16. Do you face difficulties to sell directly (via ASAT, Cutia Țăranului or WWOOF) because of…?
    ☐High taxes
    ☐Important travelling distances

☐Complicated formalities
☐Other reasons (detail below)
☐No

17. Do you have any successors that will take over your farm?
18. What are the location and the surface of your farm?
19. If you have any remarks related to this questionnaire, please write them down below.

Appendix 3: Sustainability assessment survey for the peasant production systems involved in short circuit supply chains

Eco Ruralis is a Non-Governmental Organization (NGO) and a peasant association in Romania, which supports small-scale traditional agriculture and peasant farming. Currently we conduct a research on the sustainability of peasant farms working with traditional seeds and involved in short circuit supply chains. In order to achieve this, we would like you to take a few minutes to answer our questions. The goal of this survey is to collect information about your traditional farms. There are no wrong answers, so please help us with your honest opinion! Please try to answer all the questions by giving appropriate estimations that are the closest to the reality.

1	What are the average yields of the two main crops produced on your farm? (kg per ha)		
2	What is the average cost of a labor day on your farm? (Lei per day)		
3	How many plant species do you grow on your farm? (number)		
4	How many species of weeds do you find on your farm? (number)		
5	How much fertilizer do you use? (kg per ha)		
6	What is the average amount of traditional seeds that you use and save? (percentage out of all seeds used on the farm)		

Appendix 4: Fact sheet of the evaluation of the presence of traditional seeds in the local food markets in Cluj-Napoca

Written by Eco Ruralis association, Romania.

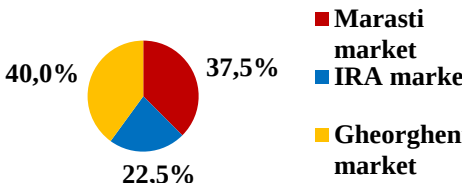
Eco Ruralis association conducted a market study from February to July 2015, in order to evaluate the presence of traditional seeds in the local food markets.

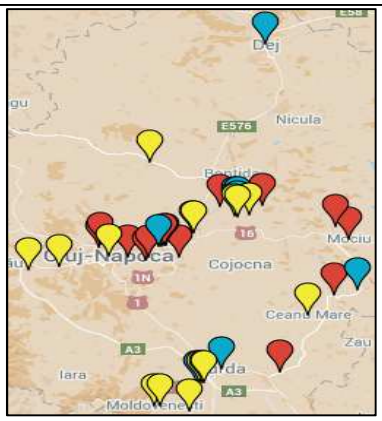
40 farmers from local food markets were interviewed:

- **Marasti** food market: 15 farmers interviewed
- **IRA** food market: 9 farmers interviewed
- **Gheorgheni** food market: 16 farmers interviewed

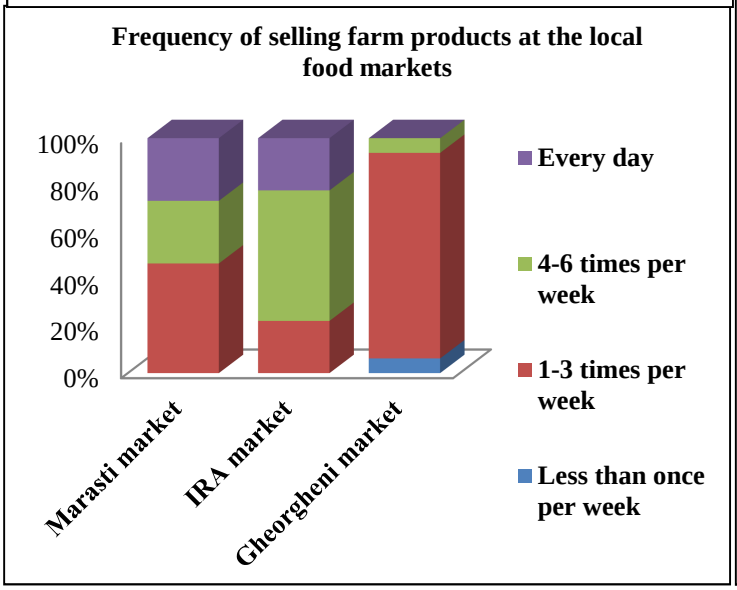
Both IRA and Gheorgheni markets are public food markets managed by the City-Hall of Cluj-Napoca, with the difference that IRA is opened daily, whereas Gheorgheni is only open on Thursdays (from June until December). Marasti is a private food market opened daily.

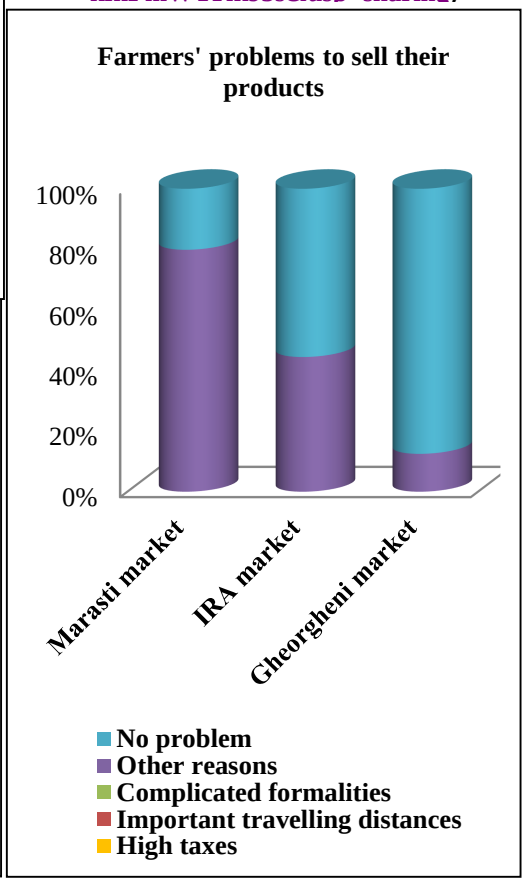
General information about the farms investigated	
Farms location	Cluj county, less than 44 km away from the markets
Surface of the farms	Average: 2.3 ha Range: from 0.07 ha up to 10.5 ha
Gender	55% of farmers interviewed were male
Farm succession	42.5% of all farmers have farm successors
Frequency of selling farm products	➢ One farmer sells less than once per week ➢ 57.5% sell 1 to 3 times per week ➢ 25% sell 4 to 6 times per week ➢ 15% sell every day
Farmers' problems to sell their products	55% do not encounter any problem 45% encounter other reasons: ✓ Both complicated formalities and variable taxes due to the Market Law ✓ Complicated notebook to fill in ✓ Competition with intermediaries ✓ Lack of consumers/their interest ✓ Lack of governmental support



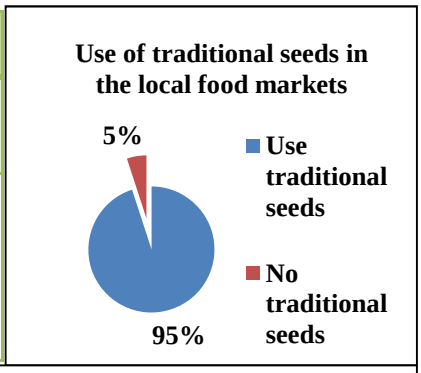


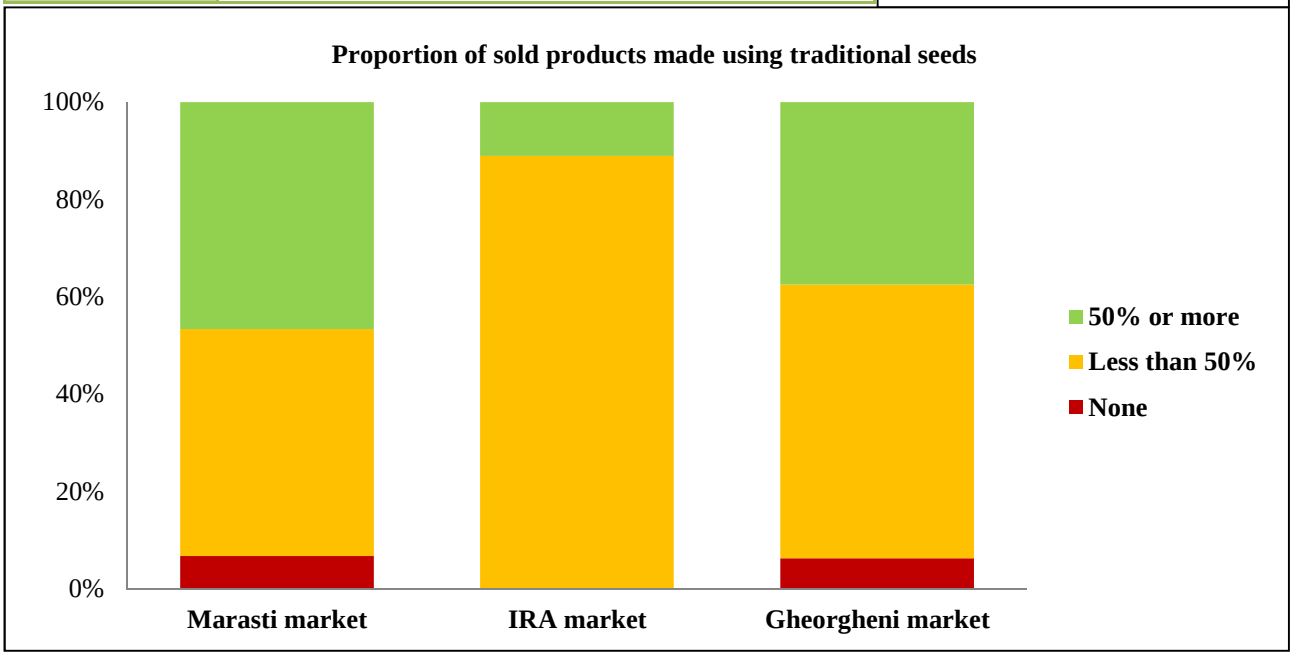
Map of the farms involved in local food markets in Cluj-Napoca. Marasti market: red dots; IRA market: blue dots; Gheorgheni market: yellow dots. (Available at: google.com/maps/d/edit?mid=zkhLaViZdqTo.kfhFmWYKk93s&usp=sharing)



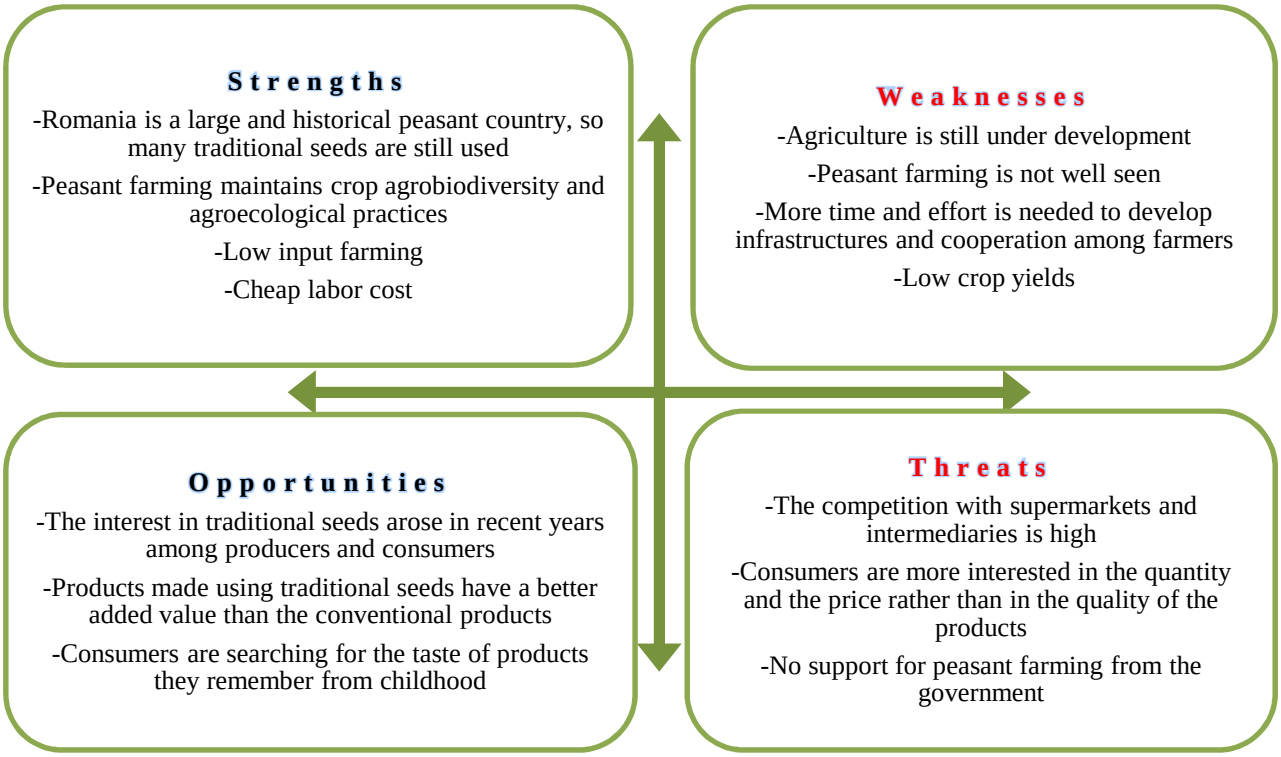


Information about the use and/or conservation of traditional seeds on-farm	
Use of traditional seeds	95% of the farmers interviewed use traditional seeds on their farm
Proportion of sold products made using traditional seeds	➢ 5% of the farmers sell no products made using traditional seeds ➢ 60% sell less than 50% of products made using traditional seeds ➢ 35% sell more than 50% of products made using traditional seeds





SWOT analysis: evaluation of the presence of traditional seeds in the local food markets



Appendix 5: Fact sheet of the evaluation of the presence of traditional seeds in Romanian local short circuit supply chains

Written by Eco Ruralis association, Romania.

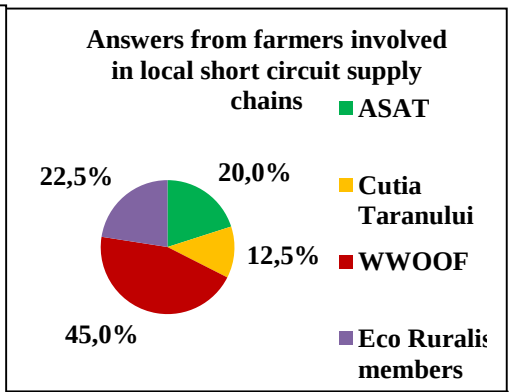
Eco Ruralis association conducted a market study from February to July 2015, in order to evaluate the presence of traditional seeds in the local short circuit supply chains.

40 farmers from local short supply chains were interviewed:

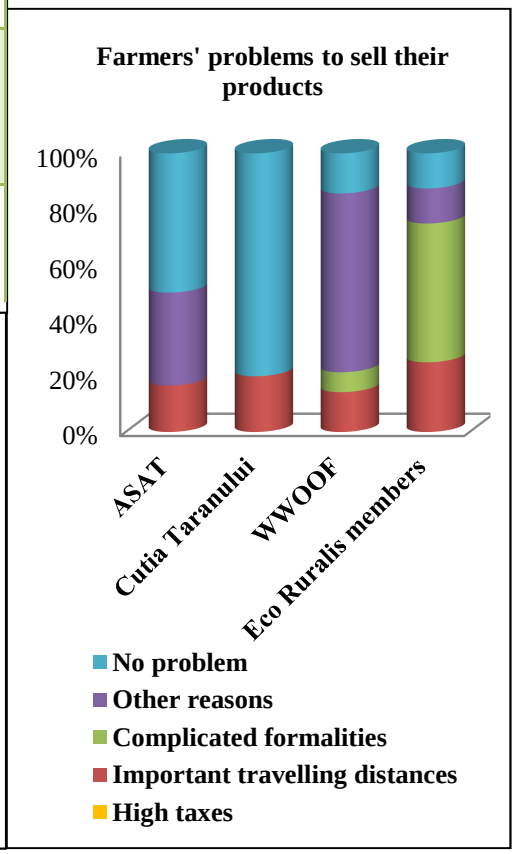
- **ASAT network** (Asociatia pentru Sustinerea Agriculturii Taranesti-Association for Sustaining Peasant Agriculture): 8 farmers interviewed
- **Cutia Taranului network**: 5 farmers interviewed
- **WWOOF network** (World-Wide Opportunities on Organic Farms): 18 farmers interviewed
- **Eco Ruralis members** (direct farm selling or selling through alternative networks) : 9 farmers interviewed

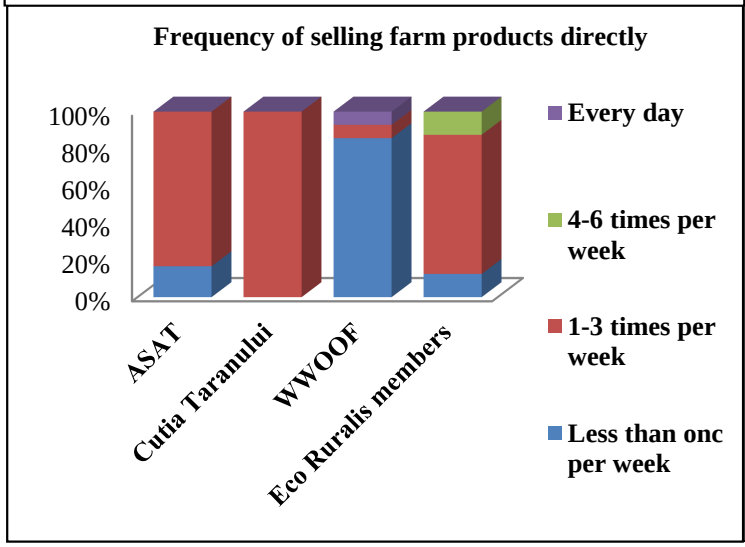
Both ASAT and Cutia Taranului are local short circuit supply chains based on CSA (Community Supported Agriculture) and direct selling box schemes.

General information about the farms investigated	
Farms location	Mostly Transylvania region
Surface of the farms	Average: 4.7 ha Range: from 0.08 ha up to 45 ha
Gender	58% of farmers interviewed were male
Farm succession	42% of all farmers have farm successors
Frequency of selling farm products directly	➢ 42% sell less than once per week ➢ 52% sell 1 to 3 times per week ➢ 1 Eco Ruralis member sells 4 to 6 times per week ➢ 1 WWOOF farmer sells every day
Farmers' problems to sell their products directly	30.3% do not encounter any problem 18.2% have important distances to travel 15.2% encounter complicated formalities 36.4% give other reasons (not specified)

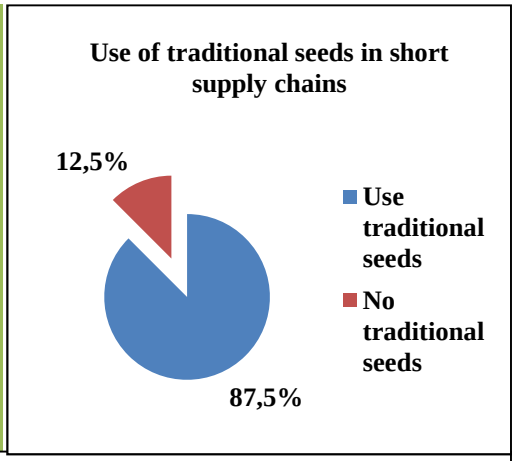


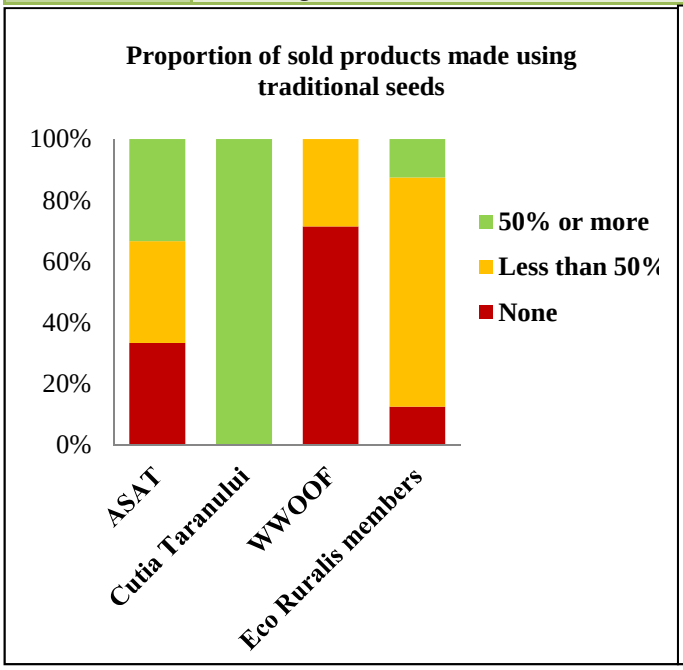
Map of the farms involved in local short chains. ASAT: green dots; Cutia Taranului: yellow dots; WWOOF: red dots; Eco Ruralis: purple dots. (Available at: google.com/maps/d/edit?mid=zkhLaViZdqTo.kt3DXplz5MRo&usp=sharing)

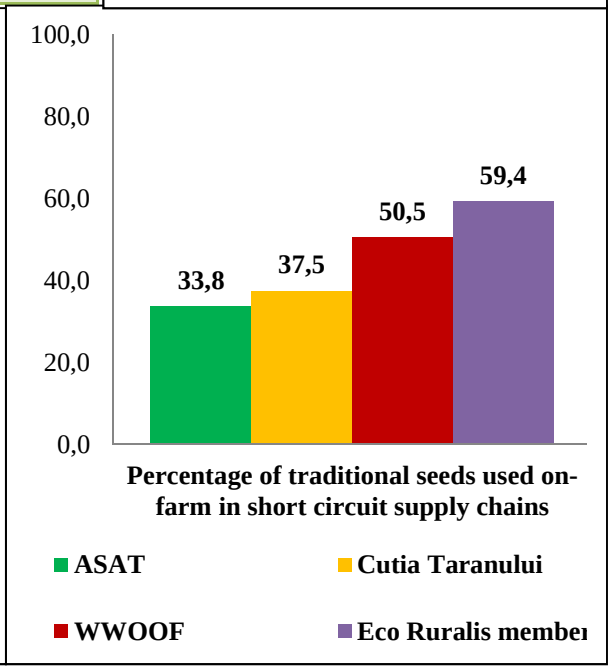




Information about the use and/or conservation of traditional seeds on-farm	
Use of traditional seeds	87.5% of the farmers interviewed use traditional seeds on their farm
Proportion of traditional seeds used	In average 49% of traditional seeds are used out of all seeds used on-farm
Proportion of sold products made using traditional seeds	➢ 39.4% of the farmers interviewed sell no products made using traditional seeds ➢ 36.4% sell less than 50% of products made using traditional seeds ➢ 24.2% sell more than 50% of products made using traditional seeds







SWOT analysis: evaluation of the presence of traditional seeds in the local short circuit supply chains

Strengths

-Romania is a large and historical peasant country, so many traditional seeds are still used

-Peasant farming maintains crop agrobiodiversity and agroecological practices

-Local short circuit supply chains are beneficial for farmers' socio-economic aspects and for the environment

-Low input farming

Weaknesses

-Agriculture is still under development

-Peasant farming is not well seen

-More time and effort is needed to develop infrastructures and cooperation among farmers

-Low crop yields

Opportunities

-The interest in traditional seeds arose in recent years among producers and consumers

-Products made using traditional seeds have a better added value than the conventional products

-Consumers are searching for the taste of products they remember from childhood

Threats

-The competition with supermarkets is high

-Consumers are more interested in the quantity and the price than in the quality of the products

-No governamental support for peasant / small-scale farming

-Curently no derogation in organic seed regulations for using traditional seeds in certified organic agriculture