Assessing small farms' role in the food systems at regional level: insights from a territorial approach

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Abstract: *According to OECD (2016) the regional and context-specific nature of Food and Nutrition Security (FNS) has been broadly overlooked. FNS is the principal outcome of food systems, if these are defined broadly (Eriksen 2008). To assess the sustainability of FNS, the functioning of the food system needs to be addressed: not just consumption, but also the environmental and social determinants of production, processing and distribution of food. A territorial approach to the analysis of the food systems makes it possible to consider the environmental and social context and thus the diversity of different territories to be taken into account. It leads to a better understanding of differences in development opportunities and thus to more targeted public intervention.*
According to UNEP (2016, p.30), food systems differ regionally in terms of actors involved and characteristics of their relationships and activities. In order to better understand all the determinants of FNS and the way they are interrelated, we need to move towards the understanding of food systems spatially, as food insecurity is in most cases based in food system failures at local/regional levels, particularly governance issues (Rastoin 2015). The spatial dimension is particularly required to describe the complex interactions between the very different socially-shaped spaces across European and African countries.
In this paper, we present both the methodological construction and the first results from an analysis of food systems as territorially-based, in 10 different regions of Europe. The food systems in these regions have been analysed in the framework of the H2020 project SALSA. Considering the diversity of small farms and the diversity of regional contexts, SALSA looks at the relationships between small farms and the household, their integration into the market, and the challenges to their survival, considering also their local context, as many of its determinants such as climate, accessibility and demography are locally and regionally specific. In SALSA, we combine qualitative methods from social sciences with advanced spatial analysis and modelling: interviews to key informants and to small farms, participatory sessions on the food chains and the food system, and spatial data analysis based on Satellite images from Sentinel 2. In this paper, we present how these two types of data are combined and the assessment we come to through in this approach about small farms' role in the food system.

Keywords: *small farms; food system; territorial approaches, farms typology*

1.Introduction

The 2013 Report by the High Level Panel of Experts (HLPE) on Food and Nutrition Security (FNS) provides a first indication of the potentially very significant role (at least in some regions) of small farms (HLPE 2013, pp.11-12): *Smallholder agriculture is the foundation of food security in many countries and an important part of the socio/economic/ecological landscape in all countries. (...) The contribution that smallholder agriculture makes to world food security and nutrition is both direct, in as far as it links production and consumption for many rural households, and indirect because (a) it is provisioning domestic markets with the main food products, (b) it does so in a potentially resilient way, and (c) because in many countries smallholder agriculture functions as an important social safety net.*

According to the 1996 and 2009 World Food Summits (FAO 1996 and FAO 2009), *food security can be defined broadly as existing when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*. This is an encompassing but consumption centred concept. In order to understand the factors that drive and affect FNS, it is imperative to also consider the conditions and impact of production, processing and distribution, and their relation to consumption. This means that the sustainability of FNS cannot be addressed without including the several dimensions of the food system, including the principal outcome of food systems, food and nutrition security, when defined broadly and generally (Eriksen 2008a).

For analytical purposes, we suggest that the contribution of small farms to food and nutrition security can be best understood and assessed through a food systems approach (Eriksen 2008 a and b). We adopt the definition of food system proposed by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security: *food systems gather all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes (HLPE 2014, p.12).*

There are various reasons for this choice. A food systems approach considers the opportunities within all food system processes, going beyond the production stage; it can directly address both undernutrition and overconsumption; it enables to consider the changes along the supply chain and their effects on food access and consumption patterns, leading to a more balanced consideration of food supply and demand within the context of actors, institutions and governance (UNEP 2016, p.24).

Focusing on a systems approach implies carefully selecting what is in and what is out of the system, for the sake of the analysis. For our purpose, we opted to assess what are the nodes and flows interacting in the system of food production, processing, distribution and consumption. We also analyse the activity of small farms in relation to actors and flows in these separate activities, defining how they are positioned, which specific linkages to other elements of the same system are relevant, and which outcomes are produced, as shown in Figure 1.

Fig.1 – Small farms contributing to the food system and by this, providing food and nutrition security outcomes

We look at food systems as territorially-based, embedded in local areas (with their differing histories, cultures and geographies) on the one hand, and in the sectoral and systems perspective (with sub-systems and inter-scale relations and effects) on the other (Fournier and Touzard, 2014). The system-based vision of food-related actors and activities needs to be considered in a dynamic perspective, reflecting the capacity of small farms to adapt to changes in their economic, social, technological and natural environments. The importance of the territory relates to local regulation, consumers' demand, civil society and governance patterns

that influence power relations and structures of the food system within the region.

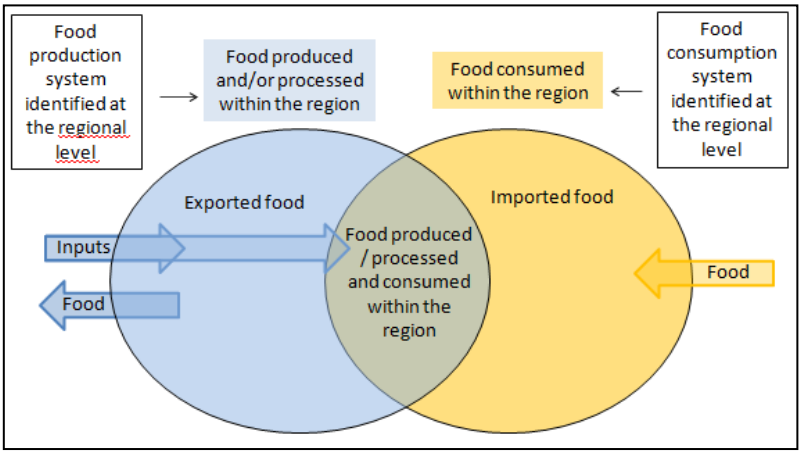

Fig.2 – Food systems at the territorial level: interaction between production and food consumption systems (modified from UNEP 2016)

The regional food system includes the production and consumption spheres, as shown in Fig.2. There is food produced in the region, and food consumed in the region. These two aggregations partially overlap, e.g., there is food produced and consumed directly in the region, and part of it may also be processed in the region. Similarly, there is a large share of the food produced in the region which is exported, while some of the food consumed in the region is imported. For different products, the balance between these two spheres will be different. Understanding the share of small farms' production that is consumed in the region is key in assessing their role in the regional food system. Such an approach has not been done so far.

Since cross-borders flows connect regional with external actors, identifying a food system within a given region highlights the intersection between a multiplicity of relationships with influences extending beyond borders. Some of the external actors (for example, retailers or processors) may have a strong influence on local actors' behaviour, thus influencing the shape and the performance of the territorialised food system. Still, through this analytical lens, relations outside the regional sphere, such are fluxes coming in and going out (even if intense and highly relevant), are considered as inputs and outputs of the system and not further explored.

In order to fully understand the role of small farms in the food system, it is key to contemplate the relation between the small farm and its household. For instance, part of the food produced and consumed in the region may have never circulated from producer to consumer as separate entities in the market, but simply produced at the farm and consumed in the farm household (self-consumption). The possible flows of food between farm and household are conceptualised in Fig.3, in the wider context of the flows of incomes, resources and investments.

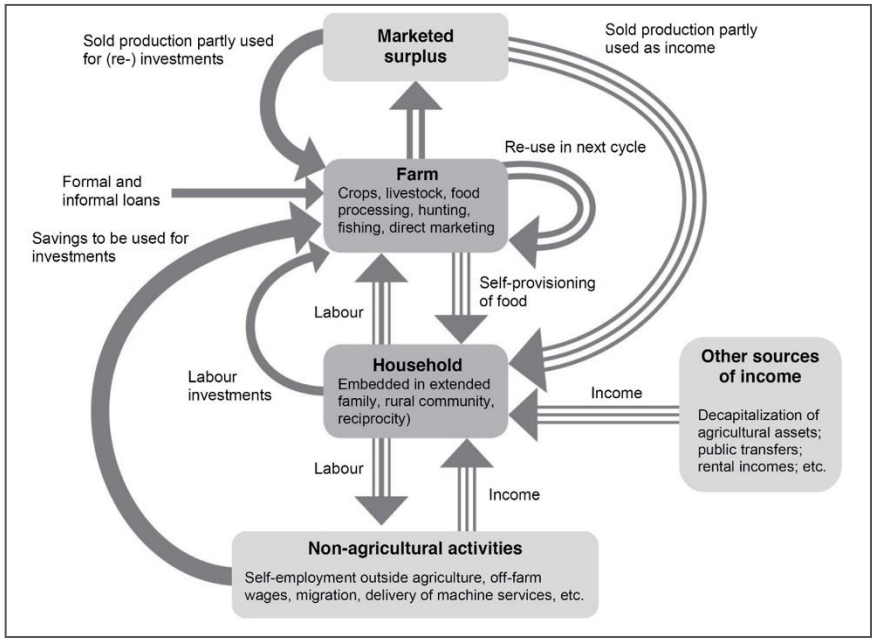

Fig.3. Flows of income and sources of investment in an agricultural smallholding (HLPE 2013)

Not all small farms are characterised by the same types of flows and relations to the household and to the market. In most regions, different types of small farms can be identified, which will be positioned differently in relation to their household as well as to the market. This set of flows between farm and household and farm and the market, according to the different types of small farms in a region, is another level of knowledge required to be able to assess how small farms are positioned in the food system. In consequence, it is not the contribution of all small farms to the food system which is assessed, but the contribution of each type of small farms found in each given region. A characterisation of the different distinctive types of small farms is thus a crucial step in understanding their role in the food system.

The objective of this paper is to provide an overview of an on-going regional analysis of the role of small farms in the food systems, in different regions in Europe. The paper is based on the H2020 SALSA project (Small Farms, Small Food Businesses and Sustainable Food Security) for the 2016-2020 period. The paper describes the methodological construction designed for analysis at the regional level and presents the project's first preliminary results. We hope this will be a contribution towards improving the understanding of the current and potential contribution of small farms to sustainable food and nutrition security in Europe and some African regions.

2.Methodological construction

In order to analyse the food system as territorially-based, the limits of the system have to be artificially defined for the research purpose. There are today no closed food systems within any regional boundaries. Nevertheless, in order to account for the regional specific context, it is possible to consider a region and to concentrate the analysis on the actors and the functioning and intensity of nodes and fluxes of the system which are within the region, in order to disentangle all the relations within the given limits. We can look at territorialised food systems as those food systems identified in the reference region as a set of dynamic interactions between human (households, enterprises, institutions, etc), natural (ecological, spatial, biophysical) and technological elements which results in the range of activities and outcomes highlighted in the HLPE definition, presented above.

The regional approach is operational in different ways: a) it represents a manageable scale at which to do empirical research, ensuring some standardisation in terms of scale of analysis between countries; b) there are many conditions and processes of the food systems depending on bio-physical characteristics and social characteristics that have a territorial variation pattern; c) it identifies administrative levels where statistics are available and policies are set; d) it establishes clear boundaries to take into account food consumption patterns; e) small-scale farmers are more likely to be closely embedded in the regional food systems; f) it is possible to include rural as well as urban areas with their interrelations.

We selected a set of regions across Europe. The regions selected are administrative regions, at Nuts 3 level, so that existing data on production and consumptions could be used and public administration mechanisms more clearly identified. The Nuts 3 level was selected as it is above the strict local level, and thus involving interactions between production, processing, distribution and consumption that are expected to take place within the region. However, Nuts 3 regions have clear regional differentiation factors and are associated with a sense of belonging for the regional population and actors.

A typology of Nuts 3 European regions was created, based on the relative importance of the small farms in the region, both in relation to the overall land occupation (agriculture, forest, urban areas, other), and to the farm sector (Guiomar et al 2018). A cluster analysis of a set of selected indicators was performed, from which 6 different types of regions were identified. Based on this typology, 25 regions (reference regions) were selected to cover the maximum diversity of types.

This paper describes the methodological construction designed for the analysis in the RRs, which consists of three main components:

1) **Production/Consumption**: Mapping of the accurate distribution and land cover pattern of small farms, per plot; estimation of the total production of the selected products by small farms, and of its total share in the food consumed in the region, considering the total population;
2) **Small farms in the food system**: Improvement of the characterization of the food system, with the main nodes and flows inside the region and from and to the outside, and positioning of the small farms in this system, with linkages to different other elements of the food system; identification of strong and weak characteristics of small farms in the system and assessment of risks and resilience mechanisms in face of chocks.
3) **Characterisation of small farms:** Identification of the types of farms that are significant in each region and assessment of the different position that each farm type has, in relation to the household and in relation to the main regional system, as well as characterising and bringing light to their main needs, challenges and problems.

2.1. Production/Consumption

This component of the analysis relies strongly on interdisciplinary integration: it combines advanced remote sensing analysis with field work at the regional scale including detailed surveys to small farms in the region, where small farms holders are extensively interviewed.

The remote sensing analysis was implemented using the images from Sentinel-2A, a wide-swath and high-resolution satellite with 13 spectral bands with spatial resolution ranging from

10 to 60m, being its images freely available. This part of the analysis aimed at providing two main outputs:

a) a map presenting an estimate of the spatial distribution of small farms in each reference region;
b) a crop type map in the context of small farms which will serve as an information source on crop diversity and crop area extent to be further extracted.

The estimated small farms distribution in each region (output a) involved the implementation of two main stages: i) to build an agriculture and non-agriculture mask to exclude for the subsequent analysis all the non-agricultural lands existing in each reference region (land with agriculture-like land cover), and ii) estimation of a surface map for the previously identified agricultural area, presenting the probability of small farms presence in a square grid with 250x 250 m size.

It is recognized that information about field size can be used as a proxy of farm size because there is a positive correlation between field size and farm size (Fritz et al., 2015). Moreover, landscape heterogeneity, in particular the configurational heterogeneity, can be used to measure the degree of spatial complexity of the landscape pattern. In the context of farmland, Fahrig et al. (2015) stated that farmland with higher configurational heterogeneity have smaller crop fields and a greater total length of field edges. Therefore, the link between total length of field edges and the farm size can be established and used as a proxy to infer farm size. The higher the total length of agricultural field edges, the smaller the crop fields, and thus, the smaller the farms.

Therefore, to produce an estimate about the extension of small farms across each reference region, a probabilistic model was developed using the field edges (edge length) as a proxy variable of small farms presence. This was completed through the following steps:

1. Small and non-small farms data collection, by visual-interpretation of high-resolution Google Earth imagery and Sentinel-2A true colour composition;
2. Edge length computation from the Sentinel-2A images using Canny Edge Detector algorithm (CED). The computation of the CED algorithm was carried out through the use of Google Earth Engine (GEE);
3. A probabilistic model for small farms prediction using machine-learning algorithm (Random Forest).

After the definition of the area occupied by small farms, the mapping of the land cover pattern of small farms was produced, e.g., of crop distribution. The crop type maps in each reference region were produced following a three step-strategy:

1) Collection of reference crop data in each region (field work). This step involved intense fieldwork for crop type data collection to be used as calibration/validation datasets in the image classification procedure. More than 10,840 points representing a huge variety of crop types, across 21 European reference regions, were checked by the respective SALSA teams between June and September 2017.

2) Quality control of collected reference crop data. Quality control serves as a validation method for all the field data acquired by the teams. This is crucial to reduce or minimize error propagation (thematic and geographic corrections) while producing the crop type map for each reference region. An average of 8.5% of the sample points (min= 5.1% and max= 15.8%) were checked in 16 out of the 21 references regions. In this way, the accuracy of the field information is highest.

3) Image processing and classification to produce crop type maps. This step involved the development and implementation of methodological procedures dedicated to use the field data and Sentinel-2A images as the main data sources to produce the crop

type maps. Overall, images download, pre-processing and machine learning algorithms programming were the core of this step.

The crop map is the second outcome of this component. A map with detailed information per each plot is produced, identifying crop types, including permanent cultures and grazing areas.

A third step aims at contributing to the improvement of the balance sheet and, by the more precise calculation of the production of the selected products, by small farms. The estimated area of each crop, resulting from the previous phases, is combined with the estimated average productivity of small farms, for the same products. In the survey to small farms in the region, a question is addressed as to the estimated yield per area of the most important crops and products in the farm. Farmers often have problems in replying directly to this question. The productivity value was obtained with a series of relational assumptions, starting from the information that farmers can provide (average harvest per week, number of weeks the crop is harvestable, quantities sold and consumed in the household, etc), leading to an estimation of this average yield. When needed, also expert judgement from technical advisers was used to validate the information obtained.

The average yield for each selected product is combined with the total area of this same product/crop belonging to small farms in the region, resulting in the total estimated production of this same product, by small farms, in the region. With this estimation, it is possible to provide information as to what is the rate of food consumption in the region, which can be covered by small farms production in the same region.

2.2. Small Farms in the Food system

In order to understand, illustrate and characterise the food systems in the different regions, teams were asked to identify and select 4 Key Products (KP) important in their respective reference regions (RR). The selection of the products complied with the common guidelines found in the *WP3 methodology protocol*: two of the products should be both produced and consumed in the region (i.e. that rank high in production and also in consumption); one product should be produced in the region but is mainly destined to export outside the region; and finally, one product important in the region for culinary, cultural or social reasons, even if it scores relatively low in production tonnage. This way, for each region, the food systems of the 4 KP have been and are currently being analysed.

Food systems were analysed using different information sources to complement and validate each other: 1) interviews to 10-15 selected key experts in each of the regions (i.e. farmers and farmer's organizations, producer and processor cooperatives, advisers, public officers dealing with farming, consumers organizations, processors, retailers, policy makers, etc.); 2) desk analysis of existing statistical data sources on production, processing, distribution and consumption flows; 3) 40 interviews to small farms and 10 interviews to small food businesses in each of the regions (approx. 10 farms per KP); 4) 4 focus groups (1 per key product) with representatives of all relevant sectors (small farmers, cooperatives, farmer's associations, business owners, small and large retailers and policy makers).

The same reporting templates were provided for each reference region in order to make sure data was comparable across RRs, both for the narratives of the food systems and for the food systems maps illustrating them.

The focus of SALSA on food systems are small-scale farms and thus, medium/large farms are only represented when and where they play an important role for small farms. An initial food systems map and narrative was prepared for each KP after the interviews with the key experts. This was then complemented with the information obtained from the small farms and small food business interviews, and finally, validated in the focus groups.

A complete narrative and a food system map was thus developed for each of the 4 KP analysed in each of the regions. They all follow the same format to ensure comparison between them. The map represents the key actors (nodes) and flows (quantity of product going from one node to another) that fall into each of the elements conforming the food system: production, processing, distribution and consumption (see fig.4 below as an example). Arrow widths represent the quantity of product flowing within the food systems, thus, clearly signalling the most important product flows. Each of these maps is elaborated together with a narrative detailing the food system, its contextual particularities and the importance and robustness of the different nodes for the resilience of small farms.

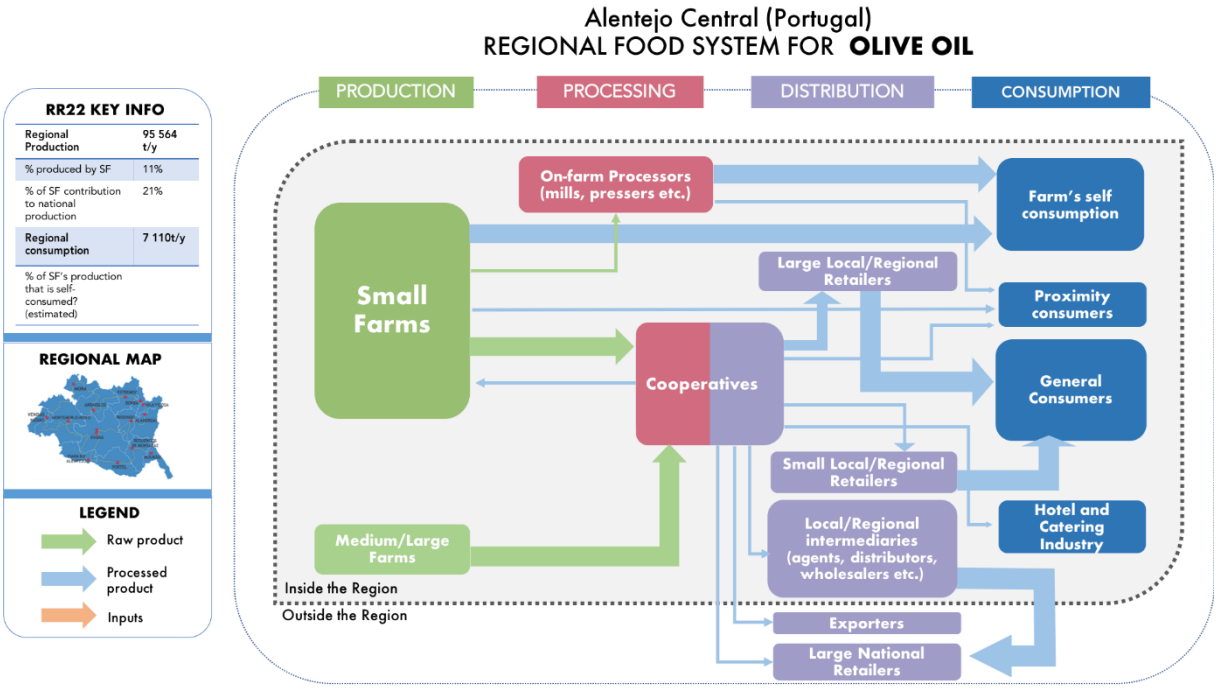

Fig.4. Graphic representation of the territorialised food system at regional level – example to be elaborated in each region as support for identification of all nodes and flows and for discussions with stakeholders

2.3. Characterisation of small farms

For the characterisation of small farms in the region, the main source of information is the surveys to small farms, described in the section above (2.2.).

The characterisation of small farms is done through 2 main methodological steps: A) cluster analysis for the creation of SF typologies; B) characterising the typologies with key indicators on livelihood strategies, challenges and opportunities.

A) Cluster analysis for SF typologies:

In order to obtain the preliminary typologies for small farms, the data from the interviews was transformed into variables and indicators following common guidelines, and a common data

base for the first 10 regions was created and used for further statistical work. So far this has been a very first preliminary analysis, as the data set only comprises the 10 regions already considered, and even for those ones, it is incomplete. No statistical analysis was performed of the data for each simple region.

The steps of the analysis were the following:

a) Defining the dataset: Selection of samples and variables: the dataset comprised 331 samples and 56 variables (18 are categorical), including 10 reference regions (pt-Alentejo, gr-Ileia, it-Lucca, sp-Castellón, lt-Pieriga, pl-Rzewzoski, kn-Ugunja, uk-Skye, cv-Santiago and nw-Hedmark). This dataset only includes variables that have less than one third of missing values and samples that are represented in at least two thirds of the variables (the initial sample size was 337 samples).

b) Data Analysis: Given the high prevalence of missing values in the dataset, we opted to conduct a mixed complementary approach to define small farm (SF) typologies. This mixed approach consisted in the use of two different types of analyses: (1) Factor Analysis on Mixed Data using imputation for handling missing data (FAMD) and (2) Hierarchical Clustering (HC) which can handle missing data.

c) Factor Analysis on Mixed Data: FAMD is a principal component ordination technique (similar to PCA) that allows to work with datasets with both numeric and categorical variables. FAMDs were performed in R-package using extensions "FactoMineR". The extension "missMDA" was used prior to FAMD analyses aiming the imputation of missing values occurring in the dataset. In a last step, we performed a hierarchical clustering on FAMD principal components to extract small farm groups (SF typologies).

d) Hierarchical Clustering: Hierarchical analysis is a classification method that uses a dissimilarity matrix to extract groups in a dataset (Small Farms typologies). Aiming to assess the best classification of groups, both agglomerative and divisive methods were tested to perform HC. The relevance of each variable in the definition of the Small Farms typologies identified in the HC analysis (differences between groups) was assessed using Analysis of variance (ANOVA) and Tukey HSD tests for continuous variables (differences between groups), and 2 tests for categorical variables.

B) Cluster analysis for SF typologies:

To define the major characteristics of each Small Farm type we compared the results of steps d) and c) above. The variables used to define these characteristics were those accomplishing simultaneously the following criteria: have a strong or moderate effect in FAMD and to present significant differences between the groups defined by HC analysis in ANOVA/Tukey HSD tests.

Once the data from all 30 regions is collected and we have a final set of typologies, these will be further characterised in terms of livelihoods and strategies, as well as contrasted against their geographical distribution,

The expected outputs for this component are the following:

1) A description of the different types of small farms most relevant in each region and identification of similarities and differences across regions and across producers of the same product.
2) A detailed characterisation of the small farms types, including their trajectory, economic functioning intra-household dynamics.
3) An analysis of the different links, by type, to the markets and the regional food system, including access to inputs, markets and governance institutions.
4) An analysis of the strategies and perspectives of the different types of small farms, identifying the drivers of their decisions, as well as their potentials and constraints.

3.Some preliminary results and discussion

The four components presented are to be considered as building blocks of a complex analysis required to capture the complexity of the small farms and their relation to food systems at regional level. Therefore, it is more meaningful to present the preliminary results as a single set of results, and not as separated outcomes.

Regarding the combination of very different approaches, an innovative and relevant dimension of this analysis is the use of remote sensing to estimate the distribution and production of small farms. Regarding the assessment of the capabilities and usefulness of Sentinel-2A satellite as a data-based method to produce information about small farms distribution, as well as its monitorization, the main findings achieved constitute probably the first remote sensing-based small farm distribution map developed by using Sentinel-2A imagery. As a first step, a set of agricultural and non-agricultural maps were produced for 21 reference regions with good levels of accuracy (OA > 90% and Kappa>0.80), demonstrating that this sensor is suitable for generating agricultural maps with high accuracy for different European environmental and territorial conditions. Results from the first step highlighted the fact that not all the agricultural areas (used and unused) are being considered in the official agricultural statistics. The main difference between the results here reported and the existing statistics is related to the fact that UAA excludes non-utilized agricultural lands. Nevertheless, this alone does not explain the huge difference detected in some regions. It is not clear whether public or communal lands are included or not in the UAA estimation in some countries, for that reason the UAA may not reflect the real agricultural land area extent. Thus UAA statistics should be used carefully mainly when small farms are the main topic to be addressed.

In order to evaluate the effectiveness in using plots edge information as a proxy of the small farm presence, a regression analysis was performed between edge density (total edge length in the agricultural mask divided by its area) and the Mean Farm Size (MFS) in each reference region. Information about MFS was extracted from the agricultural census and farm statistical survey (2007 – 2010). The obtained results revealed a significant and moderate inverse relationship ($R^2 = 0.65$, $p > 0.001$) between the edge density and the MFS, demonstrating its usefulness for estimating farm size. This result constitutes the base line for the development of a probabilistic model to estimate the presence of small farm plots using edge length information as a proxy variable. A map showing the surface probability values for the presence of small farm plots was computed for each reference region using an adjusted random forest model (Fig. 5). These results provide an interesting and promising methodological approach to estimate small farm plots distribution based on Canny Edge Detector algorithm and high-resolution Sentinel-2A images, and an effective step towards the operational use of Sentinel-2A for small farms monitoring.

Focused on the production of crop type maps, a first experiment was carried out in the Rzeszowski reference region (Poland), where products selected are cereals and potatoes. For this region, a crop type map was produced using the field crop data and the Sentinel-2A images obtained from April to September 2017 (Fig. 6). Preliminary results revealed strong capabilities of Sentinel-2A images in classifying nine different crop types (O.A= 90.0%, Kappa=0.88), being the areas occupied by cereals and potatoes mapped with an average accuracy of 91.3% and 86.3%, respectively. From the crop type map all the patches classified as cereals and potatoes with area less than 5 ha were extracted to compute the area covered by each crop (cereals = 15905 ha; potatoes = 8778 ha). Combining the production estimation of cereals (4.7 ton/ha) and potatoes (17.3 Ton/ha) obtained from field inquiries to the small farmers in Rzeszowski, it was estimated that small farm plots represent 45.3% and 97.6% of the potential production of cereals and potatoes, respectively, revealing that small farms is extremely important in this region mainly for potatoes production.

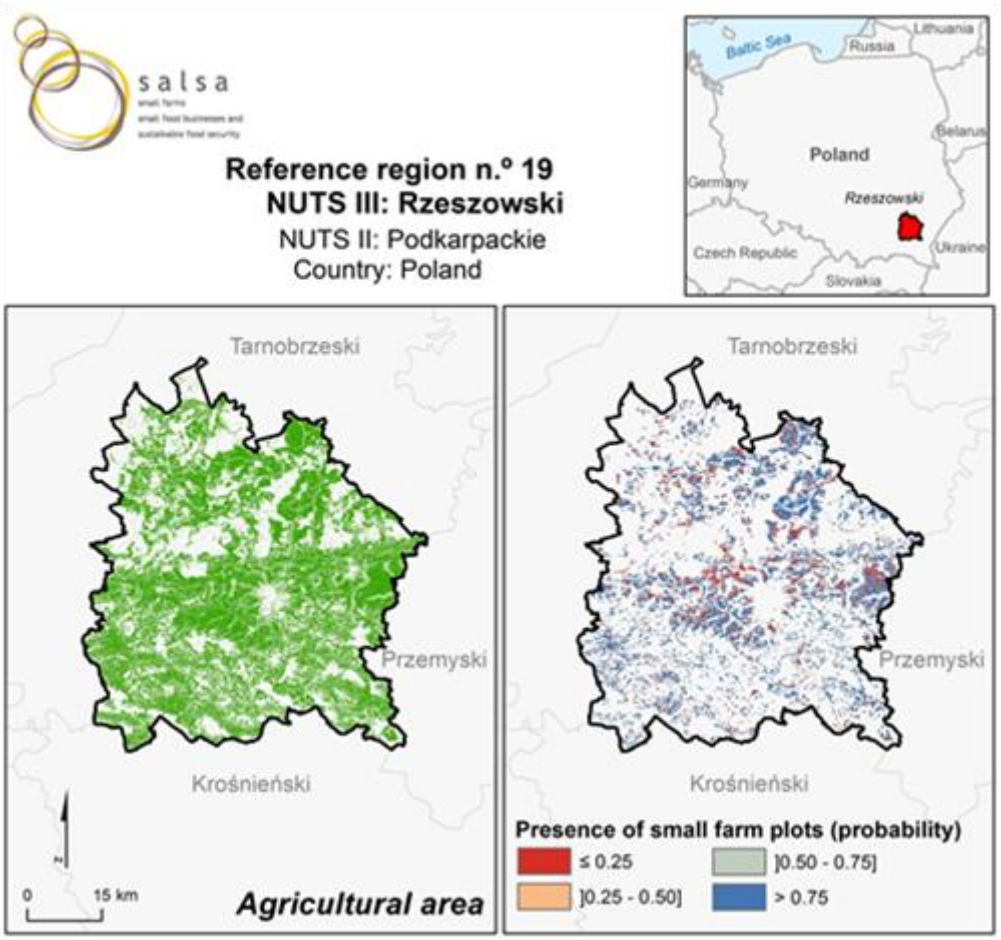

Fig. 5 – Map of the Nuts 3 Region of Rzeszowski, Poland, with identification of agricultural area and of the probability, in this area, of small farms presence.

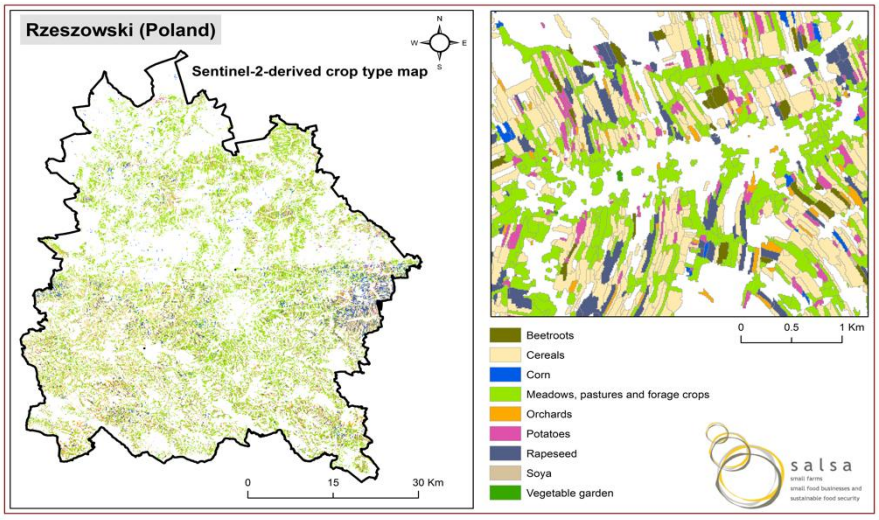

Fig. 6 – Crop map of the small farms area in the Nuts 3 Region of Rzeszowski, Poland

Regarding the analysis of the food systems, the approach proposed, strongly relying on a graphical representation, has proved to be highly appropriate to develop a participatory method of analysis, working with various stakeholders and engaging them in fruitful discussions about the relative importance of the different nodes and fluxes in the system and the relative position of small farms. The knowledge on the food system has progressed in detail and accuracy in the sequence of data collection in the different components.

We hereby present two case studies which are examples of the type of analysis and results that have been obtained from food systems at regional level. Because of the preliminary stage where we are in the project, further comparative analysis will be performed in subsequent analytical steps.

a) Food system in Rzeszowski (Poland) (information from the Regional Report on Rzeszowski)

The main actors on the potatoes market are: input suppliers (machinery and equipment, fertilizers, pesticides etc.), agricultural producers, processing plants, distributors (wholesale and retail) and consumers.

Potatoes are an important element of agricultural production and inhabitants' daily diet in the region. 67% of production in the region is provided by small farms. Farm production, especially in small farms, is intended for household consumption, seed potatoes, feed and forage. The rest is sold. A large part of the production is bought by consumers in unprocessed form (boiled potatoes are one of the main and more commonly used ingredients of the second dish (dinner), especially in the poorer regions). The vast majority of potatoes for consumption are purchased in a variety of retail outlets (supermarkets, grocery stores, marketplaces). Direct sales (on-farm purchases), food cooperatives and direct exchanges between farmers are of marginal importance as a source of supply.

In the region, there are basically no small factories processing potatoes or using them as a raw material. Information from key informants shows that there is one big manufacturing facility where potatoes are used as one of the raw materials (production of food for infants and small children), however, the suppliers to that plant are usually bigger farms.

Smaller retailers (grocery shops, gastronomy) obtain potatoes from local producers, but they also have to import these products (such as early potatoes) from other regions or even abroad. Huge retailers (supermarkets) buy potatoes directly from local producers or import them from other regions (f.e. early potatoes). Production which cannot be sold within RR is sold outside the RR. Potatoes for consumers are available all year, prices are very low.

Potatoes are very important product among the surveyed small farms. Almost all of them (92%) cultivated such product and use it for food and forage (SF with pig production still use potatoes as forage for those group of animal). Almost all farms with potatoes production use some part of production for self-consumption (only 2 farms indicated that they sell of gave away all potatoes they produced). Surveyed SF very often treat potatoes as a gifts to family members (14 farms) or as a gifts to non-family member (2 farms). When selling potatoes, farmer usually did it directly on farm (what is cheaper and easier for them). Only 2 farmers declared that they sold potatoes on farmer's market and 1 that he send production to wholesalers and intermediaries (what is connected with low area of potatoes in each surveyed SF). Exchange with neighbours were very rare – appeared only in 2 farms.

b) Food system in Hedmark (Norway) (information from the Regional Report on Hedmark)

Hedmark produces 38% of Norway's potatoes, and is also the largest producer of state-controlled seed potatoes with 70% of the country's total area of 9098 (figures from 2016). A total of 35 of the country's 55 seed potato sorts are grown in Hedmark. The two largest potato businesses in Norway, Strand Unikorn A/S and Norgro A/S, have their headquarters in Hedmark. New potato varieties are pre-processed in Hedmark, and the Norwegian Farming Advisory Board S/A has devoted a lot of effort to improve the potato production in the county through local trials as well as individual and group advising.

Per 2016 the market share for Norwegian potatoes was 62%. In 2007 the share was 81%. Norwegian growers are looking for new varieties to secure their future position. Wholesalers keep the gate closed for most small producers. A rule of thumb is that you need a minimum production of 90 tons of 'conventional' brands for the wholesalers to accept you as a supplier. Specialty potatoes can access the major wholesalers, like Mountain Mandel, or new potatoes even if the produced amount is less. Small scale producers find alternative sale channels like direct sales from the farm, at local markets, or producer networks of specialty food/ specialty wholesaler (e.g. Røros Food) who distribute to e.g. HORECA.

These are thus examples of quite different food systems at regional level, for the same kind of product. In the Polish food system the self-consumption and direct sale to consumers seems to be quite much more relevant than in the Norwegian regions. A more detailed analysis is expected to be finished soon, including a harmonized graphical representation**,** facilitating comparison.

As for types of small farms, the statistical analysis resulted in a very interesting outcome, mainly because the types identified are consistent to existing literature, but also very clearly defined from the data collected, even if this is still a preliminary set of data. There are three

types, characterized as shown in Table 1. It is important to note that their designation is still only a draft proposal, as a more detailed analysis of the results is still to be undertaken.

Characterisation	Types – draft proposed designation		
	1 ***Self-sufficiency farms***	**2** ***Market-directed specialized farms***	**3** ***Mixed Part-time farms***
Production	Farms oriented to ensure self-sufficiency of the household The production is consumed in the household (self-produced) rarely sold to the market High crop diversity Irrigated lands occupy a small extent	Produce for the market Self-production and self-sufficiency are not a priority Poor livestock and crop diversity Crops are irrigated Processing of staples is uncommon.	Farmers sell directly to the market (usually certified products) Self-production and self-consumption are significantly smaller comparatively to Type 1 farms Crops diversity is usually smaller than in the other type farms. The diversity of livestock is smaller than in type 1 farms but higher than that found in type 2 farms
Household	Staples are rarely purchased in supermarkets Largest household size	Staples are mostly purchased in supermarkets Household size is smaller than in type 1	Staples are mostly purchased in supermarkets Households are usually small
Income	Household income is mostly originated in the farm. lowest incomes	Household income is mostly originated in the farm These farms have higher incomes than Type 1 farms	Household income of farmers is originated mostly outside of the farm
Farmer	The farmer lives in the area (usually close to an urban centre) no formal or basic educational level at least 50% of time spent in farming activities	Farms are mostly run by man, who lives in the area and works in agriculture for a long-time (farming is a family tradition) Farmers sell as part of a group, in many cases articulated with cooperatives	Farmer lives far from urban centres No farming tradition (“new farmers”) Farmers usually have a university degree
Farms	Smallest farms in size Labour is mostly familiar (rarely hired)	Receive no support from neighbours or relatives (financial, technical, labour, in kind or other) Labour is mostly hired (significantly more than types 1 and 2)	Receive support from neighbours or relatives (financial, technical, labour, in kind or other). Hired labour is significantly less common than in farms of type 2 and family labor significantly less than in

			type 1 farms
	The commonest type of farms. Uncommon in gr-Ileia, sp-Castellón, nw-Hedmark and uk-West Scotland	These farms are mostly common in gr-Ileia, sp-Castellón, it-Lucca and pl-Rzeszowski. Are uncommon in African regions, lt-Pieriga and uk-West Scotland	Mostly common in nw-Hedmark and uk-Skye. Absent or rare in African regions, gr-Ileia, sp-Castellón and pl-Rzeszowski.

Table 1 – Main characteristics of the types of farms identified through the preliminary analysis

4. Concluding remarks

In this paper we present the methodological construction applied in the ongoing H2020 project SALSA, of the food system analysis at the regional level, with particular attention to the position and role of small farms. Facing the complexity of the food systems in each region, and also the extreme heterogeneity of what small farms are, across Europe and also in Africa, the challenge has been to produce an innovative and scientifically sound methodology combining different and complementary approaches, which could lead us to results going beyond the state of the art.

From a methodological point of view, we are contributing to progresses in interdisciplinary approaches and the learning required for these to develop. So far our results highlight that is most promising to combine different disciplinary approaches: on one side, on the spatially explicit methods based on advanced remote sensing analysis, and on the other, social sciences qualitative assessment of the food system and the position of small farms at regional level. There are quite some barriers to overcome in terms of disciplinary positioning and the definition of the research object. But once a consistent construction has been reached, there is a wide range of fertile pathways to exploit for improving evidence based knowledge on the food system and the small farms role and position. And at the same time, sound results are also obtained from a strict disciplinary perspective.

Also from a methodological perspective, the work on the regional level has revealed that the conceptual design of the food system and its components (as shown in Fig.4), as a basis to organize the description of the food system and as a support for a process of co-construction with stakeholders, is promising. Such schematic design has showed to be both a fertile support for discussion within the research team, for identifying key questions and missing links, and also, to be fertile in the participatory processes, by being clearly understood by the participants in the focus groups and an inspiring basis for grounded discussions. The scheme on food systems has also improved along the different steps of the analysis, and in its present form it supports the identification of key nodes in the different dimensions of the food system (production, processing, distribution, consumption), as well as of the weak and strong linkages between them, and potential strengths and vulnerabilities of the system, in particular concerning small farms.

Conceptualizing a system for research purposes always requires to define the boundaries of the system, with the related advantages and drawbacks. Opting for a territorial perspective and for the regional boundaries of the food system makes it possible to consider the particularities of each context in which small farms operate, and to make it explicit. There is

evidence already gathered on the positioning of small farms in their region's food system and of their stronger and weaker properties and linkages. Some of the remaining questions will be replied along the way, cross validating partial results into a consistent set of outcomes.

The analysis was so far only applied to a sub-set of the regions selected for the study, and even for this sub-set, not all the data is collected nor the full analysis has been completed. In consequence, as for the results presented, they are only draft results, issuing from this very preliminary analysis. In the same way, we cannot provide yet a critical appraisal of the methodological construction set in place. The work is on progress and therefore we expect to present more elaborated results in the IFSA congress.

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