Measuring multifunctional (agritouristic) characterization of the territory

Bassi I. [1] and De Poi P. [2]

[1] University of Udine, Department of Agro-Industrial Economics and Biology (DIEA), Udine, Italy
[2] University of Udine, Department of Mathematics and Computer Science (DIMI), Udine, Italy

PAPER PREPARED FOR THE 116TH EAAE SEMINAR "Spatial Dynamics in Agri-food Systems: Implications for Sustainability and Consumer Welfare".

Parma (Italy)
October 27th -30th, 2010

Copyright 2010 Bassi I. and De Poi P. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Measuring multifunctional (agritouristic) characterization of the territory

Bassi I. [1] and De Poi P. [2]

[1] University of Udine, Department of Agro-Industrial Economics and Biology (DIEA), Udine, Italy
[2] University of Udine, Department of Mathematics and Computer Science (DIMI), Udine, Italy

Abstract - **The reform of EU agricultural policy set up by Agenda 2000 was intended to develop a competitive, sustainable and multifunctional agriculture, through instruments of both the market and income support policy and the rural development policy. To design strategies and actions while simultaneously considering the multifunctional character of farming and of rural areas, it is necessary to measure the multifunctionality with reference to the sectorial and territorial dimensions. This research represents a methodological contribution to the analyses whose aim it is to describe the multifunctional character of the territory. The availability of data regarding the functions performed by farms, the private or public nature of goods produced and the location of the business, suggested focusing our research on agritourism enterprises at community level. Data was analyzed using the fuzzy clustering algorithm Fanny, which allowed us to test a procedure in order to create a partition in which the communities (statistical units) of each group were functionally similar and geographically close to each other. Furthermore, fuzzy clustering allowed us not only to classify the units into homogeneous groups, but also offered the possibility of identifying the membership degrees of each unit. As to planning all this information is important in designing sectorial and regional development paths differing with regards to each cluster and in identifying any particular intracluster properties at which to target specific projects. The last one is the case of those communities that, having the characteristics of different groups, can be made to migrate towards one cluster rather than another through specific planning, consistent with the objectives of sectorial and territorial policy.**

Keywords - **Multifunctional characterization, spatial proximity, fuzzy clustering.**

I. INTRODUCTION

The reform of EU agricultural policy (CAP) set up by Agenda 2000 was intended to develop a competitive, sustainable and multifunctional agriculture, through instruments of both the market and income support policy and the new at that time rural development policy (RDP). The strategy, confirmed by the most recent reforms of CAP and RDP, highlights the crucial role of the European model based on the multifunctionality of agriculture and of rural areas in contributing to the sustainable development of both the sector and the territory[1] [1] [2].

From a sectorial perspective, the process of diversification (included in the concept of multifunctionality) is a valid response to farmers' squeezed incomes that have been caused by a more intensive rise in agricultural costs compared to the increase in product prices. Besides the primary function of food and fibre production, other activities can provide business opportunities to improve revenue: agritourism activities, farm processing and production of wines and foods, direct sales, conversion to biodynamic and organic farming, landscape management, etc.. Surveys conducted in Europe regarding the spontaneous approaches to farm growth have demonstrated that diversification of assets and incomes is a widespread alternative strategy to farm modernization occurring through (and resulting in) an enlargement of farm size and an increase in the productivity of production factors [4] [5] [6].

To speak about multifunctionality means, firstly, to recognize the farm's capacity to implement new activities (often old practices proposed in an innovative way), other than the primary production, but still joined to it, e.g. due to technical dependencies in the production process, because input is fixed at farm level and can be allocated to various output, or because multiple output is obtained from the same input. Secondly, to recognize the public character of some secondary products for which the farmer is not remunerated (positive externalities) or does not pay for

1. At European level the multifunctionality of agriculture has become a central issue of CAP since the mid-eighties (*Green Paper*, 1985). Some important international institutions (UN, FAO, OECD, WTO) have emphasized the strong relationship between agriculture and sustainable development. In recent years various other approaches have emerged which, in a complementary way, suggest that the multifunctionality of agriculture could play a central role in contributing to the sustainable development of rural areas and society at large [3].

their detrimental effects (negative externalities)[2]. The broad portfolio of products and services of multifunctional farms can be analyzed classifying the different agricultural function in three macro categories [1] [6]:

- productive functions: production of raw materials (farm core business), processing activities, production of traditional wines and foods, hospitality services like accommodation and catering, on-farm sales, bio-energy production, food security, overproduction, etc.;
- social functions: recreational, cultural, educational and therapeutical activities, employment, retention and transmission of traditions, social cohesion, etc.;
- environmental functions: organic production, biodiversity protection, landscaping, reproduction/ consumption of natural resources, pollution and other.

This classification enables us to underline the link between multifunctionality and sustainable farm growth, meaning that to follow a development trajectory over the long term a farm has to consider social and environmental objectives alongside economical. Seen from another perspective, this means that the economic efficiency and the survival of farming systems should be based on the development or maintenance of strong multifunctional pathways. For this reason the growth of the farm is strongly affected by the territory where it derives at least some of its input and sells at least part of its goods. The connection between multifunctionality, farm development and territory is more evident when the level of multifunctionality is high[3] and is expressed through a strong diversification in the use of input and the sources of family income. Typically, these farms show a high awareness of their environmental role and a strong interaction with local communities, i.e. other enterprises, institutions and local actors [11] [12].

An agricultural system well integrated with the local economy and society is capable of generating positive effects on regional competitiveness, social cohesion and the local ecosystem. In the EU, agriculture is the largest user of rural land and is one of the pillars of the local economy. By 1988 the European Commission in its publication *The future of rural society* highlighted the multiple contributions of agriculture in terms of economic development, environmental management and viability of rural communities. Strongly influencing rural areas, agriculture plays an essential role in the creation of income and employment for local people, the strengthening of local identity in relation to both local and external actors, the inclusion of disadvantaged groups, land management and protection of heritage and of cultural traditions. These are the elements at the centre of CAP, both market and rural development policies [5] [13] [14].

Multifunctionality is therefore significant both at micro and macro scale: at micro level it represents a business strategy aimed at reorganizing internal resources for the improvement of their performances; at macro level it is one of the possible developing trajectories of the farming sector and rural territory [12].

To design policies and actions that take into account the multifunctional character of agriculture and rural areas it is necessary to measure the multifunctionality with reference to both sectorial and territorial dimensions. The measurement needs to consider at least two aspects: the first concerns the identification of a set of variables suitable to describe the functions performed by enterprises, with regard to both goods rewarded by the marketplace and externalities; the second concerns the level of the analysis, i.e. distinguishing between business and territorial level, and the last declined in local, regional, national and/or global dimensions [1] [11].

The purpose of this research has beeb to contribute to the analyses aimed at describing the multifunctional character of rural areas simultaneously considering the

2. In international debate the recurring definition of multifunctional agriculture is that of the OECD. According to this, the key elements of multifunctionality are the existence of commodity and non-commodity output jointly produced by agriculture, and the fact that some of the non-commodity products have the characteristics of public goods (externalities) [7] [8] [9].
3. Wilson [10] identifies three possible levels of multifunctionality: weak, which deals with joint production, often unconscious, of agricultural goods and externalities and does not involve a reorganization of production factors; moderate, when it involves an intentional reorganization of farm resources; and strong, characterized by an intense process of cultural and social transformation at the basis of internal reorganization.

sectorial and regional factors providing a methodological framework. For this reason the availability (and quality) of data on functions performed by farms, on the private or public nature of goods produced and on the farm location, suggested focusing our research on agritourism enterprises working at community level**.**

On-farm diversification particularly in tourism has a long tradition in Europe and in particular countries such as Italy. Agritourism enterprises, besides the production of raw materials (e.g. milk, meat, fruit, vegetables, etc.), are able to meet tourist demand with some by now traditional activities such as accommodation, catering and tasting[4]; some of these farms organize cultural and sporting initiatives related to their countryside location (exhibitions of local crafts, musical events, trekking, horse riding, biking, etc.) and are thus able to meet a more complex demand; there are also some farms engaged in processing dairy products, wines, etc. and selling them on-farm or through private buying groups. More recently, some agritourism enterprises initiated social activities in the fields of education and care targeted at students, their families and society in general (e.g. school tours, agricultural technical tours, care of persons with disabilities). According to surveys conducted by the Italian Institute of Statistics [15], the last decade has witnessed a strong growth in this sector, both overall (between 1998 and 2007 farms in the complex increased from 9.7 to 17.7 thousands units, corresponding to an increase of 82.3%) and with respect to single categories, amongst which accommodation and catering are the most widespread.

Agritourism is a segment of rural tourism, a growing sector with interesting development opportunities deriving from the ability to respond to some of the emerging trends in tourism, e.g. interest in traditional enogastronomic products, landscape, heritage, culture and other amenities related to country lifestyle. For the agricultural sector agritourism activities represent an approach to farm diversification aimed at ensuring a positive return in terms of income and employment, especially female employment, seeing that frequently tourism business on farms is managed by female family members due to the fact that it represents the opportunity to reconcile work with family commitments. In this way agritourism, and in general farm diversification, represents an effective opportunity to develop agricultural models that are an alternative to productivist models and that are increasingly multifunctional. For rural communities the interest in tourism as a growth factor can be seen in elements such as job involvement of local people, especially women and youth, opportunity for local actors to initiate new businesses even with limited private investment, induced activities and so on. Tourism development is, therefore, an opportunity to diversify the economy and revitalize rural areas, particularly those left on the confines of the modernization process of the agri-food system [16] [17].

In this paper we illustrate a methodological framework to describe the multifunctional (agritouristic) characterization of rural areas based on the analysis of agritourism enterprises in Friuli Venezia Giulia (FVG)[5] and the various activities performed by them, with regard to the communities (chosen as survey units) in which they are located.

II. METHODOLOGY

In spatial and territorial analyses the cluster analysis, a multivariate survey technique, is widely used especially in the hard version rather than the fuzzy one. The two approaches to classification are not mutually opposed seeing that hard clustering is a particular case of the fuzzy one. Arguably, fuzzy clustering is particularly useful when it is difficult to establish a precise distinction between homogeneous groups, given the presence of statistical units that exhibit the characteristics of different clusters. So, it represents a valuable tool not only in order to group the units in relation to some common characteristics

4. Tasting consists in the sampling of on-farm enogastronomic products, which does not assume the characteristic of a meal or snack [15].

5. Friuli Venezia Giulia is a region located in north-east Italy, bordering with Slovenia and Austria. It covers an area of almost 8 thousand km^2 and a population of just over 1.2 million inhabitants. Administratively it is divided into 219 communities and four provinces whose capitals are: Udine (137 localities, 62.6% of FVG), Pordenone (51 localities, 23.3%), Gorizia (25 localities, 11.4%) and Trieste (6 localities, 2.7%). The latter is also the capital of the region. The province of Udine is the largest and most populous.

but also to distinguish those units that show some properties of different groups [18] [19]. In spatial and territorial analyses units that simultaneously belong to many clusters are of particular interest, as they are the connecting elements between these groups. In previous papers we pointed out that these units can be seen as elements in transition because, enjoying the properties of different clusters, they can be made to migrate towards one cluster rather than another through specific planning [20] [21]. So, the fuzzy classification methods, unlike the crisp ones, have the advantage that the units don't have to be included in a single cluster, but with a specific membership degree they may belong to any group, in a way that the sum of degrees corresponding to each unit is equal to one. Fuzzy clustering algorithms use an initial partition of units, which can be either random or predetermined. Through an iterative procedure aimed at minimizing the objective function, they create a fuzzy classification by determining the membership degrees of each unit to the clusters. The constant $m \in [1,\infty)$ determines the degree of fuzziness of the classification process. If m=1, the fuzzy algorithm coincides with the hard one: any kind of fuzziness is eliminated and the membership degrees are part of the set {0,1}. Increasing m, the degrees assume values in the interval [0,1] and the classification obtained will be fuzzier [22] [23] [24].

Kaufman and Rousseeuw [25] have developed a program for the determination of fuzzy classifications called Fanny. Like all clustering algorithms, Fanny also has strengths and weaknesses that must be taken into account when reading the results obtained. Fanny is an extension of fuzzy k-means and, therefore, is a non-hierarchical algorithm that requires the researcher to choose the number of clusters in which to group the elements. Besides, it creates a partition that can be affected by the order in which the units are listed. On the other hand, Fanny output is not only the grouping of units in different clusters and the determination of their membership degrees, but also information about the silhouette width, which is an indication of the quality of the partition obtained. The silhouette width takes values between 1 and -1: values close to 1 indicate that the units have been located in the most appropriate clusters; values close to 0 indicate that the units could also have been allocated to other clusters; and finally, negative values of the silhouette width indicate the misplacement of statistical units [25] [26].

In earlier works we used procedures of fuzzy clustering to classify the communities of FVG on the basis of some variables concerning the agri-food system (i.e. restaurants selling traditional foods and wines and vineyards with agritourism activities). In these researches the territorial character was implicit in the choice of the communities as survey units. The problem we have had to consider in the present research has been to make the territorial character explicit with the purpose of obtaining groups of communities that are both homogeneous with regard to the sectorial phenomena analyzed (in this paper, the functions of agritourism enterprises) and that at the same time satisfy the constraint of spatial proximity.

In this way we enter the precincts of constrained clustering[6], amongst which those that impose the constraint of contiguity are of particular interest in spatial analyses. This kind of clustering requires specifying when two units are considered adjacent. Only if this condition is met will they be assigned to the same group. In the case of territorial units with irregular shape, such as administrative areas, it is usually assumed that two units are adjacent if they have at least a part of their borders in common. A different way to take into account the spatial character of the units is to calculate a distance that is a function of both the similarities between the values of variables and geographical proximity: DVG=f(DV, DG), where DV is the distance between the vectors of the variable values and DG is the geographical distance for each pair of units. The application of a clustering method to the matrix of distances DVG does not ensure that the groups obtained include only contiguous units. Nevertheless it introduces a spatial element in the classification, whose importance can be properly modified by the researcher varying the weight attributed to DG [19].

The Fanny method, like other fuzzy clustering algorithms, allows for both the input of a data frame of observed variables as well as of a matrix of distance/dissimilarity [19] [27]. These properties are of particular interest, firstly, because they allow the

6. Fuzzy clustering is also a type of constrained clustering in which the constraint regards the type of clusters, which can be hard, overlapping or fuzzy [19].

analysis of both numerical variables (matrix of distance) and categorical variables (matrix of dissimilarity) and also a combination of both (matrix of dissimilarity). More importantly, they offer the possibility to choose the way to design the input matrix, e.g. when you want to assign different weights to the variables analyzed.

Referring to the last consideration, in this research we tested a procedure that initially needed the calculation of two different matrices: one is the matrix of distances calculated in function to the values of observed variables; the other one is the matrix of distances calculated from the geographical coordinates of each unit. After, we took a linear combination of the two normalized matrices, named MF and MG, of type $MFG(b^{-1})=aMF+bMG$, with the weighting coefficients a and b positive, such that a+b=1. Suitably modifying the values of the pairs (a,b), we obtained various matrices $MFG(b^{-1})$ used as input in the Fanny procedure.

III. TESTS AND RESULTS

To analyze the multifunctional (agritouristic) characterization of FVG we chose to use an institutional source of secondary data: the database of agritourism enterprises (AE) managed by the FVG Agency of Rural Development ERSA. This data frame is structured in the way that each record corresponds to an AE and to provide some general information (denomination of the business, location, tax code, date of licence, etc.) and other information about the services offered, with more detail regarding those related to catering (providing hot/cold meals, etc.) and accommodation (number of rooms, beds, etc.).

There are 494 AE active in FVG (data updated autumn 2009) and in most cases refer to one farm. Notable is the presence of 17 farms that run two or three AE. The analysis of this data frame helped identify which farms perform the following functions: catering, accommodation, on-farm sales, recreational and sporting activities, cultural activities and exhibitions, educational activities, organic farming and/or other activities (mountain dairies, farm-camping, etc.). These are the eight variables used for the sectorial analysis (functional variables), whose dichotomous values in the business database indicate the presence or absence of these functions in each AE.

The next step was to transform the business database into a territorial data frame, in which the statistical units are the communities where the AE are located. In this way we have obtained a data frame with 219 rows x 8 columns, equal to the number of localities of FVG and the number of functional variables selected.

The analysis of the territorial data frame immediately allowed the identification of those units in which there are no AE. They correspond to 71 units (32.4% of FVG) that were consequently excluded from the following analysis steps. This gave a new territorial data frame consisting of 148 rows x 8 columns, corresponding to the number of communities with AE and the number of functional variables. In this data frame variable values represent the number of AE which perform the various functions within each locality.

Using the latest territorial data frame, the next step was to build up a matrix of functional distances between units (Euclidean metric). Afterwards, utilizing the geographical coordinates (longitude and latitude) of each community we constructed a geographical distances matrix. The two matrices were normalized to give MF and MG. These are of equal size (148x148), symmetrical, with diagonal elements equal to zero, with values belonging to the set [0,1]. Next, we took a linear combination of the two matrices type aMF+bMG and, giving different values to the weighting coefficients a and b (positive), we obtained different matrices $MFG(b^{-1})$ used for the application of the Fanny method[7].

Given the strengths and weaknesses of each clustering algorithm, many authors recommend using different procedures together. As already mentioned, Fanny is a non-hierarchical algorithm that creates a partition that can be affected by the order in which the units are listed. In this research, Fanny was applied not starting from a random classification but utilizing a predetermined partition obtained with the Ward method (squared Euclidean metric). The hierarchical algorithm was applied using the territorial data frame of normalized functional variables together with

7. Fanny tests were carried out using the statistical package R 2.10.0.

normalized geographical coordinates[8]. The tests showed substantial stability of the partitions obtained using both Ward algorithm and those subsequently obtained with Fanny even in varying the order of unit listing, as indeed occurred in our previous research [20] [21].

Another limitation of non-hierarchical algorithms concerns the choice of the number of clusters. Whereas, with hierarchical methods an optimal partition can be identified using the agglomeration program, recognizing that it is possible to interrupt the aggregation process at the stage immediately preceding the one that shows a high relative increase in the merger coefficients. In this research, the analysis of merger coefficients in addition to the analysis of groups obtained by the Ward method (number of communities in each cluster) suggested we stop the process of agglomeration at the stage where the 148 communities were grouped into five clusters.

The Fanny algorithm was thus applied by setting as initial partition the one obtained by the Ward method, using as input the various matrices MFG(b^{-1}) and repeating the procedure changing the values of fuzziness degree (m). The first test was performed with the matrix MFG(2) obtained by giving equal weight to the original matrices MF and MG (a=b). In the following tests the weighting levels were modified, gradually giving an increasing weight to matrix MF (a>b). To compare and evaluate the results obtained, also single matrix MF (functional distances) was clustered. Moreover, to avoid incurring conclusions drawn only from the territorial nature of the data, we have controlled the output obtained from single matrix MG (geographical distances).

The "optimal" partition, function of weighting level of original matrices MF and MG and of fuzziness degree, was chosen taking into account the coefficient silhouette width verifying that this value was positive for all clusters.

Table 1 shows the results obtained for m=1.20 and for some values of the weighting coefficients[9]. The displayed results take into account the average number of AE performing each of the eight functions at community level[10] and the number of localities belonging to the clusters.

The partition obtained from matrix MF highlights the presence of a group (cluster 5) that includes ten units strongly characterized by a high average number of functionally diversified AE, equal to 31.90. The agritouristic characterization is also strong in the units in cluster 2 (10.13), even if less than the previous cluster; it is moderate in the units in clusters 1 and 4; finally, it is weak in cluster 3, which represents the group more numerous. Therefore, these results help to delineate a possible agritouristic characterization of FVG, which is not however geographically constrained, as shown in Figure 1.

Using matrix MFG(2), in which a=b, Fanny returned a partition that is spatially homogeneous, but not very interesting from the functional point of view. Confirming, in fact, the presence of a group of communities with a high presence of AE (cluster 5), whereas the remaining localities are clustered in groups that are very similar between them.

Changing the weighting levels and giving matrix MF greater influence than the one assigned to matrix MG (a>b), we observed that it tends to maintain a substantial spatial homogeneity and increase the functional differentiation of the groups. For example, the clustering of matrix MFG(6) returned some results that confirmed the presence of a group (cluster 5) of ten units with a very strong agritouristic characterization: the average number of AE at community level calculated in relation to each function is equal to 31.90. The units belonging to cluster 2 are strongly characterized (9.13), albeit in a measure less pronounced than those of cluster 5. The agritouristic character is moderate in units of cluster 1 (4.61) and cluster 3 (4.14) and it is weak in those of cluster 4 (2.88). Furthermore, the partition obtained from matrix MFG(6) owns not only different functional characteristics but it shows a significant territorial homogeneity as well. For these reasons it was chosen as the "optimal" partition whose properties were analyzed with reference to: the values of the eight original functional variables, the degree of

8. Ward tests were carried out using the statistical package SPSS 15.0.

9. MFG(2) corresponds to (a,b) = (1/2,1/2), MFG(3) to (a,b) = (2/3,1/3), MFG(4) to (a,b) = (3/4,1/4), MFG(5) to (a,b) = (4/5,1/5) and finally MFG(6) to (a,b) = (5/6,1/6).

10. This number is equal to or higher than the average number of AE because a business can perform one or more functions simultaneously.

functional diversification (Table 2) and the membership degrees of the communities (Table 3).

As illustrated in Table 2, cluster 5 is the one that emerges in terms of average number of AE present at community level (14.60), well above the average regional number of AE located at the community level (3.28). The degree of functional diversification (2.25) is not the highest one but is higher than the regional average (2.16) and almost all single functional values remain well above the corresponding regional data. In all the units of this cluster there are AE engaged in catering, hospitality and direct sales; in almost all of them there are also some AE organizing recreational and cultural activities; whereas, the other functions are less frequent. The ten units grouped in cluster 5 are strongly linked from a functional point of view. This relation is more important than the geographical one, as they were placed in the same group also without constrained territorial clustering. It is possible, in any case, to note their predominant location along the eastern area of the region, especially in the province of Udine.

The thirty-two communities in cluster 2 show an agritouristic characterization that does not differ significantly from the regional average. In each community there is a high average number of AE (4.77), whose degree of functional diversification, however, it is not very pronounced: these AE, in fact, manage on average 1.98 different functions and only catering activities are present in all localities. These towns are located mainly in the plains and hills of the province of Udine.

The other three clusters are very similar with regard to the average number of AE present in each community, i.e. lower than the regional one. However they differ in the degree of farm diversification, which is low inside cluster 4 (1.51), where catering prevails even if it is not always present. Here there are some communities of the provinces of Udine, Gorizia and Trieste, many of which are located near the eastern border of the region. Clusters 1 and 3, both with a moderate agritouristic characterization, as already seen, differ by the prevalence in the communities of each group of some agritouristic functions over others (e.g. recreational, sporting and cultural activities are mainly present in cluster 1, while teaching activities in cluster 3). Furthermore differing in the degree of diversification that is higher for cluster 1 (2.71) than cluster 3 (2.34): cluster 1 includes the units in which AE carry out the highest average number of functions, in relation not only to cluster 3 but also to the other groups. This information is very valuable if one considers that the units in cluster 1 are located in the hills and mountain areas of region FVG, almost exclusively in the province of Udine. In other words, in these communities the average number of AE is still low, especially if compared with the average situation in FVG. Nevertheless, here you can find some of the farms with the richest tourist activities portfolio. To complete the analysis from the spatial perspective the localities in cluster 3 are divided equally between the provinces of Udine and Pordenone and located in the plains and hills of the region.

The use of fuzzy clustering has the advantage of conveying more information about the cluster structure by showing the degree to which each object fits into each cluster. In this way the fuzzy partition enables the researcher to differentiate between objects that (almost) completely fit into one of the clusters from those that are very ambiguous with respect to the given clusters. This last property can be measured for example referring to a threshold calculated as the average value of membership degrees. Knowing that the sum of the degrees for a single unit is equal to one and that in this research the units were grouped into five clusters, the threshold is equal to 0.20. For this reason we selected those units that have one or more membership degrees with a value equal to or higher than 0.20, apart from the one related to the crisp cluster. The analysis of the membership degrees has shown that there are 44 communities belonging to the first four clusters with at least two values higher than 0.20, i.e. with intermediate characteristics (while the adherence of the units to crisp cluster 5 is very strong, at least equal to 0.81). As an example, we have selected and displayed in Table 3 some of those communities. As illustrated, some of the units belonging to crisp clusters 1 and 3 own the properties of both clusters, that in some respects do not greatly differ among themselves as noted above. Some localities grouped in crisp cluster 2 (which has a generally strong agritouristic characterization) have a less marked character and stand in between this and other clusters. Finally, there are some communities

belonging to cluster 4 (which has a low agritouristic characterization) that show properties that are more pronounced compared to other localities of the same group, given the strong adherence to other clusters.

IV. CONCLUSIONS

The European model based on multifunctionality of agriculture and rural areas puts emphasis on both sectorial and territorial aspects. On one hand there are farms, some of which have been able to respond to new market demands using internal and territorial resources to set up development paths based on business diversification. Amongst these farms, agritourism enterprises in Italy and in Friuli Venezia Giulia have emerged, finding new opportunities to increase income and employment in the rural tourism sector. At the same time contributing to increasing the value of rural areas and to enhancing their attractiveness. On the other hand there is the territory whose challenges should be faced taking into consideration the economic, social and environmental resources that identify it.

This paper presents a methodological framework to analyses that, by combining sectorial and territorial elements, are aimed at shaping strategies and actions that look simultaneously at these two dimensions. In particular, we wanted to describe the multifunctional (agritouristic) nature of the region Friuli Venezia Giulia, chosen as the study area, through the analysis of the different activities implemented by agritourism enterprises in several communities in the region.

To analyze the functional variables selected we used the fuzzy clustering algorithm Fanny. Firstly, it allowed us to test a procedure considering simultaneously both functional and territorial characteristics in order to create a partition in which the communities (statistical units) of each group are functionally similar and geographically close to each other. The procedure consisted in the calculation of the matrix of distances used to input Fanny through the weighted sum of two original matrices: one is the matrix of functional distance built from eight functional variables selected for the analysis (catering, accommodation, on-farm sales, recreational and sporting activities, cultural activities and exhibitions, educational activities, organic farming and other activities) and the other is the matrix of geographical distances. In this way we verified that the localities with agritourism enterprises are grouped into five clusters characterized by a different average number of these enterprises at community level and with a different degree of their functional diversification. No less important, each cluster is also characterized by the geographical proximity of the units.

Furthermore, fuzzy clustering allowed us not only to classify the statistical units into homogeneous groups, but also offered the opportunity to identify the membership degrees of the units to the given clusters. In that it has been possible to recognize the level of adherence of each unit not only to the characteristics of the crisp cluster, but also to those of the other groups.

As to planning all this information is important in designing sectorial and regional development paths differing with regards to each cluster and in identifying any particular intracluster properties at which to target specific projects. This last is the case with those communities that have strong characteristics, i.e. of two or more clusters. They can be seen as units in transition in the sense that, having the characteristics of different groups, they can be made to migrate towards one cluster rather than another through specific planning, consistent with the objectives of sectorial and territorial policy.

Future research will be aimed at the definition of other variables to describe more precisely the multifunctionality of agriculture and rural areas at local level, both at territorial and at farm level, by verifying in the last case the possibility of using the geographical coordinates of the farms themselves.

Table 1 - Results of Fanny clustering (m=1.20)

	CL1	CL2	CL3	CL4	CL5	Total
Average number of AE at community level: sum of functions (see Table 2 - B):						
MF	5.86	10.13	1.88	5.86	31.90	6.89
MFG(2)	4.67	5.42	5.49	4.18	30.27	6.89
MFG(3)	4.67	8.91	3.93	3.16	31.90	6.89
MFG(4)	4.61	9.25	4.29	2.97	31.90	6.89
MFG(5)	4.61	9.00	4.17	2.87	31.90	6.89
MFG(6)	4.61	9.13	4.14	2.88	31.90	6.89
Number of communities:						
MF	28	23	52	35	10	148
MFG(2)	24	43	37	33	11	148
MFG(3)	30	32	45	31	10	148
MFG(4)	31	28	48	31	10	148
MFG(5)	31	31	46	30	10	148
MFG(6)	31	31	44	32	10	148

Table 2 - Average number of AE at community level for MFG(6) (m=1.20)

	CL1	CL2	CL3	CL4	CL5	Total
Agritourism enterprises (A)	1.68	4.77	1.80	1.88	14.60	3.28
Agritourism enterprises for each function:						
1. Catering	1.39	3.94	1.20	1.44	10.50	2.49
2. Accommodation	0.97	1.84	1.18	0.59	7.00	1.54
3. On-farm sales	0.35	1.00	0.48	0.38	4.00	0.78
4. Recreational and sporting activities	0.58	0.94	0.41	0.16	4.40	0.77
5. Cultural activities and exhibitions	0.42	0.84	0.27	0.19	3.80	0.64
6. Educational activities	0.16	0.13	0.32	0.09	0.50	0.21
7. Organic farming	0.10	0.23	0.16	0.03	1.40	0.22
8. Other activities	0.65	0.23	0.11	0.00	0.30	0.24
Sum (1-8) (B)	4.61	9.13	4.14	2.88	31.90	6.89
Degree of functional diversification (B/A)	2.71	1.98	2.34	1.51	2.25	2.16

Table 3 - Communities with strong multiple membership degrees (sample)

Communities	Crisp clusters	Membership degrees				
		CL1	CL2	CL3	CL4	CL5
Tricesimo	1	0.43	0.02	0.33	0.22	0.00
Paularo	1	0.42	0.36	0.11	0.06	0.03
Attimis	2	0.24	0.38	0.23	0.14	0.01
Spilimbergo	2	0.14	0.47	0.28	0.10	0.00
Gradisca d'Isonzo	2	0.01	0.78	0.01	0.21	0.00
Udine	3	0.17	0.07	0.54	0.23	0.00
Talmassons	3	0.06	0.27	0.43	0.24	0.00
San Daniele del Friuli	3	0.29	0.03	0.64	0.04	0.00
Reana del Rojale	4	0.20	0.25	0.27	0.27	0.00
San Floriano del Collio	4	0.06	0.37	0.13	0.44	0.00

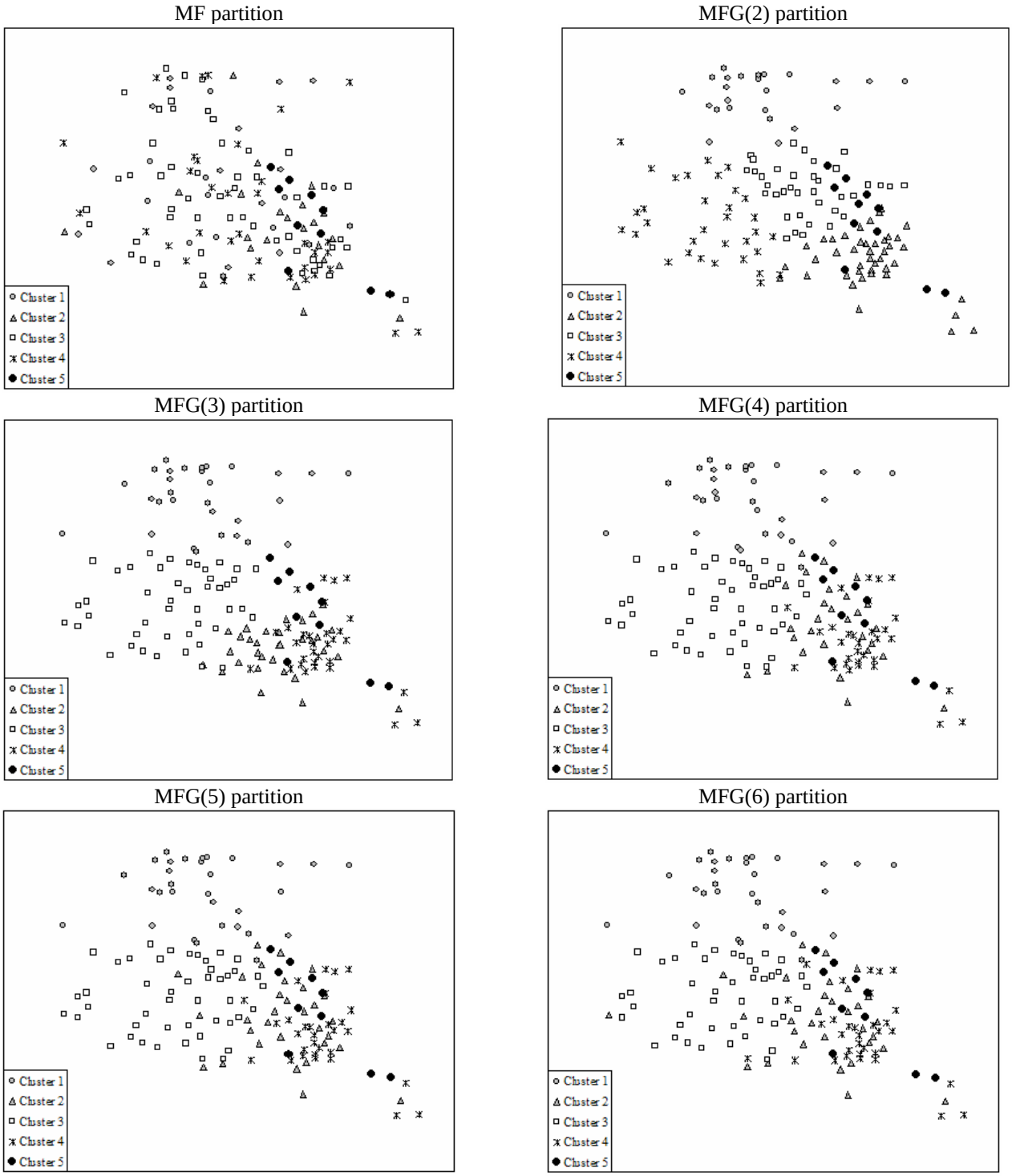

Fig. 1 - Geographical distribution of the results of Fanny clustering (m=1.20)

REFERENCES

1. Henke R. (2004) Agricoltura multifunzionale, intervento pubblico e sviluppo rurale, in Henke R., a cura di, Verso il riconoscimento di un'agricoltura multifunzionale, Teorie, politiche e strumenti, Edizioni Scientifiche Italiane, Istituto Nazionale di Economia Agraria, Roma
2. Aguglia L., Henke R., Salvioni C., a cura di (2008) Agricoltura multifunzionale, Comportamenti e strategie imprenditoriali alla ricerca della diversificazione, Edizioni Scientifiche Italiane, Istituto Nazionale di Economia Agraria, Roma
3. Renting H., Rossing W.A.H., Groot J.C.J., Van der Ploeg J.D., Laurent C., Perraud D., Stobbelaar D.J., Van Ittersum M.K. (2009) Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework, Journal of Environmental Management, 90, 112-123, doi:10.1016/j.jenvman.2008.11.014
4. Van der Ploeg J.D. (2006) Oltre la modernizzazione. Processi di sviluppo rurale in Europa, Rubbettino, Cosenza
5. Mantino F. (2008) Lo sviluppo rurale in Europa, Politiche, istituzioni e attori locali dagli anni '70 ad oggi, Edagricole, Il Sole 24 ORE, Milano
6. Van der Ploeg J.D., Laurent C., Blondeau F., Bonnafous P. (2009) Farm diversity, classification schemes and multifunctionality, Journal of Environmental Management, 90, 124-131, doi:10.1016/j.jenvman.2008.11.022
7. OECD (2001) Multifunctionality: towards an analytical framework, Paris
8. OECD (2003) Multifunctionality: the policy implications, Paris
9. OECD (2005) Multifunctionality in agriculture,What role for private initiatives?, Paris
10. Wilson G.A. (2007) Multifunctional agriculture: a transition theory perspective, CAB International, University of Plymouth, UK
11. Wilson G.A. (2009) The spatiality of multifunctional agriculture: A human geography perspective, Geoforum, 40, 269-280, doi:10.1016/j.geoforum.2008.12.007
12. Henke R., Salvioni C. (2010) Diffusione, struttura e redditività delle aziende multifunzionali, Agriregionieuropa, 20
13. European Commission (1988) The future of rural society, COM (88)501DEF, Brussels
14. European Council (2006) Community strategic guidelines for rural development (programming period 2007 to 2013), Decision 2006/144/EC
15. Istat (2008) Le aziende agrituristiche in Italia al 31 dicembre 2007. www.istat.it
16. Sharpley R., Vass A. (2006) Tourism, farming and diversification: An attitudinal study, Tourism Management, 27, 1040-1052, doi:10.1016/j.tourman.2005.10.025
17. Belletti G. (2010) Ruralità e turismo, Agriregionieuropa, 20
18. Ruspini E. (1969) A new approach to clustering, Inf. Control, 15, 22-32
19. Zani S. (1993) Classificazione di unità territoriali e spaziali, Zani S. a cura di, Metodi statistici per le analisi territoriali, FrancoAngeli, Milano
20. Bassi I., Cristea I. (2010) Vini e cibi della tradizione: strumenti metodologici per lo sviluppo del territorio", Proceedings of XLVI Congress of Italian Association of Agricultural Economists (SIDEA), Piacenza, accepted
21. Bassi I., Cristea I. (2010) Agri(eno)turismi e sviluppo rurale: una proposta metodologica per analisi settoriali-territoriali, Economia Agro-Alimentare, accepted
22. Zadeh, L.A. (1965) Fuzzy sets, Information and Control 8 (3), 338–353 DOI 10.1016/S0019-9958(65)90241-X
23. Zadeh, L. A. (1977) Fuzzy sets and their application to pattern classification and clustering analysis, in Ryzin, J. (ed.) Classification and Clustering, Academic Press, New York, 251-299
24. Bezdek J.C. (1981) Pattern Recognition with Fuzzy Objective Function Algorithms, Plenum, New York
25. Kaufman L., Rousseeuw P.J. (1990) Finding groups in data. An introduction to cluster analysis, Wiley, New York
26. Rousseeuw P.J. (1987) Silhouettes: a graphical aid to the interpretation and validation of cluster analysis, Journal of Computational and Applied Mathematics, 20, 53-65
27. Hathaway R.J., Bedzek J.C. (1994) NERF c-means: non-euclidean relational fuzzy clustering, Pattern Recognition, vol. 27, no. 3, 429-437

(ivana.bassi@uniud.it, pietro.depoi@uniud.it)