TERRITORIAL ANALYSIS IN SUPPORT OF POLICY-MAKING

"A conceptual and methodological model"

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ABSTRACT

The present work, to allow a more effective and significant overall evaluation of every sector analysis, proposes a conceptual and methodological course of action for the territorial analysis, as a support for the definition of the guidelines to plan public intervention for agriculture and the territory. The crux of a territorial analysis may lie in the difficulty of dealing with more phenomena simultaneously and, in particular, in some cases, in the need of a concise analysis of its different aspects (agricultural, urban, environmental, and socio-economic).

That is the reason why the method proposed consists of descriptive and analytical phases which determine an increasing expressiveness of data to the detriment of their initial analytical phase. The final phase of the process is the cluster analysis which allows to share the area investigated into homogeneous territorial groups. Finally, the results are displayed, at first by a dendrogram and, further on, by a map representation. To illustrate the method proposed, and as a test-bed, we have carried out the territorial analysis of the area of the future Monza's province, a territory adjacent to the metropolitan area of Milan.

1. FOREWORD

The speed of current progress, which is now involving the individual, social, and environmental spheres, has modified the policy-making dynamics, making the decisional process more complex and causing a transformation of the "policy–making" methods of governing the territory and agricultural interventions. In fact, if the problem, up to 20 years ago, had been finding the information necessary to develop "indicators", today instead, the large spread and easy access to the information produced under

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The work is the result of common elaboration; with regard to the text, Alberto Pirani has developed section 1, Anna Gaviglio sections 2, 2.4, and 3.5, Martina Licitra Pedol sections 2.1, 2.2 and 2.3 and Luca Rigamonti sections 3.1, 3.2, 3.3 and 3.4. The final considerations (section 4) are the result of close collaboration among all the authors.

the spur of new communication phenomena, have shifted the attention to the need of “managing” the information so as to transfer it to the decisional process without having it crippled by an overflow of data. Unlike the past, the value of the information lies not only in “getting” it but, mainly, in “being able to use it”. And, moreover, the participation in policy-making process has more and more widened, such that the planning techniques have changed from “exclusive” to “participative” and, as to make them well understood by the citizen, they need to have complex phenomena simplified and the aggregation of much knowledge.

The crux of a territorial analysis can therefore be traced back to the difficulty of dealing with many phenomena at the same time and, in particular, to the need of a concise analysis of different aspects, as for example the agricultural, urban, environmental, socio-economic ones. To allow a more effective and significant overall evaluation of every “thematic” analysis, the present work proposes a conceptual and methodological route for the territory analysis, as a support to the definition of guidelines for those who work in planning, processing and drawing up of projects, mainly with regard to the territory management and planning.

Just with regard to medium and long-term programs, we deem it opportune to evaluate “a priori” the quality and the effects of the decisions taken and, at the same time, to take advantage of a control procedure able to interact with the executive phase of intervention. Thus, the need of availing ourselves of an efficient and effective tool which, on the basis of some objective and measurable parameters, enables us to know the “status” of the territorial context destined to develop significantly, in particular with reference to agriculture.

The logic which has, so far, often ruled territorial planning choices, in particular in the most populated areas, has been to consider the agricultural activity as a “marginal” sector. The massive agricultural soil erosion which, it has to be remembered, constitute an irreproducible resource, has often determined an unbalanced territorial arrangement, which sees agriculture relegated to the so-called residual areas as not suitable or “not attractive” for other destinations.

Starting from these preliminary remarks, to test the actual application chances of the methodology identified in the agricultural ambit, in large urbanized areas, the study has examined the territories of the Lombard plain belonging to the Municipalities of the *future Province of Monza*, an area adjacent to Milan, with intent to represent the possibilities, from the landscape viewpoint, to use the agricultural areas confining with urban centres. In this part of the territory, in fact, there are very different realities: on the one hand, it is possible to find living, or better surviving, agriculture, in close contact with urban areas and with the infrastructural network; on the other hand, there is a real agricultural activity mainly centred on cereals (above all corn) and on a limited zootechnical activity (mostly swine, avicultural and, lately, sheeps and goats) which is, partly, in close contact with the protected areas of regional parks. The reading of the territory, from the agricultural, urban, environmental, and socio-economic viewpoint, will provide a mapping which will enable us to connote the area by highlighting the existing phenomena and correlations between concentration and the specialization of the different components identified. The final output, therefore, is the identification of more or less extended areas which are classified on the basis of the values assumed by the indicators considered, aiming at the same time to define territorial realities in line with the whole of the variables introduced in the analysis and to describe the areas identified so as to define the suitable and necessary interventions to do during the planning phase.

2. THE METHODOLOGICAL FRAMEWORK

The methodological route identified is centred on the main concept: to attain a "code" to interpret the complexity of the territorial reality to be investigated; a suitable tool for evaluating the local progress towards likely future scenarios and able to contribute to steer and improve the external intervention on the territory so as to reduce uncertainties in decisions.

The method starts from the *definition of the ambits* of the territory to be investigated by means of a mono or multi-sectoral analysis which takes into consideration one or more aspects thereto connected. In fact, the territory, meant as the whole of the components which both physically, basically, and metaphorically influence its shape, can be studied and described in both its natural (morphological and environmental) and social features (the way the population settles on the territory). It has to be taken into consideration, however, how these features appear to be subject to changes in time and how different their weight is, when "quantifying" the territorial features when a possible intervention on it, is considered.

The survey of a territory may be carried out by means of different methods, depending on the objectives attained and on the resources made available to investigate the agro-environmental and urban-demographic features. Therefore, once identified the phenomenon to be investigated and the territorial area of reference, the acquisition of more reliable knowledge of the territory through a *collection and organization of information* proves to be essential.

For the analysis of the data acquired, that is for a correct deal of more phenomena of a different nature simultaneously, a sole and highly representative synthesis has to be made possible, allowing a more effective and significant overall evaluation. With a view to comparing and analysing the performance, the recourse to *indicators* summarizing features or properties of the phenomenon object of the study into single numerical values, obtained by algebraic calculations, may prove effective. In particular, the significance of these algebraic calculations lies in settling static and/or dynamic relations among the values assumed by each variable by which a given feature is surveyed and quantified.

The recourse to indicators features the quality of a protocol which must meet the increasing need for reliable synthetic data, comparable with one another, aiming at recording the trends already taking place in a fast and clear way, or at quantifying more complex phenomena. The choice of the indicators must be guided by the aim of calling the attention, from time to time, through each of them, on specific aspects of interest for the territory survey.

For every indicator variants may be introduced, shifting the attention, as the case may be, towards temporal comparison, the territorial one, the relationship among correlated sizes, variability or the mean values assumed by the variables taken into consideration.

The indicators formulation, therefore, makes it possible to get significant synthetic information in relation to the phenomenon under study and to the comparisons to be evaluated.

The treatment of more variables and indicators, however, imposes the obligation to choose the processing method preliminarily as it may be influenced by the fact that every indicator has its own features, the one different from the others (different units of measurement, different importance of each variable compared with the others, etc.). One of the techniques to take more variables into consideration consists in reducing a wide range of indicators to one or more variables, so as to get a synthetic *index*, comprehensive of more properties and/or phenomena. In this phase it is necessary to find a method to *aggregate* the different types of indicators selected, so as to treat them simultaneously and to have a sole and satisfactory solution.

Therefore, the necessary follow-up to give the data needed for this purpose is as follows:

1. identification of data;
2. normalization of data and creation of indicators;
3. selection and standardization of indicators;
4. aggregation through the Cluster Analysis.

According to what we have indicated above, the *framework* proposed (Fig.1), from a conceptual point of view, may be schematized as follows:

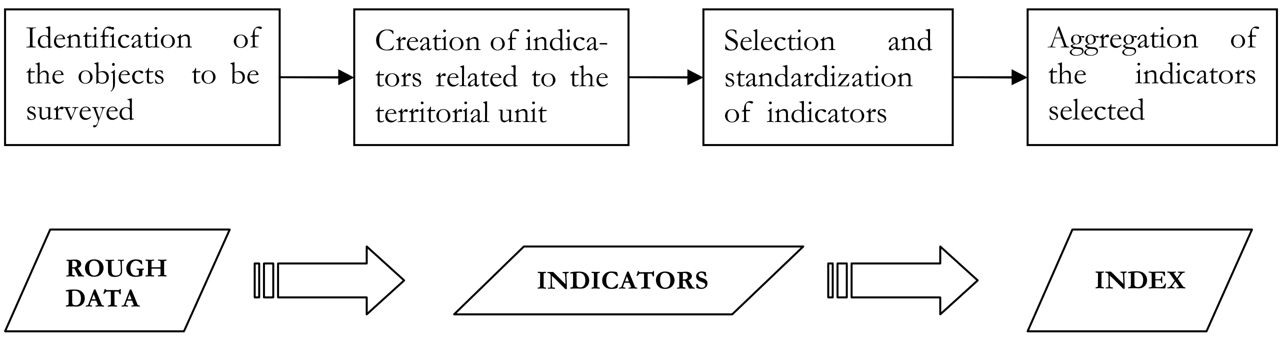

Figure 1: *The organization of the framework*

2.1 IDENTIFICATION AND COLLECTION OF DATA

In this phase the basic and featuring data of the phenomenon under survey will be identified and collected. To be able to identify and define territorial areas, reliable and quite "accurate" information is needed, in the sense that it is fair to get down to a level of information which takes into account a reference territorial unit as small as possible (such as the municipalities).

Direct surveys and measurements are not always able to meet these requirements; a valid alternative can be to make recourse to the data from official statistical sources (such as ISTAT censuses). Really, these data banks have a great role as they represent direct surveys being carried out on all the individuals and subjects representative of the units under survey (families, dwelling places, farms, companies' and institutions' local units, etc.) covering the whole national territory and making reference to only one period of survey.

The sources and the selection of data in this methodology is of the utmost conceptual strictness, aiming at directly representing the phenomenon considered.

The basic idea is that every ambit of the territory previously selected may show, through the presence and processing of the data collected, its degree of intensity in the different territorial units selected; this may be "significant" of the presence or not of the phenomenon in its overall territorial extension, though, in some cases, the different environments selected might impose a territory interpretation particularly linked to local aspects.

2.2 NORMALIZATION OF DATA AND CREATION OF INDICATORS

The normalization phase is important for the treatment of the basic data collected , as it allows us to bring the datum back to the territorial dimension and later on to start making comparisons correctly.

The data presented in the different sources, being mostly expressed in absolute terms, not always appear to be linked to the territorial dimension; it is therefore necessary to create indicators representative of the reference territorial units selected. The indicators so normalized, in fact, may become the object of both statistical analyses and map representations.

To know and "interpret" a territory, meant as a very complex system characterized by phenomena interconnected one another, it is necessary to take advantage of tools able to reduce the complexity of the phenomena and to simplify reality. Among the technical tools able to meet this requirement there are the indicators , tools which are fit for knowledge and "communication", also useful to support territorial planning and policy-making decisions.

In the perspective of connecting indicators to decisions, however, it has to be taken into consideration that indicators are a mere representation of reality and, thus, they cannot be exported as such to every environment, but it is necessary to choose them, from time to time, depending on the context to be analysed. The preliminary step to take in a territorial analysis process as the one proposed, therefore, shall foresee the choice of clear targets of survey, measurable by means of indicators and not, as sometimes happens, vice versa.

The idea of "territorial development" implies the fact that it cannot merely be traced back to economic growth; development is an all-inclusive concept embracing different dimensions among which the economic growth is certainly included, but which also covers changes inside the social , environmental and urban structure of the place. Therefore, the choice of the indicators shall aim at identifying development areas and qualifying just those aspects which characterise this process, or which may synthetically be ascribed to the development of the area under survey.

2.3 STANDARDIZATION OF INDICATORS

The indicators selected allow, if analysed one by one, to make comparisons among the different territorial units, but do not allow to make synthetic comparisons among two or more aspects (Fig.2). Therefore, to build up a data base to treat more variables simultaneously and, later on, to aggregate more indicators in only one synthetic index, it is necessary to carry out a standardization process to make the normalized indicators selected homogeneous.

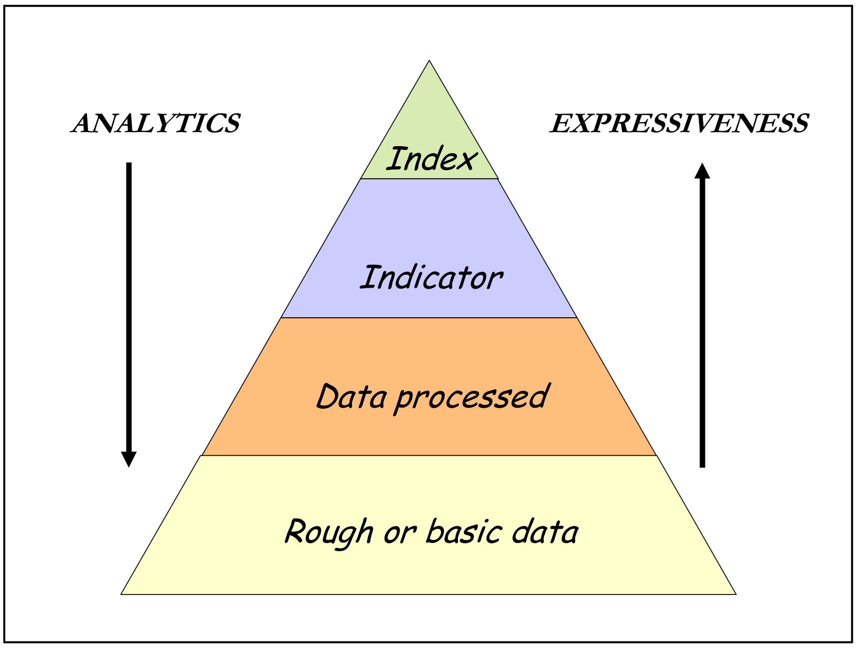

Figure 2: The organization of information

Technically, the standardization operation makes the indicators independent from the respective units of measurement and included within pre-defined intervals, equal for all variables, transforming them into "index numbers".
The standardization techniques to be used, to be chosen from time to time depending on the target of the research being carried out, may be summarized in five typologies as given below:

1. STmax: standardization which adopts as common denominator the highest value of the series;
2. STmean: standardization which adopts as common denominator the mean value of the series;
3. STtot: standardization which adopts as common denominator the value related to the all the cases in the series;
4. STsd: standardization which adopts as common denominator the value represented by the standard deviation of the series;
5. STrepr: standardization which adopts the reproportioning method of scale ranges .

The first method (STmax) is very simple and easy to interpret; it is suitable when the target of the analysis is the research of the best territorial performance. The STmean method is less constant, and thus less reliable, than the previous one as it presents a wider variation in the series. The STtot method appears to be even less constant than the others, rather approximate and the interpretation of the final result is complex as each case is just weighted on a global value. The STsd method , also called "statistical standardization", consists in weighting every deviation from the mean value of the series for the respective standard deviation. The standardized index is calculated by the following formula:

$$Xj_{st} = \frac{X_j - X_m}{Dev.Std}$$

Where: Xi st= standardized index;
Xi = indicator value
Xm = mean value of data series
Dev.Std = standard deviation of data series.

In this case, the relevant mean being equal to zero, the values around zero may take either plus or minus signs, simplifying the subsequent interpretation phase of the phenomenon, even though there is a wide spread of values and, thus, less constancy in the result. The STrepr method, finally, is based on an algorithm of difficult interpretation and therefore will not be examined.

The last step in the analysis process, in fact, foresees the aggregation of index numbers in a final size, which generically consists of an index, highly synthetic and expressive even though less analytical (fig.2). In fact, it is worth pointing out that the analysis process considered loses its analytics as its execution goes on in favour of its becoming more synthetic and expressive.

This means that the final aggregated index will represent a ranking of the different components which define the index itself. This conciseness is one of the objectives of multi variable analyses: to acquire synthetic results able to allow unit interpretations and evaluations impossible otherwise.

In the case indicators differently influence the phenomena in terms of importance, i.e. their relative values differs. Before starting the aggregation process it is necessary to evaluate the importance of each indicator in relation to the others, by giving them weights, or numerical values within a pre-established range of variability, which widen or reduce the relative importance of the single indicators. This operation, though partly discretionary, allows us to aggregate the great number of variables considered clearly and in line with the objectives of the analysis. In this phase we may have recourse to the weighted average.

For each ambit identified, a synthetic vector may be created by means of the following arithmetical formula:

$$X_n = \frac{(Xa_{st}*P_a + Xb_{st}*P_b + ... + Xn_{st}*P_n)}{(P_a + P_b + ... + P_n)}$$

Where:

Xn= value of the vector including n variables;
Xast, Xbst, Xnst = standardized index numbers;
Pa, Pb,Pn = index weight a,b,n.

2.4 THE CLUSTER ANALYSIS

The use of the *cluster analysis* allows us to classify statistical units in order to form groups, named *clusters*, as homogeneous as possible inside – that is to say, with the closest similarity among the elements which constitute them – and heterogeneous, one from the other – that is to say, every class is relatively distinct from the others –, evidencing the features which join the elements of a same cluster and make each of them distinct from the others. This type of analysis has the advantage of reducing the size of the data to analyse: from the number of statistical units, in this case the indicators, to the number of clusters. This is a partly subjective method of survey where choices are left to the researcher's competence, for whom every decision is subject to the attainment of the final aim. It is also an exploratory-type method which gives positive results for cluster interpretation only if they are already present on the territory under survey. Thus, the classification of a territory enables us to identify the features of the different clusters. This is the reason why this methodology in policy-making process is of great relevance for the operators who, through the conclusions drawn from the cluster analysis application, may define strategies, guidelines, solutions for a suitable use of the territory and, thus, to the population's full satisfaction.

Clustering methods are divided into official and unofficial: the former produces a number of clusters included among one (all remarks together in only one cluster) and a top number equal to the number of the remarks themselves; for the latter, it is necessary to indicate the number of clusters desired. The official criterion provides that the cluster shall not be split once formed. Inside this modality there are two types of clustering: agglomeration, which collects the closest elements to form one big cluster, and split, which starts from a big cluster to form a cluster for every single case.

At the base of clustering algorithms there are similarity and distance; the aim is to maximize the distance infra-clusters and, at the same time, to minimize intra-clusters, in other words, the distance is less for a higher similarity. The most widely used method of measuring the distance infra-clusters is the "Euclidean space to the square" defined as the sum of the spaces to the square among all variables of two different clusters:

$$\text{Distance (x, y)} = \sum_i (x_i - y_i)^2$$

To avoid the unit of measurement of variables influencing their distance, the variables are standardized (split for the standard deviation) before the analysis, in practice we work with standardized deviations (z).

Cases and clusters are gathered following the criteria adopted throughout aggregation and are based on distance or similarities among cases matrix. One of the simplest models to make clusters is the complete linkage (i.e. nearer/farther) in which distance among elements is the greatest existing between two elements of clusters, that is to say, between the two farthest points.

Therefore, the logical structure of these agglomeration methods may be summarized as follows:

1. In the initial phase each unit constitutes a separate group;
2. The two groups with the least distance are merged;
3. The distance between the cluster just melted and each of the remaining clusters is calculated as the greatest distance among the cluster elements and the remaining ones;
4. Steps 2 and 3 are repeated until a configuration where there is only one cluster is reached.

The adoption of this algorithm to make clusters highlights the differences among the elements; it favours homogeneity among the cluster elements to the detriment of a clear differentiation among clusters. There are different graphic modalities to evaluate the aggregation in cluster, but the most widely utilized is the dendrogram which allows not only to highlight clusters, but also to show their distance. When evaluating the dendrogram, it is very easy to verify which solution of the analysis under way is the best; in fact , if the aim is to aggregate the cases in a way as to minimize the distance of cases inside every single cluster and maximize the distance between clusters, it derives that the best solution is the one that contemplates a number of clusters such that the distance among them is sufficiently great.

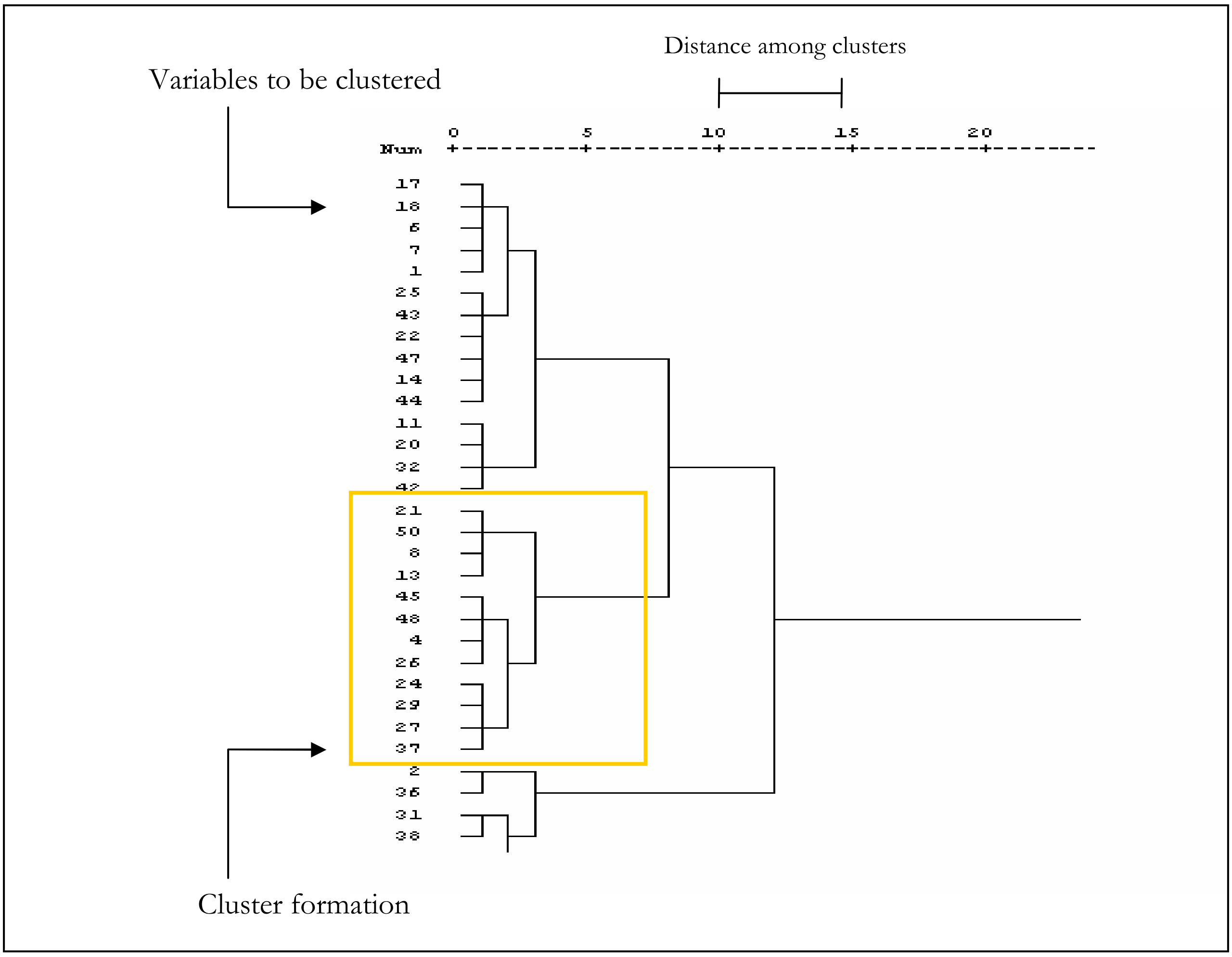

Figure 3: The dendrogram and clusters formation

3. THE APPLICATION: THE CASE OF THE FUTURE PROVINCE OF MONZA

The methodology proposed has been applied to the territory located in proximity to the city of Milan and, in particular, to the area north-east of the capital which is getting ready to become the future "Monza Province", one of the largest European conurbations. In the conviction that this application may constitute a valuable confirmation for the framework survey under examination, we give the results of greater interest obtained below.

3.1 THE SOURCE OF DATA AND THE FILING MATRIX

For the territorial analysis of the area selected as a "test-bed" of the methodology proposed, a multi-sectorial analysis has been set up which could take into consideration the natural and social features of the territory, as well as their interaction. The main phenomenon we wanted to survey is the relationship between the city and the country and, in particular, for the area under reference, the evaluation of the actual possibilities of qualification of agriculture in such a highly anthropical environment. Therefore, we have decided to limit the ambits of our survey to two main sectors, the agro-environmental and the demographic-urban ones.

COMUNI	DATI SUPERFICIE AGRICOLA TOTALE								DATI UTILIZZO SUPERFICIE AGRARIA									
	AZIENDE PER CLASSI DI SUPERFICIE						Totale		SUPERFICIE AGRICOLA UTILIZZATA				Arboricolt da legno	Boschi	SUPERFICIE AGRARIA NON UTILIZZATA		Altra superficie	Totale
	Meno di 5		5 -- 50		50 ed oltre				Seminativi	Coltivazioni legnose agrarie	Prati permanenti e pascoli	Totale			Totale	Di cui destinata ad attività ricreative		
	N° di aziende	Superficie	N° di aziende	Superficie	N° di aziende	Superficie	N° di aziende	Superficie										
Agrate Brianza	8	5,76	14	18,29	9	30,09	50	413,86	217,82	128,18	26,84	372,84	-	16,73	4,79	-	19,50	413,86
Aicurzio	3	1,80	2	3,58	1	2,72	13	282,03	263,53	-	0,17	263,70	-	12,12	1,26	-	4,95	282,03
Albiate	1	0,46	-	-	1	3,70	8	251,55	230,04	0,30	5,29	235,63	-	0,40	0,30	-	15,22	251,55
Arcore	2	1,74	1	1,75	2	6,35	14	275,12	151,24	9,74	45,02	206,00	-	52,14	1,00	-	15,98	275,12
Barlassina	-	-	-	-	-	-	1	28,56	24,38	-	4,05	28,43	-	-	-	-	0,13	28,56
Bellusco	43	22,40	12	17,90	2	5,54	68	262,70	229,53	2,05	4,23	235,81	2,34	9,02	7,61	-	7,92	262,70
Bernareggio	20	8,87	5	7,34	1	4,65	33	207,33	196,25	0,27	-	196,52	-	3,86	-	-	6,95	207,33
Besana in Brianza	24	15,43	21	30,51	19	59,50	95	656,97	269,26	13,73	289,60	572,59	-	46,89	4,33	0,26	33,16	656,97
Biassono	3	1,65	2	2,84	5	16,60	16	97,41	52,25	5,58	35,76	93,59	-	1,31	-	-	2,51	97,41
Bovisio-Masciago	-	-	1	1,93	1	3,50	4	38,98	30,96	-	-	30,96	-	2,50	2,50	-	3,02	38,98
Briosco	6	3,76	9	13,49	10	31,87	32	193,31	69,98	3,56	72,92	146,46	0,02	26,34	10,28	0,24	10,21	193,31
Brugherio	3	1,70	3	4,42	2	8,91	19	329,99	216,05	2,60	93,49	312,14	-	0,18	5,37	-	12,30	329,99
Burago di Molgora	3	2,64	-	-	2	4,02	7	103,07	65,27	31,75	0,60	97,62	-	2,52	0,20	0,20	2,73	103,07
Camparada	2	1,50	4	5,69	1	2,10	9	51,26	41,99	-	5,81	47,80	-	2,40	0,18	-	0,88	51,26
Carate Brianza	6	3,00	8	10,69	4	12,86	27	143,75	57,54	5,59	49,85	112,98	-	20,19	5,14	-	5,44	143,75
Carnate	-	-	1	1,31	-	-	3	44,66	41,37	-	-	41,37	-	1,37	-	-	1,92	44,66
Cavenago di Brianza	1	0,60	2	2,93	6	18,35	11	59,36	45,66	1,67	2,13	49,46	-	0,10	5,83	-	3,97	59,36
Ceriano Laghetto	-	-	3	4,06	-	-	8	245,00	140,18	89,56	3,87	233,61	-	-	0,10	-	11,29	245,00
Cesano Maderno	2	0,56	-	-	1	3,12	11	141,54	75,95	0,77	33,47	110,19	1,04	13,66	7,76	-	8,89	141,54
Cogliate	1	0,51	1	1,05	-	-	9	275,63	208,40	0,57	23,46	232,43	-	21,64	15,55	-	6,01	275,63

Figure 4. The filing matrix of rough data (agro-environmental ambit). From left to right: Municipalities, Farms by class of surface (data total agricultural surface), Agricultural surface exploited and unexploited (data utilization agrarian surface).

The following step consisted in the selection of data sources which, for both methodological reasons (statistics valid on the whole national territory) and practical needs (data referred to the same period of survey and easy to find) has fallen on Istat's statistical sources.

COMUNI	DATI DEMOGRAFICI				DATI ISTRUZIONE										DATI AREE PROTETTE		
	Altitudine (min. e max)	Superf. Comunale (Km2)	Abitanti attuali	Addetti delle istituzioni no-profit	Forniti di titoli di studio					Alfabeti privi di titoli di studio		Analfabeti		Totale	Denominazione del parco	Superficie	
					Totale	Laurea	Diploma	Licenza media inferiore	Licenza elementare	Totale	Di cui in età dai 65 anni	Totale	Di cui in età dai 65 anni			m2	ettari
Agrate Brianza	152/175	11,28	12708	36	10.347	253	2.538	3.720	3.836	847	154	39	13	11.233	-	-	-
Aicurzio	210/240	2,54	1980	6	1.465	30	296	500	639	97	16	5	1	1.567	-	-	-
Albiate	217/233	2,9	5216	46	3.852	75	846	1.322	1.609	316	89	38	13	4.206	Parco Valle del Lambro	574.828	57
Arcore	179/222	9,23	16663	50	13.800	529	3.612	4.782	4.877	1.051	211	54	26	14.905	Parco Valle del Lambro	1.882.051	188
Barlassina	213/244	2,87	5927	72	5.034	151	1.106	1.814	1.963	415	71	30	12	5.479	Parco delle Groane	688.032	69
Bellusco	184/214	6,48	6162	30	5.245	96	1.148	1.945	2.056	432	84	21	7	5.698	-	-	-
Bernareggio	210/249	5,87	8298	10	6.019	156	1.371	2.221	2.271	447	82	29	6	6.495	-	-	-
Besana in Brianza	244/355	15,77	14177	220	10.808	299	2.454	4.027	4.028	803	156	86	24	11.697	Parco Valle del Lambro	6.420.083	642
Biassono	167/208	4,85	11088	55	8.704	308	2.147	3.049	3.200	716	115	41	17	9.461	Parco Valle del Lambro	1.503.337	150
Bovisio-Masciago	182/214	4,93	13367	36	10.253	262	2.236	3.975	3.780	942	201	109	44	11.304	Parco delle Groane	634.472	63
Briosco	225/327	6,6	5615	12	4.505	89	879	1.704	1.833	417	71	41	15	4.963	Parco Valle del Lambro	5.548.942	555
Brugherio	137/156	10,32	31470	71	25.901	930	6.486	9.341	9.144	2.190	391	180	72	28.271	-	-	-
Burago di Molgora	171/191	3,41	4141	-	3.777	101	982	1.460	1.234	290	43	21	6	4.088	-	-	-
Camparada	137/271	1,82	1703	-	1.180	36	287	427	430	98	26	6	2	1.284	-	-	-
Carate Brianza	215/299	9,95	16119	331	13.534	460	3.031	4.895	5.148	1.026	171	94	29	14.654	Parco Valle del Lambro	3.520.469	352
Carnate	200/249	3,47	7335	2	6.051	250	1.734	2.084	1.983	460	87	22	12	6.533	-	-	-
Cavenago di Brianza	167/181	4,43	6116	22	4.185	90	942	1.572	1.581	475	105	57	24	4.717	-	-	-
Ceriano Laghetto	214/229	7,06	5440	76	4.158	78	789	1.576	1.715	388	81	39	13	4.585	Parco delle Groane	2.282.038	228
Cesano Maderno	194/228	11,49	33094	114	27.304	467	5.093	10.692	11.052	2.606	556	287	129	30.197	Parco delle Groane	1.436.922	144

Figure 5: The filing matrix of rough data (demographic-urban ambit). Form left to right: Municipalities, Demographic data (altitude min and max, surface, present inhabitants, non-profit Institutions staff), Education (degree, diploma, middle school, elementary certificate, literates no educational qualification, illiterates), Data protected areas (park name, surface).

The recourse to agriculture and population censuses (year 2000) has allowed us to take into consideration territorial units as small as possible (single municipalities) and to make the methodology application possible in other areas. The data so gathered have been inserted in a filing matrix (Fig. 4 and 5), consisting of an excel calculation sheet, which was used for the organization of rough data and their first processing. The data presented in the filing matrix, if utilised as such, do not allow us to make comparisons among the territorial units as they are mostly expressed in absolute terms and do not have a direct link with the territory object of the analysis. Therefore, according to the targets as set forth in the preliminary analysis, five indicators for each of the ambits of the survey have been selected and calculated.

3.2 CALCULATION OF INDICATORS: THE AGRICULTURAL SECTOR

To determine the features of agricultural interest, various indicators have been arranged and studied in order to evaluate: the rural degree of the territory, the presence of big and small farms (farm pulverization), the destination of the agricultural surface to sowables (in particular cereals), the mean dimension of zootechnic companies, the density of breeding (uba/ha).

a) Agricultural utilization of soil (A): It represents the percentage of territorial surface destined for agriculture and defines the degree of "being rural" of the territory.

Its value indicates the j-th municipality position considering as a comparison the ratio between the total surface[5] of all farms (Sa) and the territorial surface of the municipality (St).

It is calculated as:

$$S_j = \frac{Sa_j}{St_j}$$

b) Farm pulverization (Pj). It represents the incidence of small farms[6] and indicates the entity of the farm pulverization phenomenon.

Its value indicates the j-th municipality position considering as a comparison the ratio between the total surface of less-than-5-hectare farms (Sp) and the total surface of all the municipality farms (Sa).

It is calculated as:

$$P_j = \frac{Sp_j}{Sa_j}$$

c) Framework function (Gj): It represents the incidence of big farms[7] and is employed together with the Pj index to evaluate the entity of the farm pulverization phenomenon.

Its value indicates the j-th municipality position considering as a comparison the ratio between the total surface of more-than -50 hectare farms (Sg) and the total surface of all the municipality farms (Sa).

It is calculated as:

$$G_j = \frac{Sg_j}{Sa_j}$$

To calculate the indicators Pj and Gj we have chosen to utilize the surface value, instead of the farm number, as in the agricultural situation it sometimes happens that in terms of number of farms the Pj index value is very high, whereas in terms of surface it appears rather low. This is the case, for example, of a municipality where there are many small farms and few big farms.

[5] For total surface we mean the farm's global area of lands consisting of the agricultural surface utilized (SAU) , of the one covered by arboriculture, by woods, by the unused agrarian surface, as well as by the area occupied by parks and ornamental gardens, buildings, ponds, canals, courtyards located inside the farm's land perimeter.

[6] Small farms are those with a total surface lower than 5 hectares.

[7] Big farms are those with a total surface over 50 hectares.

d) Production specialization (Sppj): It represents the incidence of sowable cultivation[8], in particular cereals, in relation to the total surface.

Its value indicates the j-th municipality position considering as a comparison the ratio between the agricultural surface, cereal cultivated (Sc), and the total agricultural surface (Sa).

It is calculated as:

$$Spp_j = \frac{Sc_j}{Sa_j}$$

e) Breeding density (Naj): It represents the density of head of cattle bred[9] in relation to the total agricultural surface of each municipality.

It indicates the j-th municipality position considering as a comparison the ratio between the total number (Ca) of head of cattle bred (expressed in UBA), and the total surface of the farms present in the municipality (Sa).

It is calculated as:

$$Na_j = \frac{Ca_j}{Sa_j}$$

3.3 CALCULATION OF INDICATORS: URBANISATION AND SOCIO-ECONOMIC ASPECTS

The evaluation of the urban and socio-economic aspects has been carried out by processing different indicators in order to study: the population distribution (and thus the demographic density), the population framework and level of education, the presence and the entity of non-profit associations.

a) Demographic density (Ddj): It represents the number of inhabitants per sq.km and is an important anthropic pressure indicator on the territory. It indicates the j-th municipality position considering as a comparison the ratio between the total resident population[10] (number of inhabitants) (AB) and the municipality territorial surface (St).

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[8] For sowable we mean cultivations of crops subject to rotation.

[9] Cattle, sheep, goats, horses, swine and poultry have been taken into consideration. The number of head of every species has been turned to adult bovine units (UBA), by means of the following conversion factor:
-Cows 1,00 uba/head - sheep and goats: 0,15 uba/head - poultry (laying):1,30 uba/100 head
-Swine (sows): 0,30 uba/head - horses (adult): 1,00 uba/head

[10] The resident population of each Municipality consists of persons having there their usual residence whether present during the census or not (Istat reference).

It is calculated as:

$$Dd_j = \frac{Ab_j}{St_j}$$

b) <u>Middle-advanced education</u> (Smj): It represents the population with advanced education. It indicates the j-th municipality position considering as a comparison the ratio between the number of graduates (Dj) and the total of the population over the age of six (Ppj).

It is calculated as:

$$Sm_j = \frac{D_j}{Pp_j}$$

c) <u>University education</u> (Sej): It represents the percentage of the population with a degree. It indicates the j-th municipality position considering as a comparison the ratio between the number of graduates (Lj) and the total of the population over the age of six (Ppj).

It is calculated as:

$$Se_j = \frac{L_j}{Pp_j}$$

d) <u>Non-profit-making Associationism</u> (Npj): It represents the entity of non-governmental associations[11], non-profit making, present on the territory. It indicates the j-th municipality position considering as a comparison the ratio between the staff in charge[12] of non-profit associations (An) and the resident population (Ab).

It is calculated as:

$$Np_j = \frac{An_j}{Ab_j}$$

[11] The non-profit-making institution is intended as a legal-economic unit, with legal status or not, of a public or private nature, which produces goods or services destined and not to be sold and which, according to the laws in force or to its statutory rules, has no faculty of giving out, also indirectly, profits or other earnings different from the remuneration for work carried out by the individuals who have set it up or to the partners. Examples of non-profit-making institutions are: the associations, acknowledged or not, the foundations, the voluntary organizations, the social co-operative societies and the other non-profit-making organizations of social utility (Onlus), political parties, the unions, the ecclesiastic corporations. (Istat reference).

[12] For persons in charge we mean the independent or dependent staff working (full time, part-time or with a training and work contract) in the economic units included in the census (Istat reference).

e) Naturalistic protection (Tnj): It represents the entity of naturalistic protection interventions carried out on the municipal territory. It indicates the j-th municipality position considering as a comparison the ratio between the territorial surface subject to naturalistic bounds[13] (Apt) and the whole territorial surface of the municipality (St).

It is calculated as:

$$Np_j = \frac{Apt}{St_j}$$

3.4 STANDARDIZATION

Through the standardization method STsd, also called "statistic standardization", the indicators have been made "homogeneous" and thus utilizable for the following elaborations. In practice, the method consists in weighting every deviation from the mean value of the series for the respective standard deviation (ref. Par. 2.3) and eliminates the likely influence of the different units of measurement. The standardization process has been carried out starting from the excel calculation sheet created for filing data (fig.6) and has allowed to obtain "index numbers" symmetrically distributed around the mean value of the series, utilized later on for aggregative mathematic operations.

COMUNI	% superf. Agricola attuale	Incidenza delle piccole aziende (minori di 5 ha) rispetto alla sup. totale	Incidenza delle grandi aziende (maggiori di 50 ha) rispetto alla sup. totale	Specializzazione produttiva (% cereali)	Carico medio di bestiame (uba/ha sup. agr. tot.)	Densità comunale (ab. Km2)	Incidenza Aree protette (% rispetto alla sup. comunale totale)	Addetti per ogni 1000 abitanti	[Laureati/TotalePopolz>6anni]	[Diplomati/Totale Popolz>6anni]	AGROAMBIENTALE	DEMOGRAFICO URBANO
Agrate Brianza	0,33	-0,14	-0,10	-0,45	-0,45	-0,74	-0,44	-0,23	0,66	-0,45	2,865	-13,33
Aicurzio	3,54	-0,24	-0,60	1,29	-0,31	-1,10	-0,40	-0,46	-0,37	0,98	53,850	-18,10
Albiate	2,49	-0,31	-0,56	0,57	0,12	-0,04	0,84	-0,56	-0,03	-0,06	37,875	1,92
Arcore	0,03	-0,25	-0,49	0,02	-0,27	-0,04	-0,40	0,69	1,11	-0,55	-1,398	0,56
Barlassina	-0,83	-0,34	-0,67	1,33	-0,34	0,23	1,55	0,13	-0,01	-0,55	-11,647	10,16
Bellusco	0,49	0,89	-0,51	1,09	-0,47	-0,92	0,00	-0,63	-0,02	1,50	1,991	-11,71
Bernareggio	0,27	0,28	-0,50	1,28	-0,27	-0,44	-0,79	-0,12	0,25	-0,02	2,684	-10,32
Besana in Brianza	0,54	0,00	0,05	-1,39	0,18	-0,98	2,27	-0,01	0,21	-0,47	5,334	-3,94
Biassono	-0,39	-0,09	0,68	0,12	-0,36	0,46	0,02	0,48	0,69	1,82	-2,588	14,47
Bovisio-Masciago	-0,92	-0,34	0,04	-0,84	0,04	0,90	-0,47	-0,18	-0,12	-0,55	-13,866	9,04
Briosco	0,01	-0,06	0,64	-0,69	-0,46	-1,03	-0,59	-0,55	-0,70	-0,55	0,684	-22,83
Brugherio	0,12	-0,26	-0,46	-0,94	0,05	1,25	-0,56	0,51	0,76	-0,55	-1,347	17,73
Burago di Molgora	0,05	0,03	-0,36	-0,68	4,23	-0,65	-1,04	-0,07	1,06	1,59	7,620	-8,53
Camparada	-0,04	0,08	-0,35	1,51	-0,53	-0,94	-1,04	0,16	0,59	-0,55	-0,315	-18,78
Carate Brianza	-0,63	-0,04	0,04	-0,69	-0,31	-0,23	3,35	0,40	0,13	-0,55	-11,671	13,24
Carnate	-0,70	-0,34	-0,67	1,67	-0,54	0,28	-0,99	0,89	1,76	0,81	-9,382	7,94
Cavenago di Brianza	-0,68	-0,19	1,78	1,03	-0,49	-0,48	-0,27	-0,47	-0,07	0,12	1,025	-9,58

Figure 6: The standardization and the aggregation of indicators. From left to right: Municipalities, % present agricultural surface, Incidence of small farms (less than 5 ha) in relation to total surface, Incidence of big farms (more than 50 ha) in relation to total surface, Production specialization (% cereals), Mean cattle load (uba/ha tot.agric.surface), Municipal density (inhab. sq.Km), Incidence protected areas (% in relation to total municipal surface), People for every 1000 inhabitants, Graduates/Total popul. over 6 years), Professionals/Total popul. over 6 years), Agroenvironmental index, Demographic urban index.

[13] There has been considered as an area subject to naturalistic restraints the one inside the Regional Parks and the Local Parks of Overmunicipal Interest.

It has to be pointed out that, in the case analysed, the indicators calculated represent phenomena which differently influence the final result of the analysis. It is therefore necessary to take into due consideration the relative importance of every indicator so as to avoid negatively influencing the results of the following cluster analysis. We have therefore gone on aggregating the indicators in only one vector for each of the two ambits of survey by means of a weighed average (ref. Par. 2.3).

To meet the territorial analysis requirements we made sure that the most important indicators were the land agricultural utilization index (Aj) and the demographic density index (Ddj), which we have given the highest weight, whereas the remaining indexes (ref. par. 3.3.1 and par. 3.3.2) have been given decreasing multiplicative values in relation to their relative importance (Fig.7). The land utilization and the demographic density, in fact, proved to be the indicators which best describe the tendency lines in the relations between city and country, whereas the remaining ones allowed us to “improve” the analysis so as to get a better representation of reality. Through this aggregation process two “vector indexes” have been calculated, usefully employable to list the municipalities according to a “classification” which takes into consideration either parameter. From an evaluation of the indicators, first, and of the two indexes later on, great differences arise from the various territorial realities of the area under survey. In particular, a rather marked distinction is highlighted between municipalities subject to a heavy land consommation due to the settlement pressure (high demographic density, limited land utilization for agricultural purposes, presence of farm pulverization), a reality which concentrates near the city of Monza, and in the municipalities with more rural features, located in the farthest places of the area under study. However, these first impressions, which are the result of the evaluations as mentioned above, need objective statistic confirmation; the values of the two indexes, therefore, have been utilized as starting data for the cluster analysis, the latest phase of the methodology under survey.

AGRO-ENVIRONMENTAL AMBIT		**DEMOGRAPHIC-URBAN AMBIT**	
Index	Multiplicative factor	Index	Multiplicative factor
Land agricultural utilization	Aj = 15	Demographic density	Ddj = 15
Farm pulverization	Pj = -5	Mean-advanced education	Smj = 2,5
Framework function	Gj = 5	University education	Sej = 2,5
Production specialization	Sppj = 2,5	No-profit making associationism	Npj = 2,5
Breeding density	Naj = 2,5	Naturalistic protection	Tnj = 5

Figure 7: The multiplicative factors (weights) assigned to the indicators

3.5 THE CLUSTER ANALYSIS

The last step in the process of territorial analysis has been the subdivision of the territory into clusters of municipalities as homogeneously as possible. After seeing the elements which are common to, or different from, the various statistic units (in the case considered, the municipalities) we have utilized the cluster analysis which, through an agglomeration process, has linked the most similar municipalities up to form one sole big cluster (ref. par. 2.3).

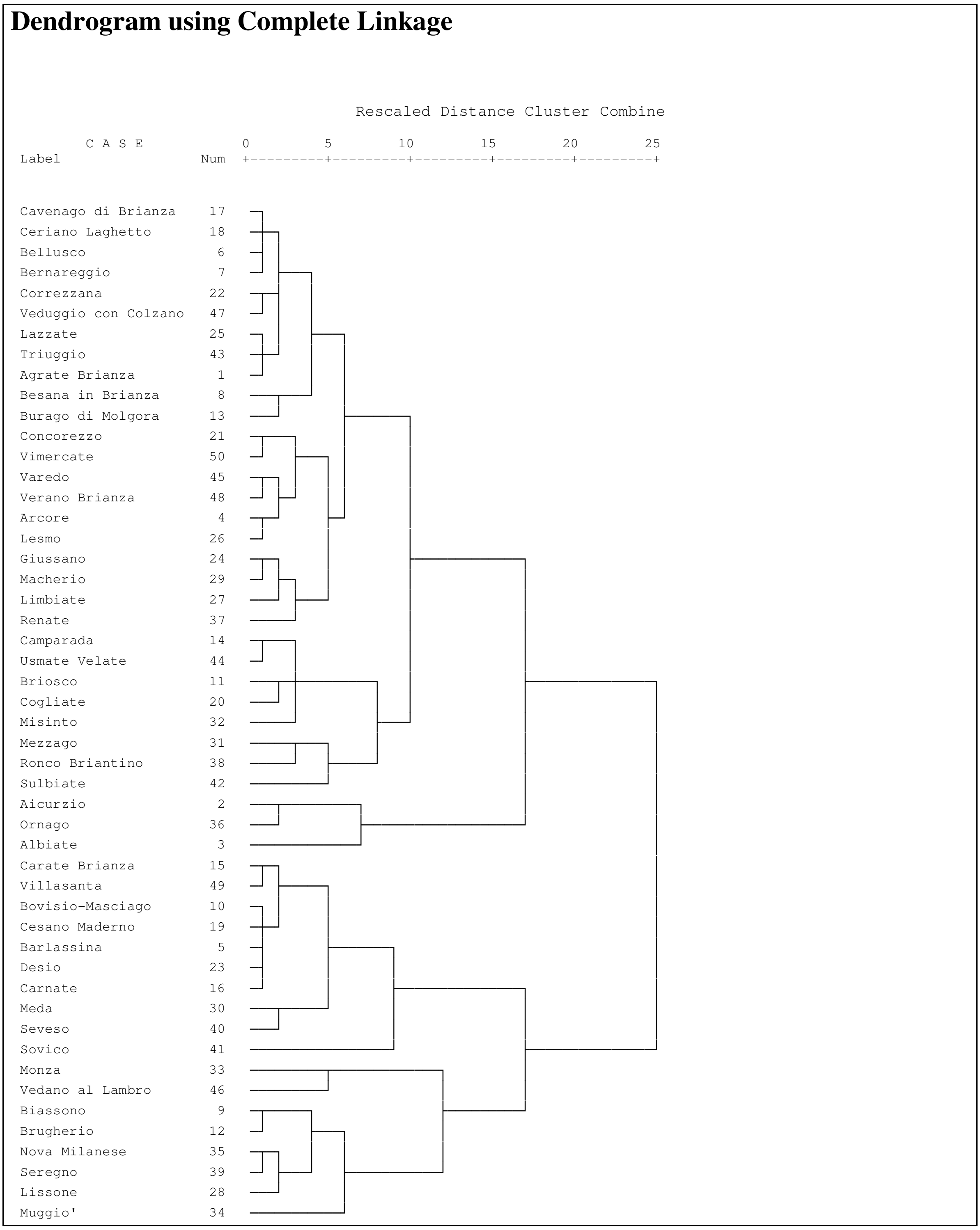

Figure 8: The dendrogram to evaluate clusters aggregation

The analysis has been carried out with the help of the statistic software "SPSS 130 for Windows" and making use of the official clustering method and of the clustering method called "complete linkage". The measurement of the distance between clusters has been calculated as "quadratic Euclidean" distance. To visualize the results, at first analysis, a dendrogram processed through the output of the program "SPSS 13.0" has been utilized so as to clarify the formation process of clusters and their reciprocal distance (Fig. 8).

From the territorial analysis point of view we have finally deemed it opportune to represent the results of "clustering" also in the form of a map. The statistic units of the area under study have been aggregated by means of the cluster analysis up to form three homogeneous areas. The results, given in a form of a map in figure 9, show a spread phenomenon of conurbation which from the city of Monza proceeds north-east along an axis which virtually connects the city to Milan on the one hand and to Como on the other hand (red area). Close to this densely urbanized area it is possible to find a portion of territory which still holds a certain degree of "rural status" and where it is still possible to find agriculture characterized by the production of agricultural goods (green area). Particular situations, with features between the two mentioned above, may be found regularly (yellow areas).

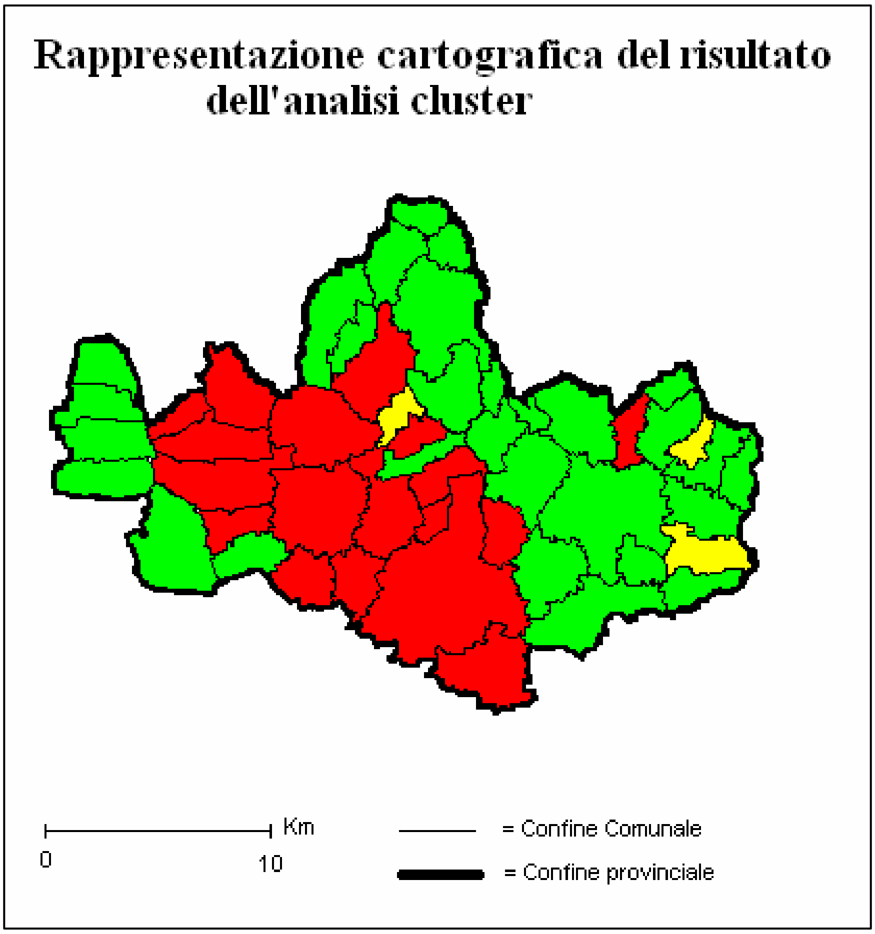

Figure 9: map of the result of cluster analysis

What we have seen up to now, without going deeply into policy-making, shows us that the planning of agricultural and territorial interventions, shaped on the features of the area, will at least foresee two typologies of "guidelines". The former aiming at keeping and improving the rural features of the most "vocational" agricultural areas, the latter focused on incentives of new forms of agriculture to exploit the already recognized "multipurpose" of the agricultural sector. The territory survey and the area splitting into homogeneous zones will allow us to define "aimed" lines of intervention, able to meet the actual requirements of the territory and of citizens, and a more effective form of intervention as it is based on the analysis of objective and measurable parameters.

4. FINAL CONSIDERATIONS

The framework analysed appears to be characterized by a given degree of "subjectivity" as both the choice of indicators and the relevant weight depend on the analyst's sensibility and experience. In regard to this, however, it has to be taken into consideration that the framework proposed, as, generally speaking, the models for the territorial analysis, is to be meant as a tool to reduce the uncertainty connected with the decisional process, and the results obtained could be the object of multiple interpretations. It is therefore suitable to point out that, to improve the effectiveness of the decisions, the identification and the selection of indicators are to be considered as two fundamental moments which make up part of the same territorial analysis and that there is no ideal indicator or a set of indicators able to explain any phenomenon. During the selection phase, therefore, three outstanding needs must be taken into consideration: rigour and scientific value of indicators, effectiveness in relation to the objectives of the analysis, political acceptability, technical feasibility (cost to obtain data).
The strong points of the method proposed lie in the "transparence" of the process phases, in its reproduction and simplicity of execution. Any individual who wants to use the method may therefore reconsider the basic hypotheses, such as the objects of investigation and the data source, the selection of the most significant or that more worthy of more interest, the single weights to assign during the aggregation phase and, keeping the analysis methodology unchanged, to interpret different scenarios.
The operating method proposed, therefore, allows one to improve the communication capacity of the operators in charge of the territorial management. From studies carried out in the ambit of the rural development program it appears in fact that, even more often, the communicative capacity and the sharing of intervention strategies constitute the key to success of public intervention programmes.

In fact, establishing the need to identify and apply specific territorial development policy started in the early nineties, and notwithstanding the presence of both empiric analyses and statistical information, there are still difficulties in defining and identifying the territory features and, often, the general conditions to recommend suitable strategies of intervention for the future development, to obtain "supervision" of the environment and to be able to realize even more plausible policy.

The work proposed, therefore, aims to be a tool of analysis for dealing correctly with information so as to attain synthetic and useful evaluations to help the decision maker in charge to study the "progress" of the local community towards the concept of "plausibility" of the territory.

BIBLIOGRAPHY

- Aa. Vv., *Agr-Environmental Indicators for Susteinable Agriculture in Europe*, ECNC, 2000.
- Aa. Vv., *Agriculture and the Environment: Lessons Learned from a Decade of OECD Work*, OECD.
- Aa. Vv., *Environmental indicators for agriculture-Volume 1 Concepts and Frameworks*, OECD.
- Aa. Vv., *Interazione e competizione dei sistemi urbani con l'agricoltura per l'uso del suolo: il quadro regionale in Emilia-Romagna*, Pitagora editrice, Bologna.
- Aa. Vv., *Agricoltura e paesaggio. Le aree asciutte a nord del canale Villoresi*, Provincia di Milano, 2006.
- Aa. Vv., *I distretti rurali e agroalimentari di qualità in Italia*, Unioncamere, 2004.
- Bernetti I., Marone E., *La valutazione dell'impatto sull'economia locale derivante dall'istituzione di un'area protetta: una metodologia di analisi ex-ante,* Atti del convegno SIDEA "Innovazione e ricerca nell'agricoltura italiana", 2000
- Borachia V., Boscacci F., Paolillo P. (a cura di), *Analisi per il governo del territorio extraurbano,* Franco Angeli 1990.
- Caiati G., *Politiche economico-ambientali per la valorizzazione dei parchi*, PAGRI, 3-4, 2004.
- Casoni G., Polidori P., *Economia dell'ambiente e metodi di valutazione*, Carocci, 2003.
- Fraire M., *Metodi di Analisi Multidimensionale dei Dati. Aspetti statistici e applicazioni informatiche,* CISU, Roma, 1994.
- Franceschetti G., Provasi C., *La "Cluster Analysis" quale strumento di zonizzazione nella pianificazione agricola nel Veneto.* In Metodologia per la formazione dei piani zonali agricoli nella Regione Veneto, Università degli Studi di Padova, Istituto di Estimo Rurale e Contabilità, 1990.

- Iacoponi L., "La complementarietà fra città e campagna per lo sviluppo sostenibile: il concetto di bioregione", *Rivista di Economia Agraria*, 4, 2004.

- Maggino F., *L'analisi dei dati nell'indagine statistica*, University Press, Firenze, 2005.

- Marangon F., Tempesta T. (a cura di), *La valutazione dei beni ambientali come supporto alle decisioni pubbliche*, Forum, Udine, 2000.

- Monti C., Pratelli A., Riguzzi G., Secondini P., *Analisi e pianificazione del territorio rurale*, Editrice CLUEB Bologna.

- Morineau A., *Cluster Analysis,* 1994.

- Pileri P., *Interpretare l'ambiente-Gli indicatori di sostenibilità per il governo del territorio*, Alinea editrice, 2002.

- Pirani A., Proverbio F., "Sustainable agricolture caught between competitiveness and protection of the environment. The marginal nature of urban fringe agricolture", proceeding of the 28th EAAE Seminar *EC agricoltural policy by the end of the century*, Lisboa, 1992.

- Prestamburgo M., "Teoria Economica e Politica Ambientale", *Rivista di Economia Agraria*, 3, 1996.

- Prestamburgo M., "La classificazione degli ambiti agricoli. Una proposta metodologica", *Rivista di Politica Agraria*, 10, 1992.

- Trisori A. (a cura di), *Misurare la sostenibilità-Indicatori per l'agricoltura italiana*, INEA, 2004.