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**Prospective Structural Analysis: An application to Rural Development  
Strategies**

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**Summary**

The Council Regulation (EC) 1698/2005 approved on 20<sup>th</sup> September 2005 was the starting point of the fourth programme of Rural Development Aid for the period 2007-2013. This communitarian programme affects Andalusia, an European region situated in the south of Spain.

The authors of this paper have helped in the elaboration of the rural strategy for this region. We would like especially to point out the use of the Prospective Structural Analysis (PSA) methodology as a competent method to analyse the complexity of elements, variables and present interactions in rural zones as well as to understand variables in the present and future situation.

Results obtained with the application of the PSA method to a region show the strength of this methodology in order to help the process of reflection about influencing economic and social agents in the analysed area. These results were compared with Rural Development Plan proposed for 2007-2013 period.

**Keywords: Rural Development, Strategic Analyses, Prospective Structural Analyses**

**JEL codes: O18**

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# **Prospective Structural Analysis: An application to Rural Development Strategies**

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## **1. Introduction**

After the approval of the Council Regulation (EC) 1698/2005 on 20<sup>th</sup> September 2005, it started to be developed the fourth programme of Rural Development Aid for the period 2007-2013. On 20<sup>th</sup> February 2006 it was approved the Decision of the Council related to Communitarian Strategies Directives for Rural Development for the same period following article nine of the above mentioned regulation. The new rural programme has the following main features:

- A unique financial and planning instrument, Rural Development Agricultural European Fund.
- A genuine communitarian strategy of rural development making greater emphasis on European Union priorities.
- Control, evaluation and reports elaboration reinforcement. An audit system of account liquidation to be enlarged to all rural development sectors.
- A consolidating rising (bottom- up) focus. State members, regions and local action groups win strength when adjusting programmes to local needs.
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Andalusia, a region situated in the south of Spain, is affected by the application of the communitarian regulation. Following European normative, the regional Government gave instructions to elaborate the Andalusian New Rural Strategy (ANRS) for the new period. The authors of this paper have contributed to the elaboration of that strategy as technical advisors. We suggest a general methodology for the whole strategy process. Particularly, we argue the need to use a concrete method to analyse the collective reflection process carried out in the 51 rural areas in which the region has been divided with their correspondent Local Action Groups.

## **2. Objectives**

The main aim is to know the behaviour and influence of the most important socioeconomic variables that define past, present and future of any local area. We believe that by applying the Prospective Structural Analysis (PSA) method it will be possible to observe the interrelation and influence among different variables which will let us classify them in order to understand the most relevant ones for the development of a specific area. Another aim of this paper is to compare the results obtained applying PSA with the strategic actions and instruments proposal by LAG in its Rural Strategy. The comparison will let us observe the concordance and utility of PSA methodology and the LAG strategy to the region.

## **3. Methodology**

In our opinion, the methodology used here is an ideal method to analyse the complexity of elements, variables, and present interactions in rural zones and it is also useful to understand variables in present and future situation. This method is based in the elaboration of future sceneries through the inference of historic tendencies of the system (Godet, 1985; 1994; 1998). The main aim pursued when applying this method is to reduce uncertainty in the future elaborating desirable and viable sceneries promoting necessary actions to reach them.

PSA method is of great help to describe any system identifying the influence relationship (instead of cause-effect relations) among elements which compose it, through a process of collective reflexion in which it is filled in a double entrance matrix.

Through the application of the properties Markov chains, this tool is able to generate different hierarchies and classifications according to motivity and dependency properties. As a result of these hierarchies, the method emphasizes the structure of the system variables for the system evolution.

To classify variables (macro-variables in our case), we have used MICMAC. This software applies the properties of Booleans matrixes to order variables according to the paths number and intensity. It also considers the motivity influence (given feedback) and the dependency influence (received feedback) exerted by each variable (Godet, 1994; Godet & Bourse, 1989).

The study of rural zones, as systemic, evolutionary and complex realities, require tools that allow considering in an integrative way, all the elements, their interrelations and their dynamic nature and also the impacts that any change in them provoke in the whole system.

Assuming that a rural region is a social construction, the interpretation made by local agents about potential restriction and incentives for change in the communities should be the main input to build rural territory as an object of study.

Prospective techniques analysis is grounded on the bases that future cannot be extrapolated from the past and it is not predetermined but, on the contrary, it can be built. This paper shows how these techniques can describe real situation and they are also useful to design the sceneries encouraging and structuring processes of collective reflection to generate a future vision for rural territories and show the necessary action to reach it (Godet 2001; Gavigan and Scapolo, 2001).

In order to analyze the complexity of elements, the factors and present interactions in rural territories, as well as to understand variables for their present and future situation we have used the technique of Prospective Structural Analysis (PSA).

This method is based on the elaboration future scenery through the inference of historic tendencies of the system (Godet, 1985, 1994, 2001). The main objective is to reduce the future uncertainty elaborating viable sceneries and proposing necessary actions to reach them.

PSA technique helps to describe a system identifying the influence relation (instead of cause-effect relations) among the integrated elements of the system, through a process of collective reflection in which a double entrance matrix is filled in. Through the application of the properties of Markov chains, this tool can show the classifications of the elements according to motivity and dependency properties.

The method points out the relationship between the variables of the system and it shows which variables are essential for the system evolution. The structure of relations is represented through variables hierarchies according to the influence that an element plays on the rest of them (motivity) and the influence that elements receives from the rest (dependency).

Taking into account that all systems contain feedback, this method makes an additional influence between direct and indirect influences. The importance of a variable should be considered not only for its direct relation with other variables but for the millions of

indirect variables (Godet, 1994). The countless indirect influences that come to and fro an element make an invisible structure of relations between the elements of a system and give a very close image of the system functioning.

In this paper, PSA has been adapted to rural zones reality for its study. It has been divided in three phases:

*Phase 1. List of macro-variables.*

The first stage is to elaborate a series of areas in which macro-variables are included to explain them. Six areas were considered: National Resources, Population and Society, Substructure and Transport, Economy, Public Administration and Environment.

**Table 1. List of macro-variables**

Accessibility & mobility	Food industry	Others industry
Agriculture	Heritage & Culture	Population basic services
Basic supplying nets	Human capital	Population settlement ways
Building	Income & its distribution	Resources situation
Cattle-Raising	Income tax & Public expenditure	Services & Commerce
CIT	Labour market	Social capital
Competences	Legal frame	Social conciliation
Cooperation & nets business	Local identity	Socio-cultural & demographic frame
Disposition territory	Macroeconomics situation	Sport & leisure
Financing source	Management & Resources use	Technologic frame
Fish (no fish in this region)	Natural resources	Tourism

The system is formed by macro-variables that can be either internal or external. That list should not contain more than 70-80 macro-variables and each one should be clearly defined, including the evolution tendency followed in the past and predicted for the future. The macro-variables list was consented with the Local Action Groups and is shown in Table 1.

*Phase 2. Description of the relationship among variables*

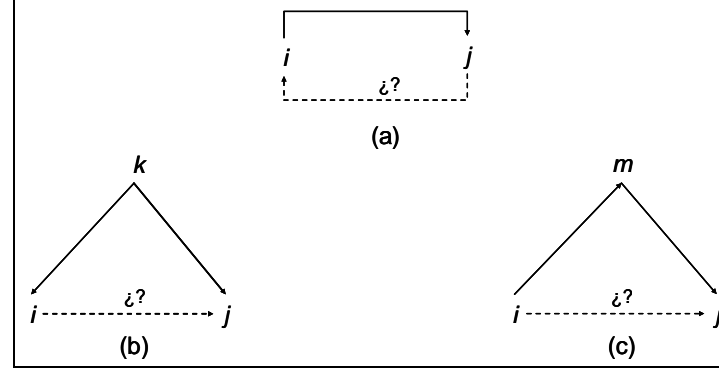
The main object of this stage is to fill in a double entrance matrix. Each element ( $a_{ij}$ ) in this matrix represents the value of influence exerted by variables in rows ( $i$ ) over variables in columns ( $j$ ). It is a fundamental step in the technique.

A deep reflection on the nature of the relationship among elements is needed (Figure 1) to identify clearly if influences exerted by  $i$  over  $j$  are direct (a), or they are affected by a third variable  $k$  (b) or even if that relation is influenced by a third variable effect  $m$  (c).

Each element of the matrix ( $a_{ij}$ ) can oscillate between 0 and 3 (0 meaning no direct influence between two variables, 1 means a weak direct influence, 2 means medium

influence and 3 is a strong influence). It is possible to assign a P value (potential) to those direct influences that can be relevant in the future in case that certain circumstances should be modified. This tool does not consider the influences sign.

**Figure 1**



The filling in of the influences matrix has been done by local actors in prospective workshops. The effectiveness of this technique is grounded on the basis of the implication and commitment made by local actors. The achievement of any desired change in rural zones is based not only on the local knowledge and experience but specially, on the commitment in the changing process and the capacity to lead it.

### *Phase 3. Identification of the key variables using MICMAC.*

This software applies the properties of Booleans matrixes to order variables according to the paths number and intensity. It also considers the motivity influence (given feedback) and the dependency influence (received feedback) exerted by each variable (Godet, 1994; Godet & Bourse, 1989).

Direct influences between variables  $i$  and  $j$  belong to relationship 1, because any element makes influence between both elements ( $i \rightarrow j$ ). These relationships are collected in the Direct Influences Matrix (DIM) the result of phase 1.

In order to incorporate indirect influences (for example,  $i \rightarrow k \rightarrow j$ , order relation 2 between  $i$  and  $j$ ), the successive DIM raising to *second*, *third*, *fourth*, .....*n* power leads to classify matrix elements according to the aggregated sum of exerted or received influences in successive iterations. From a determined power, any additional keeping stable and giving place to Indirect Influences Matrix (IIM).

MICMAC method can represent elements of a system in motivity-dependence plane form pairs of values associated to each element, by motivity and dependence. Macro-variables classification in Motivity-Dependence plane is set above two criteria.

The first criterion responds to the entrance exit logic of the territorial system. We can distinguish four types of macro-variables:

- a) Determinant. Determinant macro-variables of the territorial system functioning (those which have had or are having a high incidence in its dynamics) and those in which it is believe that other elements of the system have had a little incidence on.
- b) Environment. Macro-variables that have medium incidence over territorial dynamics and those in which other elements of the system have had a little incidence.
- c) Objectives. Macro-variables considered desires evident or territorial system goals. It is believed that the rest of elements have had high incidence on them although its influence on territorial dynamics is medium.
- d) Result. They are macro-variables considered descriptive indicators of the territorial system evolution. They show a limited motivity (their incidence over territorial dynamics is very low) and they have a high dependency. That is why we consider them rigid factors and evident system debilities.

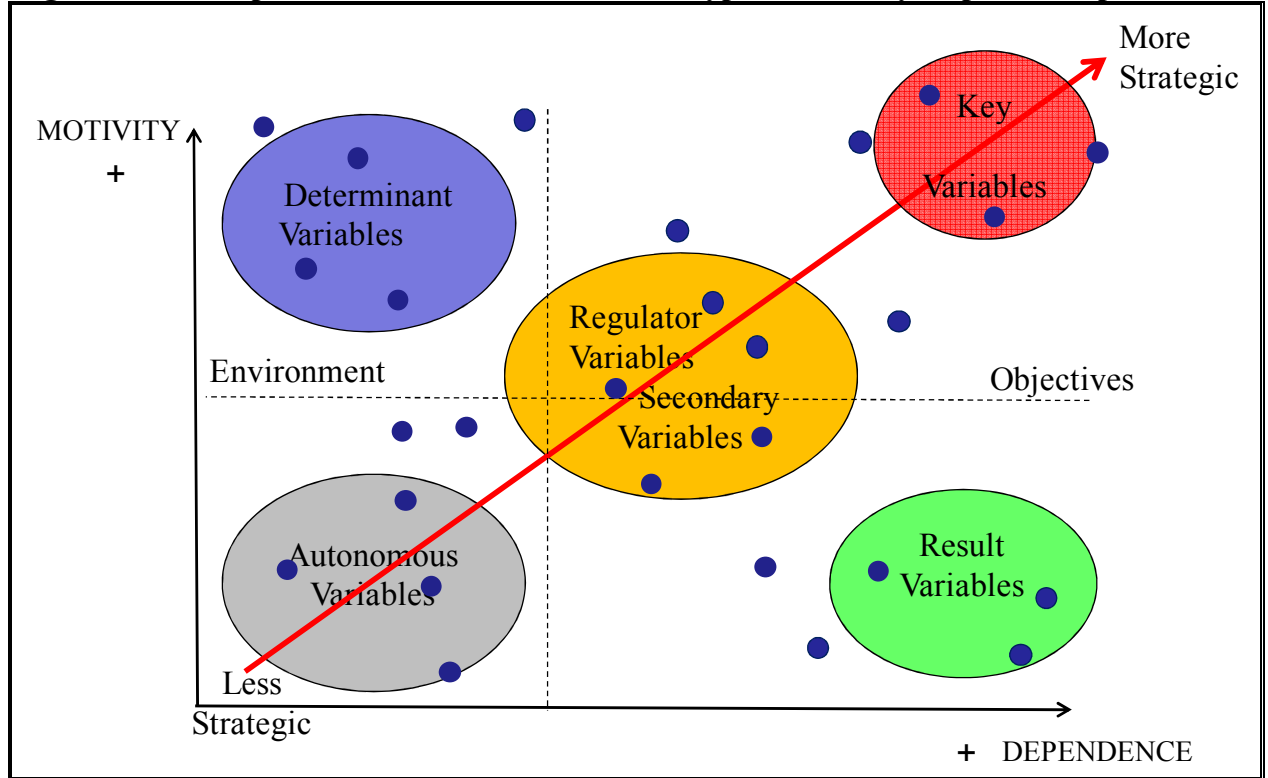
The second criterion is connected with a *strategic logic* and the capacity to provoke of multiplying effects, depending on the position a macro-variable in the strategic diagonal plane DM (diagonal which is all along the plane from its origin to the opposite extreme). This capacity to generate multiplying effects will be higher in more distant variables from the plane origin and lower in the nearest macro-variables to the origin.

We can distinguish four types of strategic macro-variables:

- a) Key. These macro-variables are considered to have had or be having a high incidence on territorial dynamics and the rest of elements in the system have a high incidence on them.
- b) Regulator. These macro-variables have medium incidence on territorial dynamics and the rest of system elements have medium incidence on them.
- c) Secondary. These macro-variables have or have had low-medium influence on territorial dynamics and the rest of system elements have medium incidence on them. Secondary and regulator macro-variables are called *squad variables* of the system.

- d) Autonomous. They have a low impact to generate changes in territorial system. The rest of system elements have or have had a low or inexistent incidence.

**Figure 2. Ideal representation of macro-variables type in Motivity-Dependence plane**



The image obtained in this plane is a product of the participants' interpretation of direct influences over the system elements. For that reason this plane should be considered specially relevant to understand which restrictions, opportunities and stir into action of the change are perceived by local actors and, consequently, to tackle their rural territory.

#### 4. Results

Results correspond to information obtained by Cazorla LAG, in Jaen province belonging to Andalusia autonomous community in the South of Spain. This information was recorded in a double entrance matrix (Influences Matrix) after several working sessions in the so called round-table local discussion. The matrix was formed by 32 rows and 32 columns according to the 32 macro-variables. The percentage of (DIM) filled in was 59%<sup>2</sup>. For that reason we

<sup>2</sup> Direct influences matrix filling rate is calculated as the percentage of values different to 0 over the total cells of the matrix (excluding diagonal values). A normal filling rate should not exceed 25%, although rates around 50-60% can also be acceptable.



opted for not making any changes in the original matrix. MICMAC method was applied to that matrix.

In order to classify macro-variables we base on the motivity-dependency plane (DM plane) resultant of DIM and we follow all steps explained in the methodology section although some modifications in the values will be necessary. The steps are the following:

- (i) Calculate macro-variables “strategic value”. These are calculated with the sum of direct influences proportions and for direct dependency.
- (ii) Discriminate “squad macro-variables”. To discriminate these macro-variables (regulatory and secondary) we get “strategic values” average calculated in the previous step “squad macro-variables” will be those whose strategic value in the interval defined by following limits:
  - Upper limit, 115% of strategic values average
  - Low limit, 85% of strategic values average
- (iii) To discriminate “regulatory and secondary macro-variables”. Considering DIM results, we will use direct influence proportions:
  - a) Average value will be obtained from direct influence proportion of all macro-variables
  - b) Values to be compared will be obtained from direct influence proportions.

After being identified regulatory and secondary variables motivity-dependence, results are shown in Figure 3.

Results obtained from the application of PSA methodology and MICMAC software to the reflection process made in the Sierra de Cazorla are shown in a simplified way in Table 1. Sierra de Cazorla is a mountainous region with a rich and varied nature that is an excellent resource for touristic and agriculture development and less in cattle. Region extension is 1,331 km<sup>2</sup> and 38.6 % of it is a Natural Park, the biggest protected zone in Spain. It was declared Biosphere reserve in 1983 by UNESCO. There are nine districts with a population of 34,000 inhabitants.

#### *Determinants and desires (entrance-exit logic)*

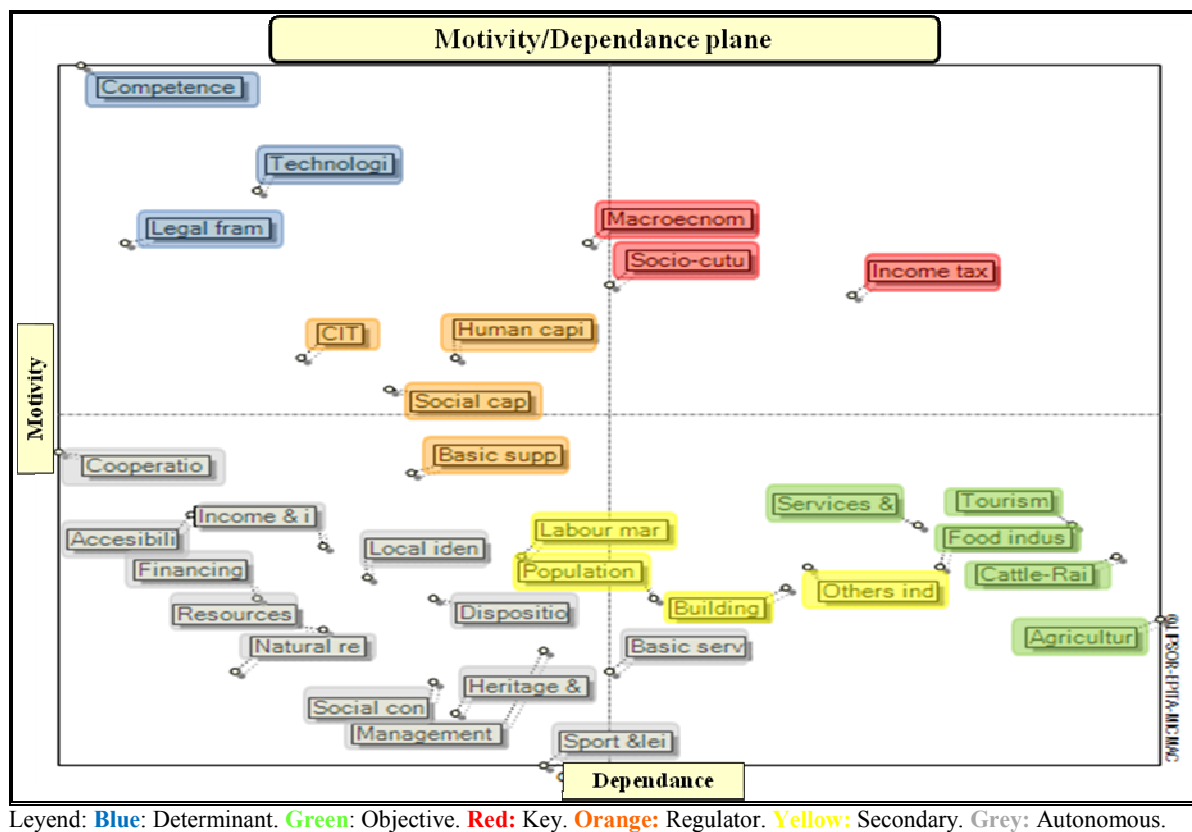
Territorial dynamics in Cazorla are conditioned by two macro-variables in the Public Administration and Environment areas. Territorial process in this rural area are determined by possibilities given by Public Administration competences in the territory and technologic frame available, under a determined legal frame. One of the region strengths in

Institutional Organization is the great number of public institution it has the cover population needs as consulting services, documents processing and so on. It is pretended, then, to promote communication and coordination among different administrations present in the region and to encourage socio-economic agents participation in rural sustainable development.

These macro-variables are perceived as external factors.

We identify five aims or desires: Tourism, agriculture, cattle-raising, food industry, services and commerce. These macro-variables belong to the Economy area. It is evident that the region main concern is in the development of economic sectors that provide income, specially agrarian sector and associated industries as well as tourism.

**Figure 3. Motivity-Dependence plane Cazorla local**



#### *Strategic elements (strategic logic)*

Strategic macro-variables have relatively close levels of motivity and dependence which show the capacity to generate multiplier effects (higher in key macro-variables and lower in autonomic ones).

According to perceptions obtained by local action group, macro-variables with higher multiplier (key) in Cazorla are three: macroeconomic situation, socio cultural and

demographic frame, income tax & public expenditure. Territorial processes are greatly influenced by the general economic situation and the evolution of the labour market.

In a territory with the agrarian sector as objective macro-variable it will probably has to take into account goods and services market situation offered. Its demand will depend on the economy general situation. For that, it is necessary the implication of public administration giving resources needed to the development of economical activities in the territory.

With a lower multiplier effect but also relevant to territorial processes (regulator) we can find the following macro-variables:

- Population and Society area: human capital and social capital.
- Substructure and Transport area: basic supplying nets, communication & information technology.

**Table 2. Sierra de Cazorla macro-variables classification**

<b>DETERMINANT</b>	<b>OBJECTIVE</b>
Competencies	Agriculture
Technologic frame	Cattle-raising
	Food industry
	Services and commerce
	Tourism
<b>KEY</b>	<b>REGULATORS</b>
Income tax & public expenditure	Basic supplying nets
Macroeconomic situation	Communication & information technology
Socio cultural and demographic frame	Human capital
	Legal frame
	Social capital
<b>SECONDARY</b>	<b>AUTONOMOUS</b>
Building	Accesibility, maintenance y mobility
Labour market	Cooperation & nets business
Others industries	Disposition territory
Population settlement ways	Financing source
	Heritage & culture
	Income and distribution income
	Local identity
	Management and resources supply
	Natural Resources
	Basic services population
	Resources allocation
	Social conciliation
	Sport & leisure

The consideration of these variables in the territory shows agents' concern in two specific areas. The first one is related to the potential that human and social capital has for the whole process of development. These elements are fundamental in the territory to reach fixed aims in the strategy. The second one is connected with substructures required and that, with a medium influence, are equally necessary to reach the aims. Substructures in this region have experimented great improvement in the last years, although there are still deficiencies to be overcome.

On the other hand, taking into account this region isolation with respect to big cities, it is very advisable to invest more in Communication and Information Technology (CIT) as a regulator factor, whose progressive incorporation in the last years is giving great support to some economic sector and public administration.

With a less multiplier effect and with less relevance to territorial dynamics we find what we call *secondary* macro-variables:

- Economy area: other industries, building, labour market.
- Population and society area: Population settlement ways.

As we can observe, Cazorla secondary macro-variables show different motivity levels: from a medium motivity (labour market; population settlement ways) to lower motivity but strong dependence (other industries; building).

Medium motivity macro-variables, due to their nature, are like structural pillars for the territorial system. They have certain importance for the region as their position show an important capacity to generate multipliers effects in other territorial processes (labour market and population settlement ways). Depending on the way we treat them, it is possible to provoke an impact on other macro-variables regulators and key. Apparently, this macro-variables don't point out to territory problems.

*Other industries* and *building* have less motivity but a big dependence. Their capacity to generate multipliers effects is a little lower and they need strong investments to have that effect in the territory.

Finally, macro-variables with lower strategic value (autonomous ones) are:

- Economy area: Cooperation & nets business, Financing source, Income and distribution income.

- Population and society area: Social conciliation, Local identity, Heritage & culture, Sport & leisure
- Infra-structure and transport area: Accesibility, maintenance y mobility, Population services basic.
- Physical and Natural Environment area: Management and resources supply, Resources allocation, Disposition territory, Natural resources.

It should be necessary to distinguish, al least, four big groups of macro-variables, according to motivity level shown (see figure 3).

Cooperation & nets business could be apparently be considered as an element of the environment. It is an activity with a great impact to the region influence due to three reasons: 1) synergies among economical activities existing; 2) cost reduction with nets working; or 3) external projection of this activities for the region, among other reasons.

Income and distribution income; accesibility, maintenance and mobility; local identity; financing source have medium motivity level. They are always autonomous macro-variables. The first one does not clearly seem to be a population concern, although it should have more strength as it depends on public administration performances.

In the case, local identity, it also has an impact in territorial dynamics although the region is not doing an additional effort to let others know about this territory identity. Maybe due to the fact that it is considered that there is a high degree of external knowledge and inner identity. Besides, financing is a factor that does not depend on the region as it is considered an external variable.

On the other side, we consider macro-variables that do not have or exert very little influence on region dynamics. Four of them belong to Physical and Natural Environment area: management and resources supply, resources allocation, disposition territory and natural resources. Obviously, natural resources of the region and their management have little influence of the rest of the region as they are considered to be sufficiently managed or because it is not possible a better exploitation.

Finally, the fourth Macro-variable is connected to Population and Society area: social conciliation, heritage & culture, sport & leisure and the last is population services basic. All those variables have a low level of influence although they have a medium level of dependency with respect to the rest of macro-variables.

Once analyzed dependency and motivity relationship among macro-variable, we have extracted action lines and instruments to carry them out from Rural Development Strategy presented by Local Action Group for 2007-2013 plan. We want to compare coherence between results obtained through the application of MICMAC methodology and LAG's proposals for the above mentioned period.

**Table 3. Action lines and instruments by macro-variables**

Macro-variables	Action linjers		Macro-variables	Instruments	
Competences	18	14,2%	Agriculture	44	9,6%
Agriculture	10	7,9%	Competences	44	9,6%
Legal frame	9	7,1%	Cattle-raising	30	6,5%
Accesibility, maintenance & mobility	8	6,3%	Management and resources supply	29	6,3%
CIT	8	6,3%	Basic services population	29	6,3%
Social capital	7	5,5%	CIT	29	6,3%
Cooperation & nets business	7	5,5%	Cooperation & nets business	27	5,9%
Cattle-raising	6	4,7%	Legal frame	25	5,4%
Management and resources supply	6	4,7%	Food industry	24	5,2%
Income tax & public expenditure	6	4,7%	Accesibility, maintenance & mobility	21	4,6%
Basic services population	6	4,7%	Social capital	19	4,1%
Food industry	5	3,9%	Social conciliation	16	3,5%
Tourism	4	3,1%	Heritage & culture	16	3,5%
Human capital	4	3,1%	Income tax & public expenditure	16	3,5%
Social conciliation	4	3,1%	Other industries	15	3,3%
Other industries	4	3,1%	Tourism	14	3,0%
Heritage & culture	3	2,4%	Human capital	14	3,0%
Resources allocation	3	2,4%	Resources allocation	12	2,6%
Technologic frame	2	1,6%	Technologic frame	8	1,7%
Disposition territory	2	1,6%	Disposition territory	8	1,7%
Local identity	1	0,8%	Labour market	6	1,3%
Labour market	1	0,8%	Basic supplying nets	6	1,3%
Basic supplying nets	1	0,8%	Services and commerce	4	0,9%
Income and distribution income	1	0,8%	Local identity	2	0,4%
Services and commerce	1	0,8%	Income and distribution income	2	0,4%

Source: Our elaboration based on data included in Sierra de Cazorla New Rural Strategy

In table 3, data is presented from mayor and minor action lines and mayor to minor instruments used each macro-variable. From the observation of data on table 3 we can make several deductions:

- a) There are proposals of action lines for only 25 out of the 32 macro-variables defining the region. Three of them are autonomous (financing sources, natural

resources and sport & leisure), two key (macroeconomic situation and income tax & socio cultural and demographic frame) and two secondary (population settlement ways and building).

- b) There are seven macro-variables for which one or two action lines are proposed (less than 2% of the total). Any of the same macro-variables reach 2% of the total instruments proposed. Three macro-variables belong to autonomous type (disposition territory, local identity, income and distribution income), one belong to secondary (labour market), another one is regulator (basic supplying nets) and the last to objective (services and commerce). The order established for these macro-variables is slightly altered if we consider action lines or instruments classification.
- c) Ten first macro-variables occupy 67% of action lines proposed and 66% of instruments is applied to first ten macro-variables. However, there is an alteration in macro-variables classification when contemplating them on action lines or on instruments.
- d) First ten macro-variables classified by action lines are distributed as determinant (competences), key (income tax and public expenditure), regulator (legal frame, social capital and CIT), objective (agriculture and cattle-raising) and autonomous (accessibility-maintenance-mobility and management resources supply).
- e) However, if we consider the first ten macro-variables on instruments proposed, two of the macro-variables classified according to action lines cannot be consider within the first ten as they are substituted by another two. At the same time, the order in the position of the variables suffers an alteration according to the last classification. In this case, variables are distributed as determinant (competences), regulator (CIT and legal frame), objective (agriculture, cattle-raising and food industry) and autonomous (management and resources supply, basic services population, cooperation & nets business and accessibility, maintenance & mobility). If we consider our six areas the macro-variables are distributing as follow:
  - National Resources: management and resources supply
  - Substructure and Transport: basic services population, accessibility, maintenance & mobility and CIT.

- Economy: agriculture, cattle-raising, food industry and cooperation and nets business
- Public Administration: competences
- Environment: legal frame

We can observe that Economy area is the most important one because it has four macro-variables. It is followed by Substructure and transport with three, and each one of the other three areas has one macro-variable. The Population and society area has not got any macro-variables in the first ten.

## 5. Conclusions

From the analysis implement using MICMAC methodology we could state that the final classification of macro-variables leads local action group to reaffirm strategies previously discussed in workshops. This contrast gave validity to the process carried out with the participation of many local economic and social agents.

We believe that method used in this paper is a new and not very complicated way of establishing a systematic analysis of variables or factors that define a region whose information could be difficult to get if endogenous socio-economic agents did not reveal it.

The application of this methodology in the processes of making decisions where it is necessary to consider the relationships among variables with direct or indirect influence (and no cause-effect relationships) has made clear its validity and strength for rural areas in which the maximum of participation is desirable.

Comparison of results obtained by MICMAC method with action lines and instruments proposed by Local Action Group shows the method strength as relationships established with its application have been taken into consideration in the new strategy of rural development for Sierra Cazorla region along 2007-2013 period.

Finally, we suggest continue using and testing this method application to establish development strategies, especially in rural zones where statistical information published is very difficult or impossible to obtain.



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