Agricultural entrepreneurship in Algeria
Prospective Structural analysis using MICMAC method

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Abstract

This study aims to identify key variables controlling the evolution of the agricultural entrepreneurship in Algeria using MICMAC method. After the listing of variables (both internal and external), the description of the relationships between variables and the analysis of both direct and indirect plan we find that the important variables controlling the evolution of our system under study are determining variables and key variables of the indirect plan. These variables are export of petrol and gas, economic growth, business climate, human capital, information and communication technology, territory development and motivation of the entrepreneur. We can add other regulatory variables such as export promotion, markets organization and partnership.

Key words: Agricultural entrepreneurship. Structural analysis. MICMAC.

الملخص:

تهدف هذه الدراسة إلى التعرف على المتغيرات الرئيسية التي تتحكم في تطور المقاولاتية الفلاحية في الجزائر باستخدام طريقة ميكماك. بعد إدراج المتغيرات (الداخلية والخارجية)، وصف العلاقات بين المتغيرات وتحليل كل من المخطط المباشر وغير المباشر نجد أن المتغيرات الهامة التي تسيطر على تطور نظامنا قيد الدراسة هي المتغيرات المحددة والمتغيرات المفتاحية للمخطط غير المباشر. وهذه المتغيرات هي تصدير البترول والغاز، النمو الاقتصادي، مناخ الأعمال، رأس المال البشري، تكنولوجيا المعلومات والاتصالات، تهيئة الاقليم، وتحفيزالمقاول الفلاحي. يمكننا إضافة متغيرات تنظيمية أخرى مثل دعم الصادرات الفلاحية، تنظيم الأسواق والشراكة.

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الكلمات المفتاحية: المقاولاتية الفلاحية، التحليل الهيكلي، ميكماك .

Introduction

The agricultural entrepreneurship is considered as one of the newest areas of research in the entrepreneurship field. The transition from classical agriculture to modern agriculture required strategic plans addressing the factors that curb rural development such as the low incomes, the rural migration, limited investments in science and technology, low levels of education, the levels of linkages or isolation and old infrastructure.

An agricultural entrepreneur is an individual or a group with the right to use or exploit the land or other related elements required to carry out agricultural, forestry, or mixed activities (Suarez, 1972). Wortman (1990) add to this definition the creation of new organizations that introduce new products, create and explore new markets, or use new technologies from rural areas. Therefore, in the rural context, we can define agricultural entrepreneurship as the creation of new employment opportunities via new ventures (Holy, 1983).

Similarly, recent studies identify rural entrepreneurship with the creation of firms in rural areas (Lafuente et al, 2007), and the development of small firms (Dinis, 2006; Meccheri and Pelloni, 2006). In addition, McElwee (2006) define rural enterprises as a business that employ local people, use and provide local resources, and generate income for rural environment.

Generally, we can define the agricultural entrepreneur as a person who see his firm as a business and a mean of earing profits. He is passionate about his farm business and take calculated risk to make his farm profitable and his business grow.

The diversification of the economy is one of the most important solutions to meet the challenges of the future; this diversification supported by the industrial sector, supporting the small and medium-sized enterprises, improving the investment climate in order to attract foreign investments, and the advancement of the agricultural sector

Algeria has tried through numerous programs to prepare the

agricultural sector to play the first roles in economic development and growth in a context of sustainable natural resource management and improvement of the degree of food security. To this end, a number of actions have been taken: the priority mobilization of water resources, the opening up of roads, the development of agri-food activities by helping the creation of small enterprises, support for the creation of cooperatives, and the development of social services and access to resources (Laib and Chakour, 2016).

Algerian agricultural sector marked by many trials, changes and experiences. The Algerian government has made considerable efforts to promote it; since the economic opening in the 90s, Algeria posted an opening speech to entrepreneurship in general and agricultural entrepreneurship in particular, through reforms and laws facilitating the creation of enterprises

In the past years, agriculture and livestock have been the main component of economic activities in rural areas. In fact, more than 39% of the employed rural population worked in this sector (Laib and Chakour, 2016).

According to the National Agency of Investment Development, there are 1316 agricultural projects between 2002 and 2016, which represents 2% of the total investments with 53445 jobs created.

However, despite these efforts the agricultural sector follow a traditional pattern of resources use, production, storage and marketing. Although vast human and natural resources Algeria has not been able to achieve a quantum leap in agricultural sector productivity, and it is classified as food-deficit areas. Subsequently, Algeria need to develop this sector through the introduction of the entrepreneurship.

Methodology

The structural analysis aims to highlight the structure of the relationships between the qualitative variables (quantifiable or not), which characterize the system under study. A system is a set of interrelated variables. The structural analysis allows us to describe this system using a matrix with interconnects. The final objective of the structural analysis is the identification of key variables which controlling

the evolution of the system under study (Godet, 1994).

Origin and evolution of the structural analysis

The origin of the structural analysis appeared in the works of Jay Forrester in 1961. It is based on Leontief's input-output matrices. It was widespread through works of R. Saint Paul and Teniere-Buchot P. F (1974) and J Barrand and C Gtigou (1984) (Godet, 1994).

The applications of structural analysis

J E Lefebvre (1982) indicate some structural analysis applications:

- Build more elaborate model such as systems dynamics.
- It can be a part or a phase of an overall approach such as scenarios method.
- It can help a group of researchers in a specific objective.

Description of the structural analysis method

Structural analysis is carried out by a working committee consisting of experts in the field related to the subject under study. The members of foresight team does not generally exceed 15. The deferent phases of the structural analysis are as following:

Phase 01: The listing of variables

The list of variables does not generally exceed 70 or 80 variable that characterize the subject. We give a precise definition for each variables. Two categories of variables are used in the structural analysis: internal variables, which characterize the phenomenon under study, and external variables that characterize the explanatory environment. The list of variables must be exhaustive as possible. We use non-direct interviews with open questions such as "in your opinion, what are the factors that control the future evolution of such or such phenomenon?" (Godet, 1994).

Phase 02: description of the relationships between variables

The filling in the matrix allows starting a dialogue and exchange of views about the subject under study between the participants. With regard to the degree of the influence between variables, there are four levels:

- 0: no direct influence

- 1: low direct influence
- 2: medium direct influence
- 3: high direct influence
- P: potential direct influence

The P value will replaced by one of the four levels.

The sum of the influences values by rows give us the level of influence of each variable on the other variables. Therefore, the sum of these values by columns give us the level of dependency of each variable in the structural analysis. According to the influence and dependency of each variable, we construct the influence/dependency plan.

Phase 03: Identification of key variables with MICMAC

This phase consists in the identifying the key variables that are essential to the system's development, first by using direct classification, then through indirect classification.

MICMAC principles

MICMAC (Impact Matrix Cross-reference Multiplication Applied to a Classification) is based on the classical proprieties of Boolean matrix. The MICMAC classification can classify the variables according to their influences described by the structural analysis matrix. Squaring the matrix shows us the indirect effects. After each raise operation, we make a classification of variables according to the level of influence and dependency. At certain level of raising, the classification of the variables stay fixed. Therefore, we can conclude the maximum of the length of paths describing the indirect relationships between variables.

Background

The implementation of prospective studies in the agricultural sector is a relatively new area. Therefore, 8% of the scenarios analysis listed in the database of the European Foresight Monitoring Network (EFMN) directly or indirectly address the future of the agricultural sector. The most important contributions in the field are:

- **Exploring Prospective Structural Analysis to assess the Relevance of Rural Territorial Development in Spain and Nicaragua (Delgado-Serrano et al, 2015)**

This study analyses the role played by Rural Territorial Development principles in the dynamics and evolution of four rural areas in Spain and Nicaragua using Prospective Structural Analysis (PSA). 53 variables are listed and 29 experts and stakeholders from both countries participates in the foresight team. Results find that flexible and adaptive policies, continuous monitoring and evaluation processes providing feedback and driving decision-making are needed.

- **Foresight-using scenarios to shape the future of agricultural research (Schwab et al, 2003)**

The foresight study analyses the integration of Switzerland in the world. The scenario technique of U H von Reibnitz was selected to realize the study. The results shows that as far as organizational measure are concerned, Staff motivation and training are key factors.

- **Structural analysis with Knowledge-based MICMAC Approach (Omran et al, 2014)**

The study apply the structural analysis with Knowledge-based MICMAC in two crucial domains in Egypt: food security and water security (milk production). 25 experts participates in the study in order to identify, analyses and foreseeing potentials of Egypt's water and food security. The most important drivers affecting Egypt's water security are global temperature, new animal disease, global economic goes up, world financial crises, economic instability, dissemination of the epidemic disease, major road accidents, major natural wildcards, significant pollution increasing, bad weather conditions and climate change in the Egyptian delta.

- **Prospective Structural Analysis: An application to Rural Development Strategies (Albalá, 2009)**

The study analyses the elaboration of the rural strategy for Andalusia, an European region situated in the south of Spain. 33 variables are listed. Results obtained with the application of the PSA shows the key variables: Income tax, public expenditure, macroeconomic situation, socio cultural and demographic frame, competencies and technologic frame.

- **Foresight analysis of agriculture sector at regional level (Gómez-Limón, 2008)**

The objective of this study is carry out a foresight analysis of the agricultural sector in Castilla y León (Spain) for 2020. The methodology used to build the various scenarios is prospective analysis. We interest only by the results of the structural analysis using MICMAC method. 75 variables are listed based on the White Paper on Agriculture and Rural development by the ministry of agriculture. Results shows 12 key driving variables that will determine the future of agriculture in Castilla y León: development of agricultural techniques, environmental conditions, energy availability, demography, macroeconomic situation, consumer preferences, life style and welfare level, WTO agreements and others, enlargement and institutional organization of the EU, agricultural policy and rural development, environmental policy, and energy policy.

Case study

Eight experts from high national school of statistics and applied economics (ENSSEA), National Institute of Agronomic Research of Algeria (INRAA) and Center for Research in Applied Economics for Development (CREAD) are participates in the study. 36 variables are listed: 11 are in the economic context, 5 in the financial context, 3 in the technological context, 6 in the social context, 6 in the agricultural entrepreneurship context and 5 in the natural context. We give for each variable a precise definition: quantitative or qualitative, percentage or quantity.

The list of variables is showed in the table 01:

Table 01: the list of variables

N°	**Long title**	**Short Title**
1	Territory development	Ter_dev
2	Export of Oil and Gas	Ex_Oil_Gaz
3	Economic growth	Eco_growth
4	Business climate	Bus_cli
5	Domestic demand of agricultural products	Dom_demand
6	Unemployment	Unemploy
7	Export promotion	Exp_prom
8	Markets organization	Mark_org
9	Urban expansion	Urb_expans

10	Infrastructure	Infra
11	Partnership	Partner
12	Agricultural support	Agr_sup
13	Access to financial resources	Acc_Fin_re
14	Agricultural subsidies	Agr_subs
15	Prices of imports agricultural products	Prices_imp
16	The modernization of insurance and social security funds	Mod_ins_so
17	Innovation	Innovation
18	Information and communication technology	ICT
19	Technical progress	Tech_prog
20	Human capital	Hum_cap
21	Motivation of the entrepreneur	Motivation
22	Local culture	Loc_cult
23	Rural migration	Rur_mig
24	External pressure	Ext_press
25	Professional training	Prof_train
26	Chemicals and Fertilizers	Chemic_fer
27	Logistic	Logistic
28	Agricultural machinery	Agr_machin
29	Irrigation techniques	Irrig_tech
30	Quality of the agricultural products	Qlt_agr_pr
31	Access to energy	Acces_enrg
32	Climate change	Clim_chang
33	Water resources	Water_res
34	Rainwater	Rainwater
35	Desertification	Desertific
36	The protection of the environment	Prot_envir

Source: realized by the participants

The next step is the filling in the matrix of direct influences using a dialogue between the experts participating in the analysis. Five levels are used to evaluate the influences between variables: 0, 1, 2, 3 and P. The results of the first step are showed in Table 02.

Table 02: Direct influences matrix (MDI)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1 : Ter_dev	0	1	1	2	0	1	1	1	1	2	1	1	1	0	0	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	1	0	0	0	0	0
2 : Ex_Oil_Gaz	1	0	3	0	2	2	0	0	1	2	1	2	1	1	0	1	1	1	1	1	0	0	0	2	0	0	1	1	0	0	0	2	0	0	0	2
3 : Eco_growth	2	0	0	2	2	3	1	0	2	2	2	2	2	2	0	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2
4 : Bus_cli	2	0	3	0	0	2	0	2	0	0	0	0	2	0	0	1	0	0	1	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
5 : Dom_demand	0	0	1	0	0	0	0	1	0	0	0	0	0	2	2	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1
6 : Unemploy	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	3	2	2	0	0	0	0	0	0	0	0	0	0	0
7 : Exp_prom	1	0	1	1	1	1	0	1	0	0	2	1	0	1	2	0	0	0	0	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
8 : Mark_org	2	0	0	2	1	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0	3	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0
9 : Urb_expans	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	2	1	0	0	0	0	0	0	0	0	0	0	1
10 : Infra	2	0	1	1	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
11 : Partner	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12 : Agr_sup	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 : Acc_Fin_re	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0
14 : Agr_subs	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 : Prices_imp	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 : Mod_ins_so	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 : Innovation	0	0	P	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	2	2	2	2	2	2	0	0	0	0	2
18 : ICT	1	0	0	1	0	0	0	3	0	2	1	0	0	0	0	3	0	0	2	3	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
19 : Tech_prog	0	0	P	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	2	0	0	0	1	1	1	2	2	1	0	0	2	0	0	2
20 : Hum_cap	3	0	1	2	0	0	1	1	0	2	1	0	0	0	0	1	0	2	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1
21 : Motivation	0	0	1	1	0	2	2	1	1	0	2	0	0	0	0	0	0	1	1	0	0	3	3	0	2	0	0	0	2	2	0	0	0	0	0	0
22 : Loc_cult	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
23 : Rur_mig	2	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
24 : Ext_press	2	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1
25 : Prof_train	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	1	0	0	0	2	0	0	2	2	0	0	0	0	0	1
26 : Chemic_fer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	3	0	0	2
27 : Logistic	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0
28 : Agr_machin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	2	2	0	0	1	0	0	1
29 : Irrig_tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2	0	0	3	0	0	0
30 : Qlt_agr_pr	0	0	0	0	3	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 : Acces_enrg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
32 : Clim_chang	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	0	0	2	2	2
33 : Water_res	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
34 : Rainwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	1
35 : Desertific	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	2	1	2	2	0	0
36 : Prot_envir	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0

Table 03: Descriptive statistics of the Direct Influences Matrix (MDI)

INDICATOR	VALUE
Size of the matrix	36
Number of iterations	2
Number of zeros	1012
Number of one	131
Number of two	126
Number of three	25
Number of P	2
Total	284
Filling rate	21,91358%

Source: Realized using MICMAC

Characteristics of Direct Influence Matrix

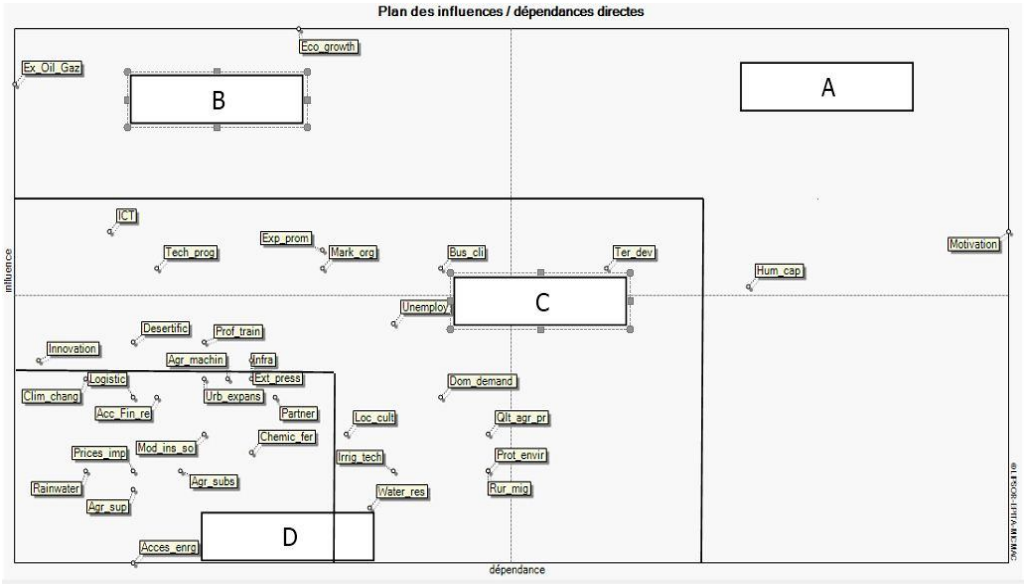
The 21, 91% fill rate reflects the direct influences between system variables. This rate is less than 30%. It is considered a good rate of filling. The rest 78.09% represents the indirect influences between the variables of this system, of which the rest of the MICMAC method is based.

The stability of the matrix

The matrix becomes stable starting from the second iteration; this means that from this iteration the classification of the variables by influence and by dependence no longer changes because all indirect influence relationships have been detected. The longest path is of length two.

We construct the direct plan using Influences and dependencies of the direct influences matrix (MDI)

Figure 01: Direct Plan



Source: realized using MICMAC

The direct plan results from the short to medium-term interplay of relationships between variables. The horizon analyzed by this plan is less than ten years.

We have four sectors of variables:

Sector B: which regroups the variables export of petrol and gas and economic growth. These input variables or determining variables are very influential and less dependent on the evolution of the other variables of the system. These variables control and condition the evolution of the system.

Sector A: regroups the variables human capital and motivation of the entrepreneur. In this sector, we find the key variables or the relay variables, they are both very influential and very dependent. These are sensitive variables and should be carefully monitored for the development of scenarios and strategies.

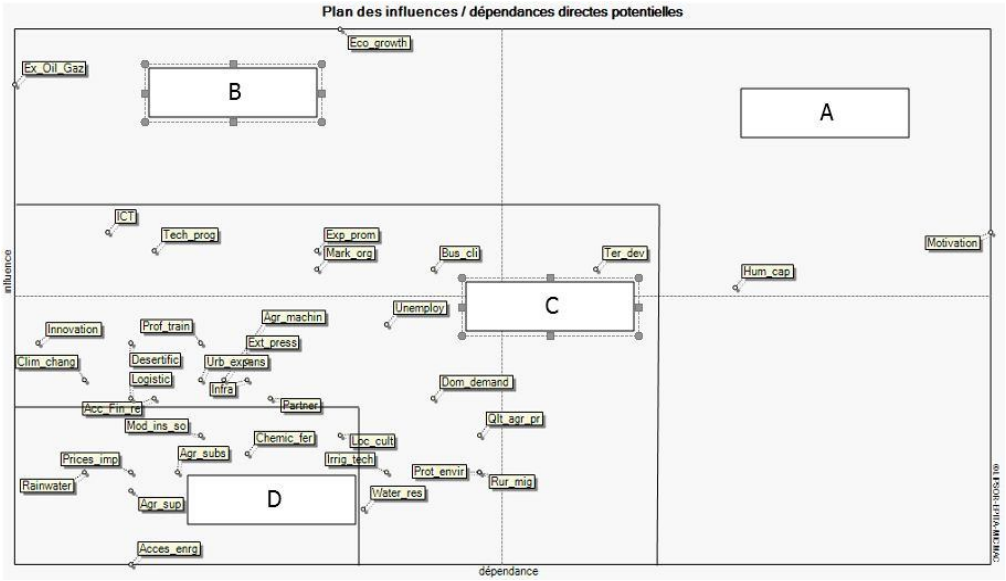
Sector D: regroups variables logistic, climate change, partnership, access to energy, rainwater, prices of imports agricultural products, the modernization of insurance and social security funds, agricultural support, agricultural subsidies, access to financial resources, chemicals and

fertilizers, external pressure and urban expansion: variables excluded, they are both less influential and less dependent.

Sector C: Middle cluster variables. These variables are averagely influential and/or dependent variables. We can say nothing about these variables. These variables are information and communication technology, technical progress, innovation, desertification, agricultural machinery, professional training, infrastructure, export promotion, markets organization, business climate, unemployment, local culture, irrigation techniques, water resources, domestic demand of agricultural products, quality of agricultural products, rural migration, protection of the environment and territory development.

After the consultation among the members of the foresight team, we decide to replace P by one in order to construct the direct potential plan.

Figure 02: direct potential plan

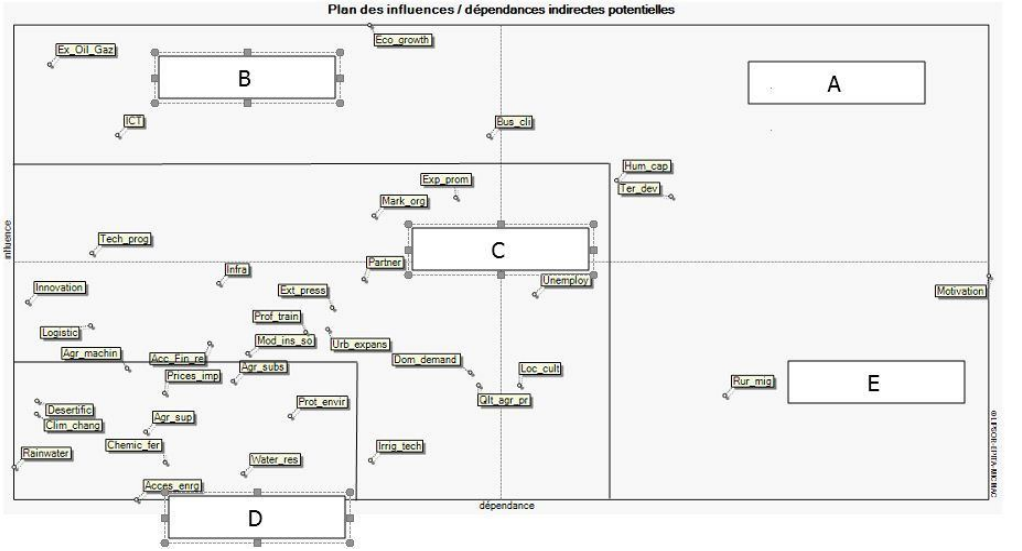


Source: realized using MICMAC

The direct potential plan integrates chain of reactions that are necessarily taken between ten and fifteen years. According to this plan, we note that the sectors A and B do not change. The variables climate change, logistic, access to financial resources, urban expansion, external pressure and partnership becomes a middle cluster variable. We can say

nothing about these variables. Squaring the matrix shows us the indirect influences. We can construct the indirect potential plan.

Figure 03: Indirect potential plan



Source: realized using MICMAC

The indirect potential plan goes farther than the direct potential plan, with repercussions on the system in the very long term.

This plan gives the final result of the MICMAC method applied to analyze the interactions between the variables of this system. This plan is divided into 5 sectors:

Sector B: which regroups the variables export of petrol and gas, economic growth and information and communication technology. These input variables or determining variables are very influential and less dependent on the evolution of the other variables of the system. These variables control and condition the evolution of the system.

Sector A: regroups the variables human capital and territory development. In this sector, we find the key variables or the relay variables, they are both very influential and very dependent. These are sensitive variables and should be carefully monitored for the development of scenarios and strategies.

Sector D: regroups variables logistic, climate change, partnership, access to energy, rainwater, prices of imports agricultural products, the

modernization of insurance and social security funds, agricultural support, agricultural subsidies, access to financial resources, chemicals and fertilizers, external pressure and urban expansion: variables excluded, they are both less influential and less dependent.

Sector E: Middle cluster variables. These variables are averagely influential and/or dependent variables. We can say nothing about these variables. These variables are information and communication technology, technical progress, innovation, desertification, agricultural machinery, professional training, infrastructure, export promotion, markets organization, business climate, unemployment, local culture, irrigation techniques, water resources, domestic demand of agricultural products, quality of agricultural products, rural migration, protection of the environment and the modernization of insurance and social security funds.

Sector C: regroups variables rural migration and motivation of the entrepreneur. They are more dependent and less influential. Many variables influence them.

Conclusion

Prospective Structural Analysis using MICMAC method represents a good tool in decision-making process, which we can use to analyses the complexity of elements, variables, and present interactions of the agricultural entrepreneurship in Algeria.

The application of this methodology in the processes of making decisions where it is necessary to consider the relationships among variables with direct influence has made clear its validity and strength for agricultural entrepreneurship field.

According to the indirect potential plan, we can extract the important variables controlling the evolution of the agricultural entrepreneurship in Algeria. The key variables are human capital, territory development and motivation of the entrepreneur. The determining variables are export of petrol and gas, economic growth, business climate and information and communication technology. We can add other regulatory variables such as export promotion, markets organization and partnership.

The structural analysis is insufficient; it must be improved by other techniques such as actor's strategy analysis in order to identify actors

controlling our important variables of the structural analysis.

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