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Management of Innovation for the Economic and Social Development of the Rural Production Sector in the Southeast Region of Mexico

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Abstract: Currently there is a greater deterioration of resources and social fabric in large areas of the Mexican Republic, and with it the loss of opportunities for the population living in them. The strategies to mitigate this problem have been insufficient for a problem of such magnitude; the effort of the Government of Mexico with a welfare policy has not yielded the fruits that indicate that the structural problem has been mitigated for a growing population. In the National Institute of Forestry, Agriculture and Livestock Research (INIFAP) strategies have been developed that contribute to the reduction of poverty, without this being referred to as a success, given that, up to the first decade of the 21st Century, such efforts production technologies were linear and in the year 2000, real participative technology transfer efforts began, with the presence and decision making of those involved, in this case producers from marginalized areas in the southern states of Mexico. An intervention was carried out in four states of the Mexican Republic, and each with two municipalities and 60 families for each municipality, 23 researchers and six institutions from Chiapas, Oaxaca, Veracruz and Yucatán participated. In order to manage innovation and create a network of inter-institutional articulation in the four states, after two and a half years of work the producers have carried out their own management to become organizations with legal status and have adopted processes and components for the sector. productive in corn, beans, red tomatoes, bees and biofertilizers.

Keywords: Innovation, Mexican Southeastern, Marginalization

1. Introduction

The diagnoses of the governments in the states of Veracruz, Yucatán, Chiapas and Oaxaca coincide in the existence of the potential to improve the living conditions of the rural population living in poverty. The respective state development plans highlight, for example: i) in Veracruz the need to design strategies to achieve an equitable, integral and sustainable development, by increasing competitiveness, through improving productivity, better environment for business, organization and motivation. In as much; ii) the government of Yucatan indicates that science and technology show a great lag compared to other entities, which requires the reactivation of the primary sector, competitiveness and sustainable economic growth. iii) the government of Chiapas points as its main objective to make the most competitive state in the country, through the linking of science and technology with productive systems, through training and productive reconversion. iv) the government of Oaxaca emphasizes its strategic objective to achieve a balanced regional development, taking care of the economic, social

and ecological sustainability, through the promotion of the sectors that present the greatest competitive advantages.

Based on the above, this methodological proposal always sought to respond to the need to increase productivity to boost competitiveness. In other words, to achieve better levels of the south-southeast region through technological innovation for the economic and social development of the rural productive sector, emphasizing the application of a model of INNOVATION MANAGEMENT with peasant families living in high and very high-income municipalities. high marginalization, with a marked presence of native peoples, but that have productive potential for some product systems, are organized and there is little infrastructure used. This situation is relevant for the states of south-southeast Mexico, which are characterized by their lower integration into the global economy and deficient management of their natural resources [1]. The central problem is the scarce innovation in its broad sense, which has as a consequence the low productivity and competitiveness of the agricultural production systems of the south-southeast region of Mexico.

The objective was to increase technological innovation through the application of the proposal described in this document when proposing an innovation management model to increase productivity and make the agricultural and forestry production units of the states concerned competitive by contributing to increase innovation levels generating more production in a competitive way. Although the South Border College (ECOSUR) defines the management of Innovation and adds the "socio-environmental" aspect, as the sum of scientific, technological, organizational, cultural, financial, etc., efforts that seek to respond to the problems of rural development, with the conservation of natural resources and the sum of knowledge and learning for the autonomy of rural actors, [2].

2. Materials and Methods

The model for the Management of Innovation (MGI) proposed is based on five key elements; i) the analysis of social networks, for the identification and assessment of the spreading and structuring actors in the social fabric of the producers and other involved actors; ii) an analysis of the articulation network between organizations and institutions, to propose actions that lead to the efficient use of supports, iii) a training strategy seeking human development based on the process of learning by doing; iv) technologies relevant to the context of each state, and; v) the design of business plans appropriate to the conditions of the producers.

The operation of MGI involves the implementation of six key actions, namely: i) contextual analysis and baseline; ii) the design of alternatives; iii) the adequacy of the MGI that will be applied; iv) the application of the training model; v) coordination-monitoring of actions; and vi) the systematization of information and documentation of learning [3-4]. The products generated in this initiative allow proposing an MGI, with emphasis on training and technology transfer, as well as a model of integration of an articulation network to improve collaboration and participation of organizations and institutions involved in municipal and regional development [4, 5, 6].

Figure 1. *Geographic location of the intervention of the innovation proposal for the economic and social development of the rural productive sector of the south-southeast region of Mexico. 2010-2012. Source: [9].*

Location of the Geographical Area of Study

According to the [1], of the eight states that comprise the south-southeast region of Mexico, six are of low competitiveness (Chiapas, Guerrero, Oaxaca, Tabasco, Veracruz and Yucatan) and only two of medium level (Campeche and Quintana Roo). Low-competitiveness entities are less integrated into the global economy, mismanage their natural resources, observe poor institutional development and have priority agendas that are insufficiently focused and misaligned with the entity's own advantages and have poor institutional development. The south-southeast region comprises 27.1% of the Mexican population [7], [8]. In this region there are 45 ethnic groups, the Mayans, Zapotecs, Mixtecs, Amuzgos, Popolucas, Zoques, Tlapanecos and Totonacos. In this part of the country there is a wide diversity of climates, fauna and vegetation, which confers restrictions and localized development opportunities. The altitude in the region goes from sea level to 5,600 meters above sea level, with slope lands predominating for production with around 15% or more of slope, which is another adverse condition for agricultural and forestry production.

The proposal was applied and validated in two municipalities by participating state: Copainalá and Ocotepec (Chiapas); San Jacinto Tlacotepec and Santo Domingo Teojomulco (Oaxaca); San Andrés Tuxtla and Santiago Tuxtla (Veracruz); and Chan Cenote and Thadziu (Yucatán). The universe of direct attention was 480 families, 60 families on average per municipality.

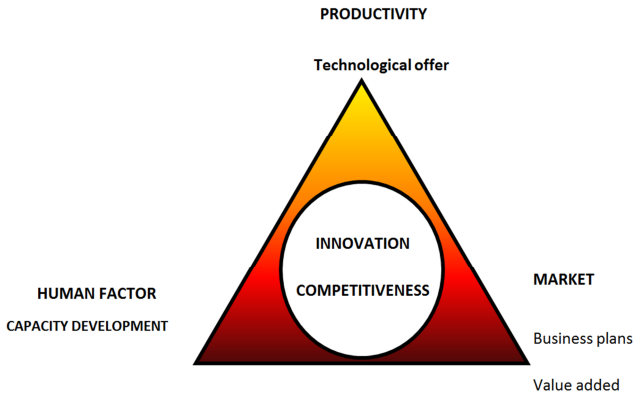

Figure 2. *Model for the Management of Innovation generated in the innovation project for the economic and social development of the rural productive sector of the south-southeast region of Mexico. 2010-2012. Source: [9].*

The production systems in these municipalities are characterized by extensive type, temporary regime, low capital investment, little adoption of technology, temporary management, oriented to the local and national market, self-consumption, with low use of supplies, located on hillsides and / or stony ground. In general, they are disconnected from value chains, unsustainable management and survival, which offer low productivity, sustainability and competitiveness. The population of the region presents alarming levels of food poverty, with income of less than US $ 45.00 per month; Most of the municipalities with high and very high marginality are located here (ninety of the 100 municipalities in the country with the lowest human development index, which takes into account the income, education and health indexes, are located in Oaxaca, Guerrero, Chiapas and Veracruz [10].

In each work area, the characteristics that make it up are highlighted, for example: for the Human Factor it focuses on a capacity development approach, privileging field schools as a work tool to promote "learning-doing", discussed widely in: [11, 12, 13, 14, 15, 16], technological tours, peasant meetings to share experiences and knowledge, the elaboration of teaching materials in cartoons that reinforce teaching, as well as a tool to detect the social actors that interact in the locality or region through the analysis of social networks, according to the methodology de [17].

In the case of productive or technological development, works were developed with the focus of field schools, as well as studies of regional productive potential, land use letters in order to glimpse a possible business plan in the immediate future. School-greenhouses were established for the production of red tomato (*Lycopersicon esculentum* L. or *Solanum lycopersicon*) and flowers in Oaxaca, Veracruz and Chiapas, the plots of milpa-escuela, the school apiaries for the production of honey (*Apis mellifera* L.) (Only in the state of Yucatán) and the plots of milpa interspersed with fruit trees (MIAF) in Veracruz, and Chiapas. [11, 18, 19, 20, 21].

The third strategic point of the project is the business plans, in which it was intended that the producers in the first place would give an added value to their primary production, and then make a business plan with these products, mainly produced in the greenhouses and in the apiaries, because it has been concluded that it is useless the fact that training courses are always given, updating, besides the existence of a technological offer and a promising productive potential if there is no access to the market and with it a greater appreciation of the work of the producers. [4, 9, 21].

3. Results and Discussion

The application of the innovation management model for the economic and social development of the rural productive sector, through its constituent elements, yielded the following results for the states of Chiapas, Oaxaca, Veracruz and Yucatán:

The analysis of social networks in each of the municipalities of the four states, which is widely discussed in: [6, 9, 22, 23, 5, 21].

After two and a half years of work through intervention with the "field schools" in the municipalities where the model was tested, the following results were achieved with the understanding that the values were very high in terms of the number of applications of pesticides, the use of landraces, yields, tomato topological arrangements and a high population density, producers and their families were incorporating the easiest components that required less

investment and that in some way they already carried out but in a way artisanal or without proper or recommended care.

Table 1. *Appropriate technological components in process of appropriation in tomato production in Santo Domingo Teojomulco and San Jacinto Tlacotepec, Oax.*

TECHNOLOGICAL COMPONENT	ADOPTED	N	IN PROCESS	n
Chemical analysis of water and its interpretation	√√	60		
Disinfection of soil and substrate	√√	120		
Seedling production	√√	120		
Hybrids with higher yield potential	√√	120		
Topological arrangement and pruning	√√	120		
Nutritional program and irrigation	√√	75		
Tutoreo	√√	80	√√	40
Integrated Management of P and E		0	√√	120
Hydroponics		0	√√	120
Good farming practices		0	√√	120
Commercialization		0	√√	120

n = 120 families

In the case of the components and technologies proposed and improvement for the production systems of "milpa", the following results were obtained, which, as in the case of the tomato or red tomato of Table 1, the indicators of the baseline they were very high, and it is significant that the vast majority of the components proposed in the field schools were easily adopted since no investment was required.

Table 2. *Appropriate technological components in process of appropriation in the ħilpa"system in Oaxaca, Chiapas, Veracruz and Yucatán.*

TECHNOLOGICAL COMPONENT	ADOPTED	N	IN PROCESS	n
Soil pest control	√√	480		
Planting method	√√	480		
Fertilization opportunity	√√	480		
Form of fertilization	√√	480		
Weed control		360	√√	120
Selection and improvement of their seeds		240	√√	240
Commercial corn	√	180	√√	300
MIAF (Corn interspersed with fruit tres)		240	√√	240
Biofertilizers	√√	120		360
Good farming practices	√	80	√√	400

n=480 families

In all the cases presented there are advances in the acceptance of certain components that help to improve the productive process and at least they already produce the corn necessary for their family and their "backyard" animals, achieving self-sufficiency for the whole year without having to have to go out and sell their labor within the locality or outside of it, in order to buy the corn they needed before the intervention with the project. In the inter-institutional coordination work in local form there are indications of some collaboration. However, it is necessary to work even more; In each state where the proposal was developed, collaborative actions and sum of efforts were promoted, of which the state of Veracruz stands out as being more illustrative, where the involvement of the institutions was graphed following the methodology suggested by [17].

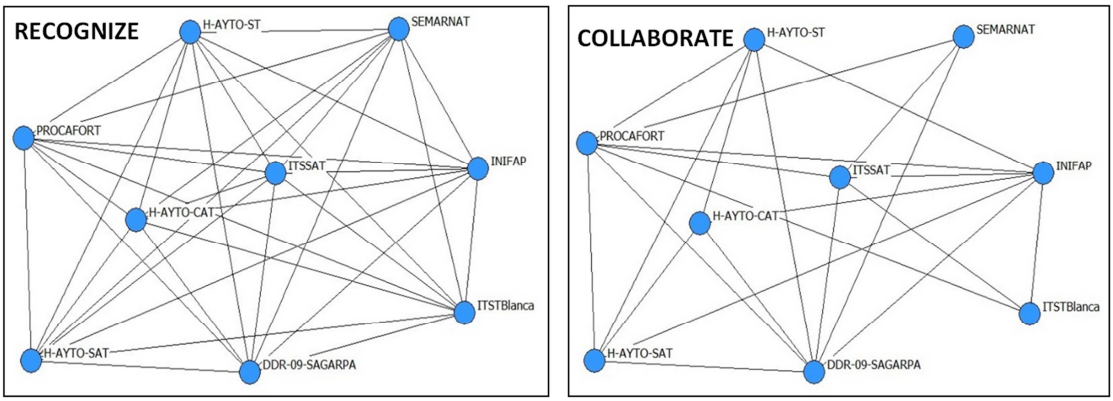

Figure 3. *Social maps derived from levels of relationship between institutions with presence in the project area, in the region of Los Tuxtlas, Veracruz, Mexico 2011-2012, in the stages of recognition and collaboration, according to [17]. Source: [21].*

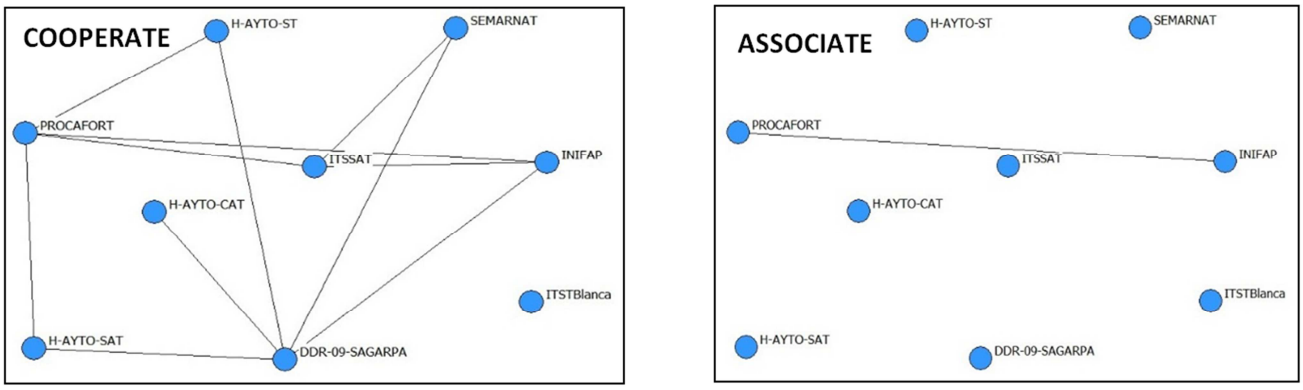

Figure 4. *Social maps derived from levels of relationship between institutions with presence in the project area, in the region of Los Tuxtlas, Veracruz, Mexico 2011-2012, in the stages of cooperates and associates, according to [17]. Source: [21].*

As can be seen in the previous figures, of the nine institutions that have the same area of action, all are recognized and the links between them have a diffuse framework. However, as one moves from one level to another, the links between institutions tend to disappear, as shown in the previous figures of cooperation between them; It may be that this operation occurs, but they do not have a mixture of resources and it is only done at the level of "I support you" in what you want training, but my regulations do not allow... etc. In the last stage described of associating, that is, putting resources for an activity or a training program or practices of productive processes, the links between institutions almost disappear and those that remain are more "*motu proprio*" than of the institutional response; this is normal, since there are no clear rules for the mix of resources at the local level (given that each agency or institution responds to its own emanated norms or the nature of its creation and operation), in Mexico the mix of resources is only This is done at the central level and is carried out in the operating cells at the state or local level for the exercise of fiscal resources. This exercise of network analysis or institutional framework may discourage many. However, the analysis of networks allowed us to identify the main actors that play a very important role in the articulation of the groups, we believed, however in the state of Chiapas we found the following: the two municipalities where the project was operated were mapped and the premise was that both worked independently separated from each other, however, found four actors that play a very important role in the articulation of the two municipalities including a provider of professional services (PSP05), a marketer (CO02) a Government institution, (IG07) and an organization (OR04). Between these four actors they articulate the two municipalities of Chiapas. This allows us to see the goodness of the analysis of a priori networks to start with a training and transfer intervention, because detecting these actors and working with them can increase the chances of success at the time of carrying out the operation and not throw a shot of "Shotgun" through the transfer of traditional knowledge, as was previously done. Each of the keys in the figure corresponds to an actor within the network or social, technical and marketing framework and these are shaped through the links created by them.

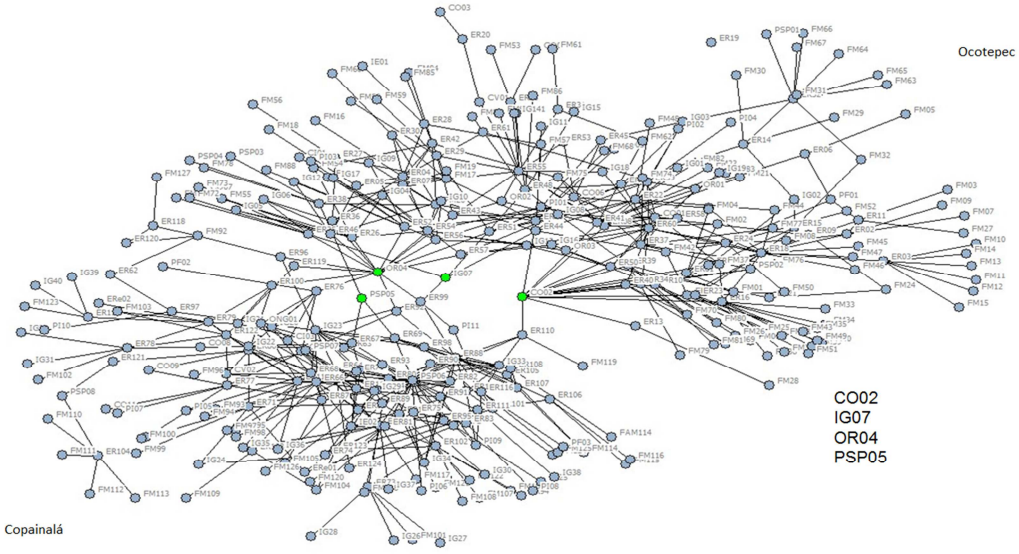

Figure 5. *Social fabric of actors in two municipalities of Chiapas and the articulation of key actors between both. 2011-2012 Source: [24].*

In order to determine the business plans to be carried out in each of the working municipalities, the productive potential studies were carried out and four business plans were drawn up in each of the states. Product of this intervention and once the participating producers and their families observed the benefits of the training and the culmination of their work, they themselves emerged the idea of establishing itself as a company with legal status, exceeding even in the state of Oaxaca the creation of more than one legal figure per municipality, in addition to its producers were integrated into what is known in Mexico as the product systems and diversified their production and not only for red tomato. In Chiapas for the production of greenhouse roses, in Yucatan for stamped wax and byproducts of honey and in Veracruz for the production and commercialization of tropical fruits and the conservation of soil and water and production in hillside soils. The expectation is that the groups organized once the facilitators leave the communities can continue themselves detonating their productive potential and are empowered by the knowledge poured through the training and transfer strategy that was carried out during the intervention with the project. In addition to generating positive impacts in various areas where they have worked together with heads of family in each location, which are presented as statements without these have been measured so far:

3.1. Technological Impact

The participants substantially improved their management capacity to implement innovation processes in their family and community units. Components have been incorporated in each locality and in each productive process, in addition to improving the productive processes of the "milpa" system.

3.2. Economic Impact

The participants know and value the same or more than the economic resources coming from government programs, since with the training they have improved their productive processes and with this they have also improved the quality of their primary products, mainly those derived from the greenhouses, the MIAF, the roses produced in the greenhouses, and honey in the Yucatan Peninsula.

3.3. Social Impact

The participants are motivated by their participation and the results they obtain from the proposal, in such a way that they have put money from their "money" to legalize their organization and thus have more possibilities when proposing productive projects that are feasible for financing by a public or private entity.

Environmental impact: There is greater awareness in the participants for the conservation of natural resources, the main one is that the producers no longer burn their waste, that, with the combination of moderate to strong slopes, in a short time they would no longer have soil to produce and with it two things could happen: the opening of more land to agriculture or migration outside of their locality. Regarding competitiveness, in economic terms, producers would not be competitive in a free market model. However, in terms of peasant persistence [25], the 480 families that were considered in the intervention of the proposed MGI reached productive levels that allow them to access with their own efforts and soil, economic and environmental resources. hand, to food self-sufficiency during the 12 months that require basic grains, in addition to the third year of work could already see the first trials of fruit trees, and with it have an income that can be the economic engine of its production unit. In the case of honey production in the state of Yucatan, the fact that producers have been so motivated that they are now the suppliers of the "mini boxes" with queen bees for the production of honey and the demand for biofertilizers for the gradual substitution of industrial nitrogen fertilizers. [19].

Table 3. *Groups legally constituted and with legal status in the area of the project "Innovation for the economic and social development of the rural productive sector of the south-southeast region of Mexico"2010-2012.*

ORGANIZATIONAL LEGAL FIGURES	PROOFABLE DOCUMENT
Organización “Horticultores de la sierra sur Tlacotepec” S. R. de R. L (Oaxaca)	Constitutive Act
Organización “Productores de chile de agua Tlacotepec” S. R. de R. L. (Oaxaca)	Constitutive Act
Organización “” Granos básicos de los Chinteños” S. R. de R. L. (Oaxaca)	Constitutive Act
Sociedad Cooperativa “San Juan de Tahdziu” S.C. de R.L. (Yucatán)	Constitutive Act
Sociedad cooperativa de responsabilidad limitada de capital variable “Rosales de Nazareth S.C. R.L. y C.V.” (Chiapas)	Constitutive Act
Organización de productores PROCAFORT, S.C. de R.L. (Veracruz)	Constitutive Act
Sociedad de Producción Rural “Integradora Nuestra Señora de Guadalupe”, S.A. de C.V. (Veracruz)	Constitutive Act

For the state of Veracruz in the municipalities of San Andrés Tuxtla and Santiago Tuxtla with a n = 97, the results indicate that there is a division by strata according to the level of the competitiveness index. The first stratum was negative indexes of which for San Andrés Tuxtla 19 production units were located in this stratum, the second stratum was between 0 to 1 in which only one Productive Unit (UP) was located within it, for the third stratum was located 34 UP, where it was greater than one. In the municipality of Santiago Tuxtla, Veracruz, a total of 43 UP were analyzed and, as in San Andrés Tuxtla, 3 strata were defined, within the first stratum 10 UP are located, in stratum two 7 while in stratum 3 a total of 26 UP. For the analysis of competitiveness with project, the results obtained are: of the three strata managed in the first part of the study two were determined in this new analysis, eliminating the negative stratum, within the municipality of San Andrés Tuxtla within stratum two they were located 13 UP, while for stratum 3, 7

UP. In the municipality of Santiago Tuxtla in the stratum from 0 to 1, 18 UPs were established and only 4 in stratum 3.

According to the criterion of the competitiveness index for the municipality of San Andrés Tuxtla, Veracruz, at the beginning of the analysis it was -5.23% at the general level, while for Santiago Tuxtla it was presented at 8.47%, however, for the analysis with project this indicator was presented in the first municipality of 1.05 and for the second of 0.91, which suggests that there was a change within the UP that allowed it to be mostly competitive.

In the case of the State of Oaxaca with n = 99, in the municipalities of Santo Domingo Teojomulco and San Jacinto Tlacotepec, for the analysis without project, according to the presented results, 4 UPs are presented in the negative range, while 33 UPs are above the unit, and only 2 are within the competitiveness range, in the municipality of Santo Domingo Teojomulco, and in the municipality of San Jacinto Tlacotepec, the UPs focus more on the competitiveness range, presenting a total of 4 UP in the range of 0 to 1 and 49 in the range greater than 1; for the results obtained with the project already established, the competitiveness indicators move satisfactorily for both municipalities because for stratum two this moves for the first municipality to 13 UP, while for San Jacinto this is 17 UP, with project which suggests that this municipality is mostly competitive.

According to the RCP (Competitiveness Index), the general indicator shows an RCP of 4.23 without a project while with a project of 3.33, where the variation is of a RCP of 21.27%, in the municipality of Santo Domingo, while in the municipality of Jacinto Tlacotepec the indicator without project is of 7.65 and with project is presented in 3.32, which represents a change of 56.60% of variation between with and without project.

For the state of Chiapas, competitiveness indicators with and without project in production units are distributed as follows: for the municipality of Copainalá with n = 64, it was found that 4 UP are negative, 37 are greater than one and 19 between 0 and 1, for the start of the first evaluation, later for the analysis with the project the negative layer disappears and the UPs are located within stratum 2 and 3 where 17 UPs are in the competitive stratum while only 7 UP are on the non-competitive stage greater than 1.

For the municipality of Ocotepec, the Production Units analyzed are: no project 9 within the negative stage, 17 in the competitiveness strata, while a total of 36 UPs are above the competitiveness index in stratum 3. For the analysis with project as the municipality of Copainalá disappears the stratum of negatives and the stratum from 0 to 1 increases to 26 UP, while in stratum 3 this decreases to 21 UP. According to the composition of the strata with or without a project, it can be observed that in carrying out the project the production units were modified in such a way that they tend to be mostly competitive.

According to the RCP for the municipality of Copainalá, 3 strata were presented, the negative presented a competitiveness index of -10.92, stratum 2 of 0.96 and stratum 3 was 3.78; subsequently, a competitiveness index is presented where, with the project disappears, the RCP within the competitive ones is 0.48, while for stratum 3 it is 1.82, the general variation for this municipality is 56.86% overall; while in the municipality of Ocotepec the RCP without project is for stratum 1 of -17.53, stratum 2 of 0.79 and stratum 3 of 7.38, but with project as in the previous municipality the stratum of negative disappears and are presented for the stratum of competitiveness of 0.5% and for the stratum 3 greater is 2.34.

As in the previous states for the municipality of Yucatan, two scenarios were presented. The first was without a project in the Chan Cenote and Tahdziu municipalities; and it was divided in three strata presenting itself in the following way for the municipality of Chan Cenote, the first stratum has a total of 8 UP in the first stratum, whereas in this stratum, with this project it decreases to 4 UP, in stratum 2 without a project you have a total of 4 UP and with a project of 13 UP, finally for stratum 3 without a project you have a total of 39 UP and with project this is 22 UP. Within the second municipality of a total of 53 without a project, there are 15, 5 and 33 for each stratum and with a project it is 7 for 1, 20 for the second and 13 within the third.

According to the competitiveness index for the municipality of Chan Cenote without a project it is presented for the first stratum of -32.13, in the second one of 0.47 and in the third one of 4.71, for With Project this index moves to -32.49, 0.51 and 3.49 according to the established strata and for the municipality of Tahdziu it is presented for without project of -10.14, 0.66 and 13.20 and with project this is -36.00, 0.71 and 8.35.

4. Conclusions

a) Small marginalized producers can... unleash innovation processes in their broadest sense to access better living conditions. This is a counterbalance to the arguments of those who claim that rural poverty is a structural problem.

b) It is important to identify the local potential to generate business taking into account the market. This is congruent with the theory of competitiveness.

c) If the human capacities of the actors are improved and the availability of knowledge is facilitated, it is possible to trigger innovation processes at a local scale and thus access higher levels of competitiveness.

d) In addition to field schools, more activities are required to strengthen the capacities of producers to achieve their empowerment and sustainability.

e) The results indicate that the proposed MGI contributes to increasing both the level of adoption of innovations and competitiveness at the local level. The analysis of social networks allows the identification of the main actors, in such a way that the traditional approach of transference works in other areas of work, but not in marginalized areas, where learning-doing is the best option for empowerment.

f) Finally, the proposed MGI gives priority to giving attention to the technical improvements for the production, consisting among others, to the increase of the added value of

the products of the field and to the management of markets for said products

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