

Model of Management for Innovation in Small Farmers of Latin America; A Successful Proposal

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Abstract: A model is proposed for the management of innovation in marginalized or depressed areas in three different countries, following the methodology of the Field Schools and taking advantage of the resources available in the region, work began with producers of areas with high marginalization and speakers of its original language, based on the fact that producers are subjects and not only beneficiaries, to say that, based on their decisions, they are the ones who cause the changes in their way of acting and producing, in such a way that in addition to the technological offer that allows access to better productive levels, as well as training in their own contexts, they can: have a third component more; Access to the market through the added value of its primary products and the culmination of the model: agribusiness or agribusiness creation. The work was carried out in Nicaragua, Paraguay following the model proposed and developed in Mexico taking advantage of existing agreements between these countries, the results indicate significant progress in Mexico, Nicaragua, in Paraguay part of the suggested model is still being implemented, thus It will be in the coming years when progress can be reported.

Keywords: Innovation, Paraguay, Nicaragua, Mexico, Transfer Models

1. Introduction

Developing countries have a common denominator, highly technical areas with a productive approach to the market, intermediate areas with a partial focus on the market and depressed or marginalized areas with a productive approach towards self-consumption. In this proposal, work was carried out in Mexico, Nicaragua and Paraguay, which have similarities in the productive segments and the type of producers, as well as the final destination for agricultural products. Within the framework of the bilateral agreements that the Government of Mexico has signed with these countries, the expertise of various professionals in the area of technology transfer and innovation management was taken

advantage of to bring the appropriate methodological tools and technologies to the producers of those for this, it is necessary to have a relevant and sufficient extension service that allows rapid innovation in the different farming systems that are in Latin America. In these countries the State has detached itself from these agents, once called a bridge between the producers and the technology generation system. The case of Mexico is well documented in these studies [1-3], where the state simply "liquidated" the extension service and thereby 25 thousand professionals. And only now is this aspect being reassessed, and not only in Mexico but in several Latin American countries, and although there are efforts to reactivate the extension agent, the truth is that policies framed under a neoliberal model consider the

reduction of public spending.

1.1. Paraguay

Although agriculture is the most important activity of the Paraguayan economy, the country has barely taken advantage of its agricultural potential, the Paraguayan population has a surplus in food production and with it the comparative advantage allows it to export to several neighboring countries and beyond. Paraguay's comparative advantage in agriculture is in products, such as beans *Phaseolus vulgaris*, cotton Plant *Gossypium barbadense hirsutum* (L.) Triana et, oilseeds Soya *Glicine max*, sugar cane *Saccharum officinarum* and tobacco *Nicotiana tabacum*, all which are expected to have strong demand in world markets and will therefore be a major determinant of economic growth over the next few years. The Government is committed to a policy of increasing the production of exportable agricultural goods and of expanding the cultivable area through the colonization of virgin lands. In the future, the Government should try to overcome some basic limitations: a) the limited availability of urbanized land; b) the low level of capitalization at the farm level; c) the lack of roads and marketing infrastructure; d) the insufficient institutional capacity for planning the sector and for the delivery of services; and e) the seasonal shortage of labor. Although the duration and permanence of extension programs is similar to several countries in Latin America, the difference is that in Paraguay there are still no specialized extension programs, that is, only for self-consumption or income or livestock farming. In this sense, there are a little more than 310 extension workers dependent on the Ministry of Agriculture who provide services to producers in self-consumption crops and income crops such as: Soja, Sesame *Sesamun indicum*, sugar cane; and now Chia *Salvia hispanica*, in addition to extensive livestock farming, with these extension agents it serves 184 municipalities of 250 that Paraguay has. Rural extension is a strategy of great importance to promote rural development processes. However, although there are numerous scientific works that address issues related to this issue, few have empirically studied rural extension, it is noted that their situation is fragile, since a very high percentage does not have permanent contracts (55, 4%) and does not have a university education (60.1%). Regarding the gender of the extensionists, it is highlighted that most of them are men (71.6% vs. 28.4%). [4-5].

1.2. Nicaragua

In the case of this Central American country, the situation is different, given that the International University of Agriculture and Livestock of Rivas in Nicaragua, (UNIAG) when realizing an introspection of its link with the rural sector realized that the activities to make arrive the knowledge to the different segments of the society were very little developed and only unidisciplinary works were realized like part of a program of practices with the students, without these were involved with the rural producers of that country.

As mentioned by Swanson [6, 7] by FAO, it was practically a focus of training and visits in its most minute expression. Taking advantage of the bilateral cooperation treaties, Mexican experts were invited to collaborate and put together a project that could be quicker to bring technologies to rural producers near and far from UNIAG. The rector of the International University of Agriculture and Livestock of Rivas Nicaragua, the rector of that house of studies, indicated that after 63 years of existence of the school, they required a change in the paradigm of his work of extension, that is to say; not to take the technology generated in another context or training and visits individually, but to involve current and potential users, for this they required successful models in other parts of the world that had similar social, productive and environmental characteristics.

2. Work Methodology

Visits were carried out in the countries of Nicaragua and Paraguay based on the experiences that were developed in Mexico through two work projects, one financed by the National Council of Science and Technology (CONACyT) and the other with resources from the National Institute of Science and Technology. Forestry, Agricultural and Livestock Research (INIFAP). It was participated with the International University of Agriculture and Livestock in Rivas Nicaragua, (UNIAG) and with the National University of Asunción in Paraguay, (UNA) in both cases was counted with the participation of peers, the purpose was to find alternative solutions to the technology transfer of Nicaragua's most representative crops such as milk production and the value added to this product and the production of banana *Musa paradisiaca* for the production of Chips, and of Sesame *Sesamun indicus* in Paraguay.

The methodology was simple based on the results that had been achieved in Mexico when implementing in areas of marginalization for the management of innovation, several actions were carried out in both countries, first to operationalize a new work approach based on six points as described by Morales-Guerra [8], and taken up by in a study [9], and the work approach is shown in Figure 1.

By itself the phases that compose it explain the work done, however, the first three phases determine the work to be done in phase IV, about the main concepts, processes and productive activities that you want to promote and / or promote its management for get to innovation. Based on this work strategy, the model to be followed for the management of innovation was proposed, this last concept which is widely described in these studies [10-11].

The model for innovation management proposed by the Government of Mexico through the National Institute of Forestry, Agriculture and Livestock Research (INIFAP), consists of three axes: 1). The technological offer based on environmental resources, flora and fauna existing in the region and the potential use of crops or plantations that the producers themselves determine, which has been called "portfolio of opportunities." In addition to the technologies

generated locally through research or empirical technologies 2). The capacity development of the producers involved, through the field schools, this methodology of work is widely described and developed in these studies [3, 8, 12-15] andragogic processes and supported by a multimedia strategy

consisting of field trips, Technological tours and support materials written, and 3). The market; based on giving added value to primary products and business plans. With this vision, the model was developed following the steps described in figure 1.

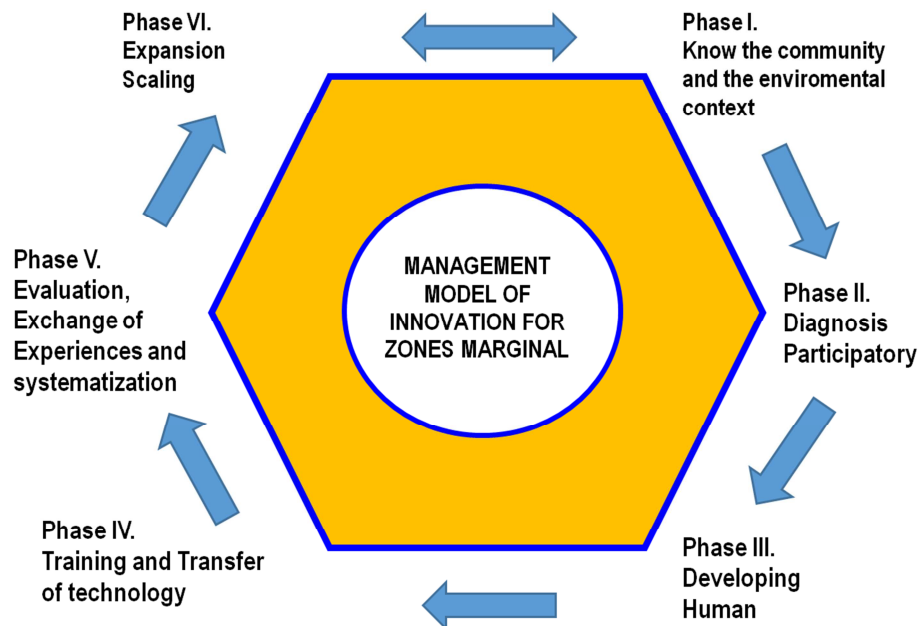


Figure 1. Work phases for the management of innovation in Mexico, Nicaragua and Paraguay. Source: [8] y [9].

It starts from the premise that you must work with organized groups, so it is suggested that these be less than 25 people, to be able to visit them in their respective farms, in such a way that the extensionist can provide quality and timely attention and advice, In this part we consider what is

stated in the methodology of the Field Schools widely described in a study [16], and of more institutionalized authors who modified and adapted to the circumstances said methodology, which in figure 2, is represented by the capacity development [3, 13, 15].

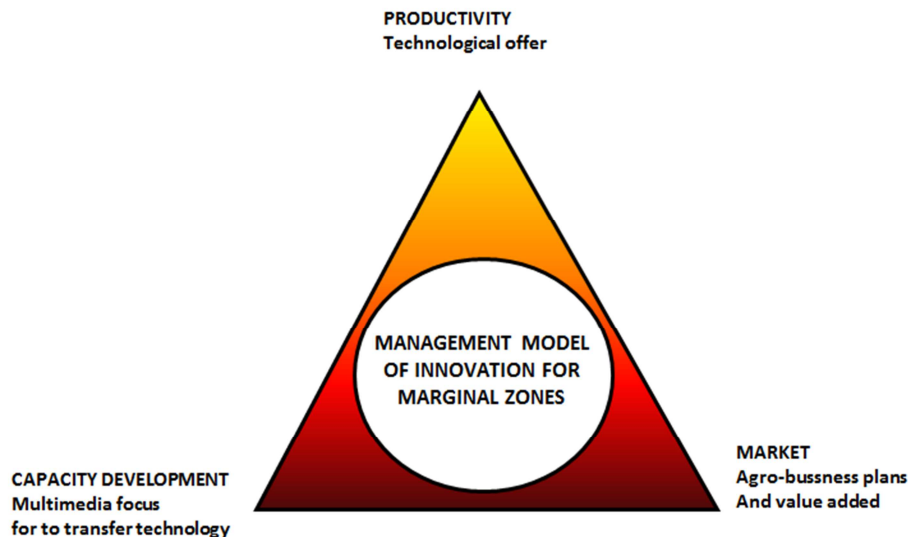


Figure 2. Model for the Management of Innovation generated in the innovation project for the economic and social development of the rural productive sector of the south-southeast region of Mexico. 2010-2012. Source: [17].

3. Results

3.1. Results in Nicaragua

Based on the stays made in the Nicaraguan country, the

following results could be verified:

1. Based on the training given in January 2012 (first stay), they already have a model called the Validation and Technology Transfer Model of the International School of Agriculture and Livestock (MOVATT-UNIAG). That is to

say, from the first training that was carried out, the personnel of the UNIAG, determined and created their own work model, to be able to serve the communities near the poles of development and around the University.

2. A project in operation whose methodological foundation is the MOVATT-UNIAG model with two groups of women

producers in the towns of "mono negro" and "Horconsitos" which transform the banana raw material into packed banana chips. in bags at grocery stores and points of sale. The work with these groups serves as the basis for the massification of the strategy with different groups.

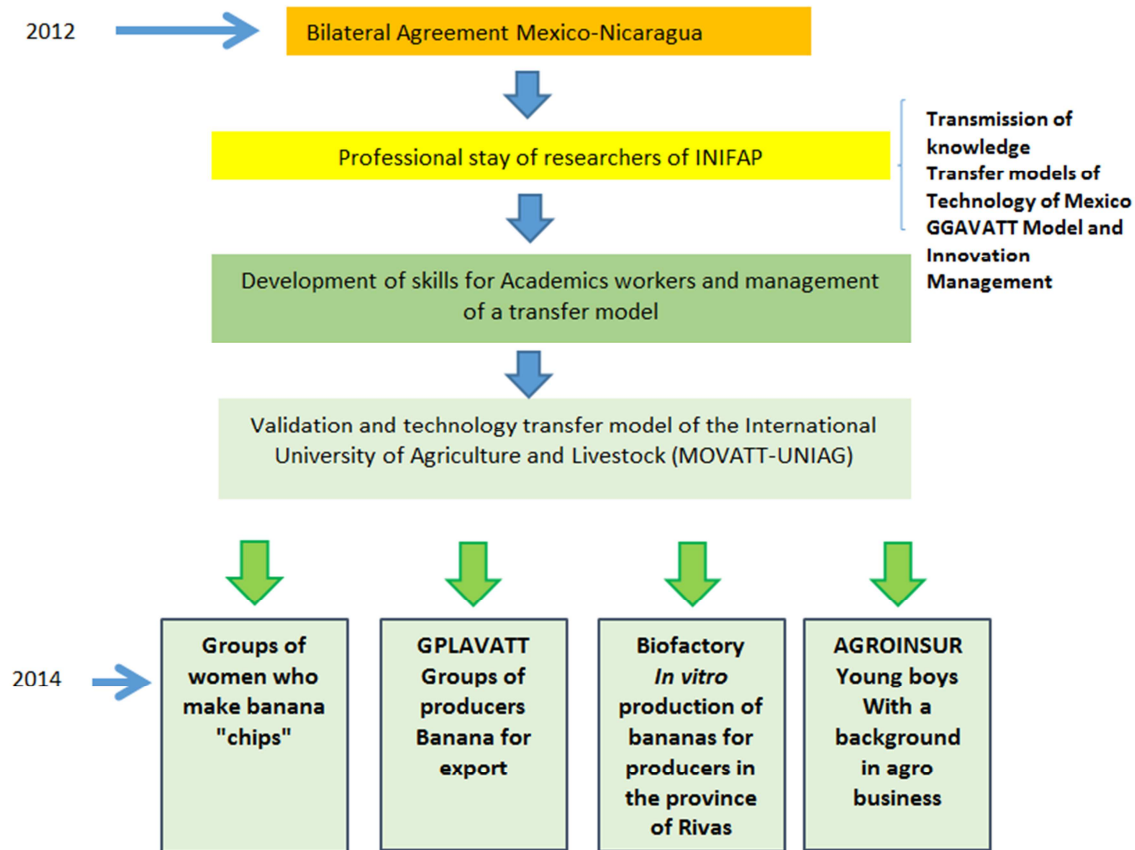


Figure 3. Results in Nicaragua from collaborative work with experts from Mexico, in two professional stays with the International Agricultural and Livestock University of Rivas, Nicaragua Source: own elaboration from the stays, 2016.

3. The transfer project called Banana producers group for validation and transfer of technology (GPLAVATT) that uses the MOVATT-UNIAG methodology.

4. Project to strengthen the capacities of UNIAG to meet the demand for agro-industrial technological innovations (FORCADIT) of the youth of the department of Rivas that will serve as a support to open the new Agroindustries career of UNIAG, the status of this project is approved and has resources from the European Union, Ministry of Industrial Development and Trade of Nicaragua (MIFIC) and UNIAG.

5. "Biofactory" project with a mix of resources from the Inter-American Development Bank (IDB), the Canadian International Development Agency (CIDA) and the Mennonite Association for economic development for the production of plantain vitroplant (MEDA) for the Association of Plataneros de Rivas (APLARI), Exporters of banana of the South (EXPROSUR) the UNEAG, and the NETWORK of Musaceas of Nicaragua (MUSANIC) for the development and scaling of this model, 10 technicians train 50 leading producers and these in turn to 10 other producers in their environment, which in the first year train 500 farmers

6. AGROINSUR Project, with shared resources, is the staggering of FORCADIT to the southeastern region of Nicaragua (Granada, Rivas, Carazo and Masaya), which serves as the basis for a new professional career in agro-industries at UNIAG. The scaling model is that the 40 students accepted in the new career are professionals who train 10 producers in the first year, which would have 400 new agribusinesses in the four provinces of south-east Nicaragua. The consultancy that was carried out in the Republic of Nicaragua, also consisted of the direct training to the academic staff of the areas of extension, research and projects, of a meeting with producers who are using vitro banana plants and with the methodology of MOVATT-UNIAG based on the GGAVATT model of Mexico and Innovation with competitiveness described extensively in these studies [2, 17-18], as well as monitoring the implementation of the methodology in projects that contribute to the food security of the Nicaraguan people.

3.2. Results in Paraguay

In the Mexico-Paraguay cooperation, the trilateral

agreements between these two countries, besides the Government of Japan, were taken advantage of through the financing of the Japan International Cooperation Agency (JICA), with the project: "PROJECT FOR STRENGTHENING AND CONSOLIDATION OF THE PRODUCTION AND USE OF IMPROVED SEEDS OF SESAMO FOR THE SMALL PRODUCERS IN PARAGUAY". We worked with several links of the Sesame production chain, given the interest that the Paraguayan Government has for the primary product for export to the Far East. All the provinces of Paraguay were visited where the ENA has subsidiaries, and in the province of San Pedro Apostol in the city of San Pedro del Parana, in the southeast of Paraguay, the trainers of new professionals have a novel transfer scheme, and this facilitates that the multiplying effect of any productive activity is faster, all the students involved are the children of producers, which makes them potential extension agents, and who can solve a daily problem in the "farm". It highlights the operation of this school that can serve as a scaling model of any technology and knowledge for its dissemination, given that if we assume an internal population of 50 students who must have their own plot with the knowledge acquired in the instruction and should advise to five more plots, then in a single crop cycle there is a multiplication of 300 producers in a region, this transfer model to manage the innovation coincides in its operation with the Mexican model called Producer Experimenter [19-20]; students have to check the establishment of their plot or garden and the advice of the other four plots of their relatives and / or neighbors to meet the requirement and be able to advance to the next level of semi-professional or professional training. If this is repeated semester with semester or year with year, the potential for transfer with this model is very high, and this contributes to the work of transfer of the Faculty of Agricultural Sciences (FCA) of the National University of Asuncion, which are complete since they have used a range of multimedia strategies, among which stand out: the interpersonal means to transfer technologies such as visits to agencies and key actors within the sesame production chain, as well as intergroup media such as demonstrations of results and classroom training for extension agents and producers, as well as the use of electronic and digital media such as videos, have also made successful inroads in the preparation of technical guides for productive processes, such as teaching materials with cartoons, and demonstration days in fields of UNA / FCA.

However, it is necessary to work more in the field of functional productive organizations, that is to say of producers linked to projects that allow to be the climbers or masters of the technologies, as well as a program of organizations of producers that support economically, validate and be carriers of new technologies, methods of planting and testing new varieties of sesame or another crop or plantation. A factor that could be a barrier to manage the innovation in sesame was found, and this is the mix of varieties that are exported, so it is highly recommended to initiate the steps for: that the FCA of the UNA and the extension system of the Paraguayan Government carry out

joint collaboration activities to carry out the extension in sesame, in which both regional managers, as extension workers in the workforce and those recently hired, and that the information generated in the UNA / FCA is used by extension agents and in turn they can make the multiplier effect before the producers of their respective region. In the same way that the negotiations begin so that the private initiative dedicates financing for the genetic improvement of sesame for the resistance to *Macrophomina* spp, and that it is connected with the validity of the current funding source. Also, purification of the varieties in experimental fields of the UNA / FCA is made with a view to having and / or rescuing the organoleptic characteristics of the Paraguayan variety "white broom", in addition to making tests through the agronomic management of the variety "white broom" to decrease the attack of *Macrophomina* spp. That the UNA / FCA design an innovation management model like the one suggested in this proposal, where the organization of the producers is privileged and they are accompanied by a promoter of the locality, so that when the project is finished the actor developer stay in the locality.

3.3. Results in Mexico

It is here where better results have been achieved with this model of innovation management, the projects developed from 2009 to 2013: the first "Innovation for the economic and social development of the rural productive sector in the southeast of Mexico", which a financing from the National Council of Science and Technology (CONACyT); The second project continued from the first: Generation of a model for the competitiveness of small farmers in extreme poverty based on agribusiness was developed in eight locations in four states in southeastern Mexico, with six research institutions, two state universities, and two organizations non-governmental organizations: Vision Mundial México, AC and the Rural Development Agency (ADR) COPRACTA; 23 researchers from different disciplines and 480 families that belong to four of the most important original ethnic groups: Mayas de Yucatán, Populucas de Veracruz, Zoques de Chiapas and Zapotecos de Oaxaca. The general objective was to increase technological innovation for competitive production in the agricultural and forestry production units in the south-east of Mexico. The results are very encouraging and allow us to see, on the one hand, that small producers can unleash a productive economic process that takes them out of their poverty, if and only if, in the medium and long term, they have a work strategy that lead to continue cultivating for their basic needs through *Zea Mays* corn and *Phaseolus vulgaris* beans, but also to promote a business model through a plantation crop such as: Hass *Persea americana* avocado, *Prunus persica* peach, flowers cultivated in spaces of protected agriculture, the honey produced by European bees, *Apis mellifera*; red tomato *Solanum lycopersicum* and the milpa system interspersed with fruit trees (MIAF).

The research products were transferred in each session of the field schools in the four states and eight localities, the

transfer mechanisms in addition to the talks, trainings, technological tours, publications and regional and national meetings where the producers participated, they have the Support documentation for each activity, which was given in each of the stages of the project. The actions developed to achieve innovation were first to ensure that the families of the producers had the food for the whole year, in such a way that they did not have to go out to offer their labor.

Table 1. Some results in protected agriculture, for the production of red tomatoes, in the states of Oaxaca, Chiapas and Veracruz, Mexico. INIFAP. $n = 360$.

Technological component	Adopted	In process
Chemical analysis of water and its interpretation	√√	
Disinfection of soil and substrate	√√	
Seedling production	√√	
Hybrids with higher yield potential	√√	
Topological arrangement and pruning	√√	
Nutritional program and irrigation	√√	
Tutorio	√√	√√
Integrated Management of P and E		√√
Hydroponics		√√
Good farming practices		√√
Commercialization		√√

Source: own elaboration based on field work, INIFAP 2016.

With this management, the following results were achieved, which was previously harvested without the intervention of the work team in two of the four states; 15kg m² of red tomato were produced and six applications of insecticides were made and by M². After work the producers and specialists, it was possible to reduce to three applications of insecticides and harvest 25kg M².

Table 2. Some results in the management of Milpa and MIAF, in four states of southeastern Mexico. INIFAP. $n = 480$.

Technological component	Adopted	In process
Soil pest control	√√	
Planting method	√√	
Fertilization opportunity	√√	
Form of fertilization	√√	
Weed control		√√
Selection and improvement of their seeds		√√
Commercial brands corn		√√
MIAF ($n = 240$)		√√

Source: own elaboration based on field work, INIFAP 2016.

Although the components that require less investment are more easily adopted, it is certain that that component that are more complicated also takes time in its adaptation to the productive systems, for this reason it is required that this model be accompanied by constant and / or permanent advice of the extensionist. Another aspect that means a step in the management of innovation, is that seven agribusinesses were created with their respective legal figure, which were paid in full with resources from the producers of each organization, all because they saw the convenience of doing Consolidated purchases and sell in the same way given that the main

problems identified are proper marketing, by the intermediarism that exists to reach the large distributors of the markets. On the other hand, in an organization in Chiapas a business plan was made where it was found that by producing its satisfiers such as corn and beans, in addition to the MIAF in this case with Hass avocado, in a projection of 13 years producers can achieve a B / C ratio of 4.89 in Mexican national currency, which is very good business. This means that in addition to continuing to produce their corn and beans in the diet of Mexicans, you can have the fruit, which means that it is the economic engine from the fourth year and can do business. These results are very encouraging as in Nicaragua, where organizations have realized the potential of continuing to produce their satisfactions as well as entering a new production model where added value and the creation of agribusinesses mean economic growth that helps to the families of the countries where the innovation management model has been promoted [21].

4. Conclusions

In all three countries, Paraguay, Nicaragua and Mexico, there is ample potential for producers or farmers in marginalized rural areas to have access to the market, provided they are encouraged to initiate technological innovation processes and, therefore, to access better living conditions. However, it is important to identify the local potential of its natural resources to generate business taking into account the market, since if the human capacities of rural actors are improved and the availability of knowledge is facilitated, it is possible to access higher levels of competitiveness. In addition to the Field Schools, - a fundamental pillar for "doing and learning" - more activities are required that strengthen the capacities of producers to achieve their empowerment and sustainability at their productive levels and in the management of innovation. In addition to the results presented in Mexico, a significant step in Nicaragua was that the International University of Agriculture and Livestock of Rivas, incorporated into its curricula the training of entrepreneurial professionals who must graduate with their agribusinesses, it was understood that to generate wealth in Marginalization areas need to add value to primary products, and this is part of the strengths of the model. The proposed model was well received among the participating groups in the three countries and an escalation is only expected between the agencies or ministries in each country where organized groups and professional service providers are included to replicate the innovation of the management model.

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