



Model Forests: Case Study in Calakmul, Campeche, Mexico

Genovevo Ramírez-Jaramillo¹, Alejandro Ayala-Sanchez²,
Mónica Guadalupe Lozano-Contreras^{3*}, Jorge H. Ramírez-Silva¹

¹Centro de Investigación Regional Sureste del Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Mérida, Yucatán, México

²Campo Experimental Zacatepec del Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Zacatepec, Morelos, México

³Campo Experimental Mochochá del Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Mochochá, Yucatán, México

Email: *lozano.monica@inifap.gob.mx

How to cite this paper: Ramírez-Jaramillo, G., Ayala-Sanchez, A., Lozano-Contreras, M.G. and Ramírez-Silva, J.H. (2023) Model Forests: Case Study in Calakmul, Campeche, Mexico. *Open Access Library Journal*, 10: e10899.

<https://doi.org/10.4236/oalib.1110899>

Received: October 20, 2023

Accepted: November 25, 2023

Published: November 28, 2023

Copyright © 2023 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

In August 1990, the governments of Canada and Mexico signed a cooperation agreement for the establishment of the Calakmul Model Forest (CMF). The basic rationale is that the forest can be managed by achieving both economic and ecological objectives. Thus, in 1994, the Regional Council for Pastoral and Agroforestry Systems of Xpujil Campeche (RAFSX) and the CMF joined efforts in order to diversify the production of lands opened to cultivation, improving conservation of forest in an ecological way and rescuing archaeological mayan sites. In this research, the practical knowledge of local peasants for planning the sustainable management of natural resources were studied and analyzed keeping in mind a broad intersectoral vision. The work includes an inter-institutional framework such as peasant organization and participation, available and required technology, available and needed resources, evaluation and monitoring of social impact. In the process of planning and execution the program was presented to 72 ejidos (communal farms), starting with 22% active ejidos and ending with 71% after 6 years after launching the program.

Subject Areas

Agricultural Engineering

Keywords

Sustainable Development, Model Forest, Social Participation

1. Introduction

Model forests are born from the real participation and decision-making of people in the management and use of forest and land resources [1] [2] [3]. Since the establishment of the International Model Forest Network (IMFN) in 1992, many countries have implemented model forests, and the concept is considered a relevant one at local, national and international policy levels [4]. The model was promoted by the Government of Canada through the Ministry of Natural Resources and defined a Model Forest as a large-scale landscape that encompasses many different land uses based on sustainability.

Every model forest should be characterized by six attributes: 1) An inclusive and dynamic partnership with the stakeholders. 2) A commitment for sustainable forest management. 3) A landscape large enough to be representative of the various forest uses and values. 4) A representative, participatory, transparent and responsible government structure. 5) A program of activities that reflects the needs and values of the society and finally 6) A commitment to the exchange of knowledge at national to the international level [5].

In August 1990, Mexico requested its membership to be part of the International Model Forest Network (IMFN) and proposed the Calakmul Model Forest (CMF) (decreed as a Reserve on May 23, 1989). The reserve is actually the second largest area of tropical forests in America with a total of 723 thousand hectares [6], an ideal region for a model forest.

It is in this region that, starting in 1994, the civil association named: Regional Agricultural Forestry and Services of Xpujil (RAFSX) and the Calakmul Model Forest (CMF) joined efforts for a common objective of diversifying and improving the use and production of lands opened to cultivation considering an ecological and forestry management of the area.

The objectives of this work were: 1) study and analyze the practical aspects of peasant participation for planning the sustainable management of natural resources through a broad intersectoral vision, and 2) generate information that shows the benefits of the observed experiences and contributes to the improvement of the activities carried out in the projects by the communities in the Calakmul Model Forest.

2. Materials and Methods

2.1. Materials

Geographic location. The work was carried out in the municipality of Calakmul, and specifically in the buffer zone of the Calakmul Biosphere Reserve located in the state of Campeche Mexico between coordinates 17°50'11" and 19°10'32" of North Latitude and 89°19'05' and 90°09'08" of West Longitude. Bordered to the south by the Republic of Guatemala, to the west by the Calakmul Biosphere Reserve and to the east by the state of Quintana Roo Mexico (**Figure 1**). The area is considered as the second largest area of tropical forests in America, only surpassed by the Amazon rainforest.

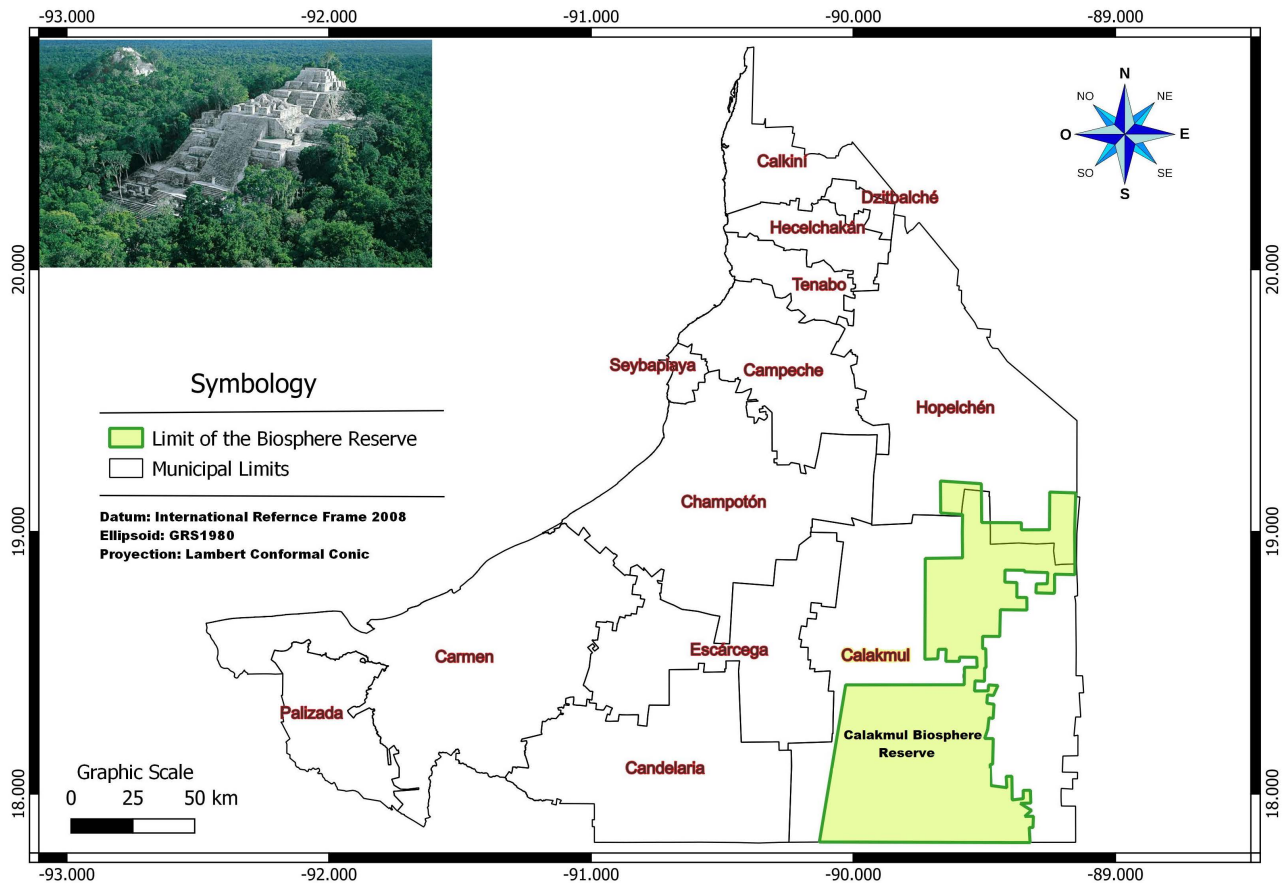


Figure 1. Territorial limit of the Calakmul biosphere reserve.

As part of the investigation, documents, work plans and reports related to the Model Forest Program in Calakmul, as well as statistical information and maps of the region.

2.2. Methods

Research Strategy. Due to the time proposed to carry out this study, it was decided to divide the research into two parts: one documentary and one field.

In the documentary, bibliographic files were made on plans, documents and the Calakmul Model Forest program.

For the field work, structured interviews were designed and directed to key informants as follows: four to technicians responsible for the projects of each of the subprograms; four to key informants from the ejidos selected for their active participation in various projects and finally four to the directors of the Regional Council for Pastoral and Agroforestry Systems of X'pujil Campeche. The questions were aimed at capturing information about the planning process for the sustainable management of natural resources, organization and peasant participation, technology, land use and available resources, mainly [7] [8] [9].

According to the data obtained in the field work, a descriptive analysis of the study was made with the purpose of know the intensity of peasants' participation

in sustainable management tasks of their own natural resources.

3. Results

3.1. Organization and Peasant Participation

The work strategy of planning is mainly based on peasant organization and participation. Practical planning begins with the participation of the total farmers from the attached communities. This is done in the General Assembly where, through a consensual and democratic process, the most urgent tasks are well defined and prioritized.

At the General Assembly of Delegates, the communities' requests are presented out loud and are received by signature and seal of the RAFSX, who gives a written response to the Delegate according to the nature of the request. The RAFSX/CMF analyzes and determines the response for each of the requests.

Once the needs are analysed and approved the RAFSX/CMF indicates to the responsible technician, together with the council directors, to execute the field actions per each approved project (Figure 2).

Peasant participation in BMC improved over time, going from 17 ejidos in 1990 to 51 ejidos (71%) in 1996 (Figure 3); The land allocations and the number of ejidatarios per ejido are variable.

Of the total participating ejidos, 36 have established permanent communal forest areas, in order to manage rationally the harvest of timber and non-timber, fauna and archaeological resources. However, more than 66% (24) have permanent forest areas of less than 1000 hectares, 25% (9) between 1001 and 10,000 hectares and only 9% (3) have areas greater than 10,000 hectares that can be subject to a sustainable management.

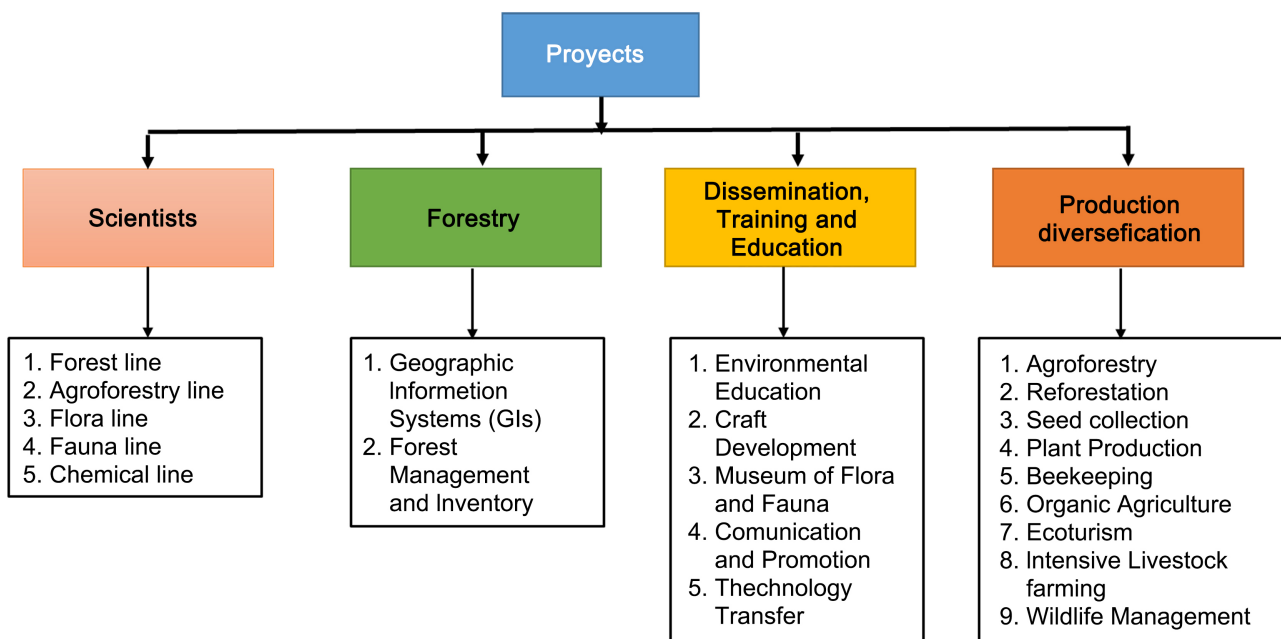


Figure 2. Projects developed in the Calakmul model forest.

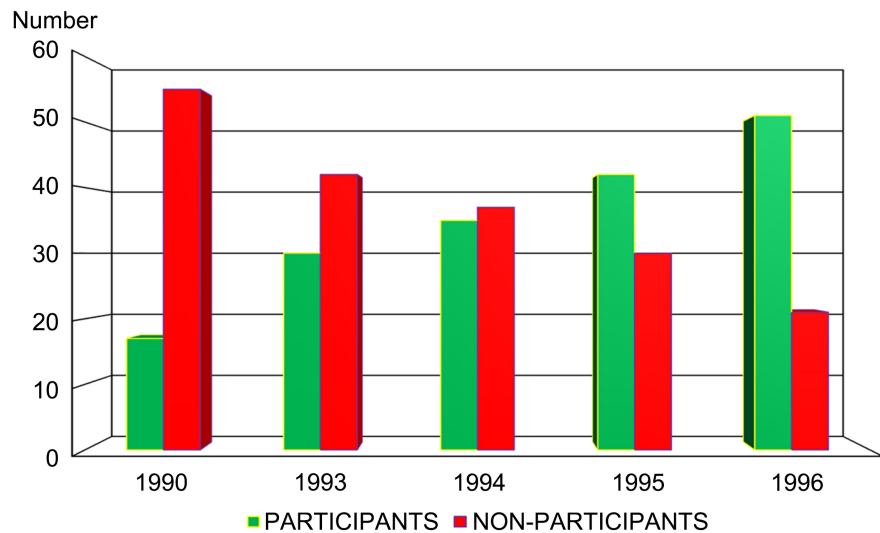


Figure 3. Peasant participation in the Calakmul model forest (1990 to 1996).

3.2. Institutional Collaboration

An important component to support planning for the sustainable management of natural resources has been the active participation of other institutions, with the same interest as the RAFSX/CMF. These institutions contribute with funds and/or technical support for several projects (Table 1).

3.3. Management and Use of Natural Resources

The peasant communities of Mexico are characterized by the lack of economic resources and infrastructure for their healthy development; in addition, their natural resources are at constant risk of degradation. The jungles of Calakmul have been used for Shifting Cultivation (Slash and Burn Agriculture) since the times of the Mayan civilization. In 1900 onwards began to be intensively exploited for “dye stick”, the latex of chewing gum and the selective extraction of cedar and mahogany [10].

The area of influence of the CMF is concentrated in 380 thousand hectares; in 1993, only 36% was covered by high, medium and low forests. 64% of the surface was intervened by man, dedicating 80 thousand hectares to agricultural activities, populated areas and roads, while 162 thousand were covered with secondary vegetation, with ages between 1 and 20 years, a product of the Slash and Burn and accidental fires [11]. The predominant soils in the region are very thin, deficient in phosphorus, stony and with low moisture retention like the stony *Lep-tosols* and other soils such as the flooded Vertisols, difficult to manage.

Surface water sources are non-existent, underground water sources are difficult to use and are of poor quality. Rainfall is erratic, with a dry period of six months (November to April). Families have between 30 to 50 hectares of land to carry out their productive activities. These may include areas potentially for mechanization, diversified fruit orchards, reforested surfaces, grazing areas and areas for migratory agriculture, as well as jungle.

Table 1. Participating institutions in the Calakmul model forest, campeche.

Institution	Collaboretion
Autonomous University of Campeche Mexico	Collaborate in Geographic Information Systems (GIS), beekeeping and environmental education projects. Responsible for the biodiversity inventory. Offers training to people in the region.
Mexican Federal Government	It contributes two million, 265 thousand pesos a year for the development of projects of the Production Diversification Sub-programs and the Dissemination, Training and Environmental Education Sub-programs.
National Indigenous Institute of Mexico	It provides 330 thousand pesos a year in support of the beekeeping project of the Production Diversification Sub-program.
Governmente of Canada	It provides two million, 703 thousand pesos a year to support a Diversification Sub-programs and the total administrative expenses of the RAFSX/CMF binomial.
National Commission for the Knowledge and Use of Biodiversity	Partner in aerial photography. In coordination with the UNIVERSITY OF CAMPECHE. It develops biological inventories of the Reserve.
World Wildlife Fund (WWF)	Partner in forest inventories, remote sensors and geographic information technology. Contributes a total of 385 thousand pesos.
PRONATURA Yucatan Peninsula	Strongly involved in beekeeping and organic agriculture projects, it also supports water collection and management projects, solar development and environmental education. It contributes a total of 113 thousand pesos.
Queen's University	Involved in research on migratory birds. Involvement of a graduate student with the community for the training of field assistants. Contributes 27.5 thousand pesos.
University of Ottawa, and the Mohawk Council of Akwesasne	These two partners have started a project on Traditional Knowledge Systems.
International Centre for Research in Agroforestry (ICRAF)	Partner in participatory research with corn cultivation farmers, addressing aspects of environmental characterization and diagnosis of production systems, selection and evaluation of multiple-use trees, and design and evaluation of agroforestry systems. Contributes a total of 84 thousand pesos.

Continued

Stanford University	It supports the training of technicians for the management of GIS equipment and is a partner for research on the botanical study of native species and the study of bat communities. Contributes a total of 65.5 thousand pesos.
National Autonomous University of Mexico	Collaborator in research on inventory of nitrogen-fixing tree plants.
Xpujil Beekeeping Committee	Partner in the training of new beekeepers, improving the quality of equipment, increasing colonies, collecting honey, planting honey plants and training producers.

In the backyards, of around thousand square meters, are cultivated fruit and timber trees, vegetables and medicinal plants. Some animals like pigs and chickens are raised. In addition, many communities have permanent forest areas for communal use for timber production, fauna or ecotourism. In the region, there were 72 communities that support 16 thousand people; half of these are children under 15 years of age and 80% of economically active individuals working in the agricultural and forestry sector. On the other hand, there is a strong exchange of labor between families in the community that may or may not be paid.

More than two thousand farmers from 51 communities participate in the 35 training projects developed by the RAFSX/CMF. There is a staff of 32 people in the RAFSX/CMF including managers and technicians.

The infrastructure for field production is deficient. The CMF area is located more than 100 km from the nearest cities so marketing of products is a big problem. Roads are very rustic so vehicular traffic is complicated. There are no telephone or mail services within the area and there are a small number of vehicles that offer transportation services [12]. Although there are several government institutions providing very low economic subsidies, it is very limited to achieve sustainable development.

Most of the activities carried out by farmers are for self-consumption. The economic resources that peasant families obtain, as a product of their agricultural and forestry activities, are temporary and scarce. This is the main reason that the RAFSX/CMF has been allocating a high percentage of its economic resources to: the establishment of agro forestry plots, reforestation and organic agriculture, development of beekeeping, intensive livestock farming, ecotourism, craft projects and support of spicy cultivation.

4. Discussion

Model forests were designed to occupy an intermediate place between policy and practice but focused on sustainable development.

According to García Azuero, 2003 [13] to implement and consolidate the

CMF, the commitment of the management group is essential and its linkage with different sectors is highly required. In the municipality of Calakmul, during 1990 to 1996, 17 participating ejidos began in the program and ended with 51 ejidos, out of the total 72 ejidos forming the municipality (**Figure 3**).

It is important to emphasize that the Calakmul Biosphere Reserve presents one of the best-preserved surfaces in the Yucatan Peninsula [14]. In addition, 90% of its extension (21,000 km²) corresponds to undisturbed vegetation. That is why this reserve is considered the most important in the Mexican Republic because with the largest extension of tropical forests according to Sandler *et al.* (1999) and García-Gíl *et al.*, (1997) [15] [16].

Due to the foregoing, more than 66% of the participating ejidos have permanent forest areas of less than 1000 hectares, 25% between 1001 and 10,000 hectares and only 9% have areas greater than 10,000 hectares.

In the understanding that the main objectives of the Calakmul Model Forest Program was to ensure a better standar of living of the ejidos, the initial principle toward stainability is a basic task [17].

Model Forests generally showed their effectiveness in temperate zones, since they were generated in the Forests of Canada and were later transferred to other countries such as Mexico. The state of Chihuahua in Mexico was the first one implementing the model in a temperate zone and later on in Calakmul, Campeche, a region located in the tropical Mexico. Some adjustments were made to facilitate the adoption of productive projects and technological innovations.

5. Conclusions

1) In the area of influence of the Calakmul Model Forest there are several institutions that support the community organization for planning the sustainable use of natural resources. However, there are other institutions counteracting sustainability models by incentivizing deforestation.

2) The communities or ejidos have an internal structure that allows them to interact and manage support due to their great participation.

3) The interviewers manifested failures in the technical aspect due to the lack of appropriate technologies and technical extension programs.

4) The resources available in the region are scarce and a large proportion are degraded.

5) In the region, the population is characterized by ethnic diversity, a high degree of illiteracy and high marginalization.

Acknowledgements

We thank the National Institute of Forestry, Agricultural and Livestock Research (INIFAP) of MEXICO and the International Development Research Center (IDRC) for supporting this work as part of the: Network for Monitoring the Impacts of Silvicultural Practices in Commercial Forest Plantations for the States of Veracruz, Campeche, Tabasco and Chiapas Mexico.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Johnson, E.A., Miyanishi, K. and Weir, J.M.H. (1998) Wildfires in the Western Canadian Boreal Forest: Landscape Patterns and Ecosystem Management. *Journal of Vegetation Science*, **9**, 603-610. <https://doi.org/10.2307/3237276>
- [2] Welsh, D. (1998) Country Report, Canada. In International Workshop, Model Forests for Field-Level Application of Sustainable Forest Management (1998, Tokyo, Japan). Record of Workshop Discussions. Tokyo, RIBM, Forestry Agency, 73-83.
- [3] Casaza, A.J. (2001) Los bosques modelo, filosofía y acciones. Santiago de Chile, Banco Mundial en América Latina y el Caribe, 29-34.
- [4] International Model Forest Network (2008) Model Forest Development Guide. International Model Forest Network Secretariat, Ottawa, Canada, 34 p.
- [5] Instituto Universitario de Investigación (2023) Bosques Modelo. Consultado 11. <http://sostenible.palencia.uva.es/content/bosques-modelo>
- [6] Secretaría de Medio Ambiente y Recursos Naturales (2018) Programa de manejo de la reserva de la biosfera Calakmul. <https://www.gob.mx/semarnat/articulos/reserva-de-la-biosfera-calakmul-157277?idiom=es>
- [7] Cebreiro, B. and Fernández, M.C. (2003) Estudio de casos. In: Salvador, F., Rodríguez, J.L. and Bolívar, A. Eds., *Diccionario enciclopédico de didáctica*, Aljibe, Málaga, 34-46.
- [8] Rojas Soriano, R. (2002) Investigación Social teoría y praxis. 11th Edición, Editorial Plaza y Valdés, México, 21-49.
- [9] Martínez, C. and Piedad, C. (2006) El método de Estudio de caso: Estrategia metodológica de investigación científica. *Pensamiento & Gestión*, **20**, 165-193. <https://www.redalyc.org/pdf/646/64602005.pdf>
- [10] Richardson, L. (1995) Análisis de agroecosistemas en Narciso Mendoza, Campeche, México. Master's Thesis, University Colegio de Postgraduados Institución de Enseñanza e Investigación en Ciencias Agrícolas, Montecillos, Mexico, 147 p.
- [11] Bosque Modelo (1994) "Bosque Modelo para Calakmul, Ecología Productiva", propuesta. Ministry of Supply and Services, Quebec.
- [12] Simmons, H. (1996) How Can We Develop the Program of Environmental Education in the Calakmul Model Forest. A Report. CRASX/BMC, Campeche, México, 9 p.
- [13] García Azuero, A.F., Campos, J.J. and Villalobos, R. (2003) Identificación y selección de áreas piloto y actores sociales en el Bosque Modelo Reventazón, Costa Rica. *Recursos Naturales y Ambiente*, **46-47**, 109-116. <https://repositorio.catie.ac.cr/handle/11554/10068>
- [14] Gallegos, J.R.D., Acosta, O.C. and Gil, G.G. (2002) Distribución espacial y estructura arbórea de la selva baja subperennifolia en un ejido de la Reserva de la Biosfera Calakmul, Campeche, México. *Ecosistemas y Recursos Agropecuarios*, **18**, 11-28. <https://era.ujat.mx/index.php/rera/article/view/235>
- [15] Sandler, B., Weiss, S., Fay, J., Martinez, E. and Galindo-Leal, C. (1998) Analisis de la deforestacion y de los tipos de vegetacion de la Reserva de la Biosfera de Calakmul, utilizando sensores remotos. Reporte final inédito. World Wildlife Fund-México,

México, 38 p.

- [16] García-Gil, G. and Pat-Fernández, J.M. (2000) Apropriación del espacio y colonización en la Reserva de la Biosfera Calakmul, Campeche, México. *Revista Mexicana del Caribe*, **10**, 212-231.
<http://www.redalyc.org/articulo.oa?id=12801006>
- [17] RIBM. sf.a. La red internacional de bosques modelo (1999) Guía para el desarrollo del bosque modelo. RIBM, Ottawa.
https://ribm.net/wp-content/uploads/2019/01/IMFN_ImpactNotes_09_Spa.pdf