

The Social Contribution of the Adoption of the Systems Intensive Silvopastoral in Tierra Caliente Michoacan, Mexico

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Abstract—The production model intensive silvopastoral system must be evaluated from three perspectives of sustainable development: economic, social and environmental. The evaluation has been the most important economic aspect; while the environmental part has only been evaluated as justification to funding research and the social aspect was downplayed. The objective of this study was to know the social contribution through adoption intensive silvopastoral systems in Tierra Caliente, Michoacán. The information was provided by farmers through interviews. The data were diffusion source of the intensive silvopastoral system, year of diffusion the production model, production objective of intensive silvopastoral system, benefits perceived by the adoption of the production model and factors that influenced in implementing the intensive silvopastoral system. Since 2006, NGO have played an important role in the dissemination, implementation and adoption of these productions model. Intensive silvopastoral systems have been implemented with livestock objectives; farmers said they have received benefits by the adoption; the most influential factor in the implementation of the intensive silvopastoral system was the confidence generated from the experiences and previous results in other farmers. The adoption of intensive silvopastoral systems, increase the productivity and profitability of production units in addition to promoting environmental sustainability and social welfare.

Index Terms—SSPI, livestock socioeconomics, social welfare, diversification in livestock

I. INTRODUCTION

The technologies adoption is a process of decision making itself, which begins with the first knowledge and ends when the individual incorporates the innovation in question, in order to raise the productivity and the economic profitability of its system of production [1]. This possibility constitutes a challenge, especially because most of the farmers do not know the technological alternatives that exist to implement them in their production units [2].

The current tendencies of the agricultural production do emphasis on the models that have a harmonic development between the social, environmental and economic aspects [3].

In the tropical regions of México predominate the traditional systems of double purpose animal production; these are characterized for being principally of extensive pasture with monoculture grasses; which produce low yields of forage and of deficient quality (suppressed fiber high place, low nitrogen levels and soluble carbohydrates, low digestibility and mineral imbalances) especially in the epoch of low water season, which affects the productive performance of the cattle; being pronounced seasonal nature in the production and availability of the pastures the biggest limiting for this type of systems [4].

In the search of strategies that contribute to revert the previous problems has designed a production model called Intensive Silvopastoral System (SSPI, for its acronym in Spanish), this one has been established and adopted principally in warm areas how Tierra Caliente Michoacán, México. It is considered to be a very promissory alternative in the animal production, since it represents multiple productive, environmental, social and economic benefits.

One admits that the central element in the process of decision making that the agricultural productive processes affect it is constituted by the farmer, its family and its socioeconomic environment. The production and the productivity are a consequence of the decisions that involve the allocation of such productive resources like ground and labor to different segments of the process of production. This implies that the phenomenon is not exclusively biological, but rather, the biological thing is subject to the socioeconomic elements [5].

The SSPI are a form of the agroforestry systems that are characterized by the presence of several strata where the cultivation gets together agro-ecological of forage shrubs in high thickness (bigger than 10 000/hectare) for the direct browse of the cattle; using chosen tropical grasslands associated with trees, under pasture models rotational intensively with electrical fence and offer water of drinking trough [6]. The social objective together with the human component they are not pointed out that straight in the definitions, nevertheless, it can be established that the human being is the key of the development of the system, and the positive, ecological and economic interactions will have to result in the securing of a social end [7].

Manuscript received September 25, 2015; revised January 11, 2016.

In Tierra Caliente Michoacán, México this model of production has the association of *Leucaena leucocephala* cv. Cunningham, grass star (*Cynodon plectostachyus*), grass Tanzania (*Panicum maximum* cv. Tanzania) and some types of native and fruit-bearing trees.

The SSPI represent a series of benefits of different ambit, inside them they can be cited: major production of forage, major animal load, major production of milk and meat, major carbon capture, decrease of the emission of methane, improve the quality of the soil, help to maintain the quantity and water quality; they contribute to the maintenance and arranging of the biological diversity, decrease the costs for feeding and external inputs, the profitability increases and it generate employments [8], [9].

The high capital investment to the beginning, major permanent labor and technical assistance are considered to be the biggest limiting for its adoption, in addition to irrigation systems for its ideal yield and exploitation.

In Tierra Caliente, Michoacán, México has realized a series of economic, productive and environmental studies in order to evaluate the SSPI. The studies of environmental character have been realized only how investigation object, and not with a justification sustainable, since the farmers implement the SSPI with productive ends, not with contribution ends to the environment.

The general functioning of a system of production must be evaluated bearing in mind its contribution combined to the economic prosperity, the quality of the environment and the social welfare, that is why the study of the SSPI must be from three perspectives of the sustainable development: economic, social and environmental [10].

From the social perspective the adoption of the SSPI has not been studied and has justified itself in economic studies. For which the objective of the present study was to know the social contribution for the adoption of the SSPI in Tierra Caliente, Michoacán, México.

II. MATERIAL AND METHODS

The present study was realized in the municipalities of Apatzingan and Tepalcatepec, Michoacán, México. Apatzingan, it is located between the parallels 18°42' and 19°14' of north latitude; the meridians 102°11' and 102°39' of longitude west; to an altitude that ranges between 200 and 2 000m. Its climate is tropical and dry with rains in summer. It has a 900.0 millimeters annual rain precipitation and temperatures that range between 18 and 30 degrees centigrade. Tepalcatepec, is located west of the state of Michoacán, México, in the coordinates 19°10'19" north latitude and 102°55'25" west longitude at an altitude of 320 meters above sea level. Its climate is tropical and a dry steppe with rains in summer. It has 822.0 millimeters annual rain precipitation, and temperatures that range between 12.0 and 44.5 degrees centigrade [11].

For the information, was designed a structured survey which was applied by means of a guided sampling across an interview, to ten farmers who adopted the SSPI.

The aspects tackled in the survey on the SSPI were: precedents of the system, area implemented (initial and current), productive activity before implementing the system, cattle objective (initial and current), factors that influenced the decision to implement it, requests of the SSPI, benefits perceived by the adoption and diversification with the SSPI.

TABLE I. WAY OF DIFFUSION, YEAR OF ADOPTION AND AREAS ESTABLISHED OF THE INTENSIVE SILVOPASTORAL SYSTEM (SSPI), IN TIERRA CALIENTE MICHOACÁN, MÉXICO

Municipality	Apatzingan Michoacán			Tepalcatepec Michoacán						
	1	2	3	4	5	6	7	8	9	10
Production Unit										
Year and Way of Diffusion	2009 NGO	2005 NGO	2008 NGO	2008 Farmer	2008 NGO	2006 Farmer	2008 Farmer	2007 NGO	2007 NGO	2008 NGO
Year of adoption	2010	2006	2009	2008	2009	2007	2008	2007	2007	2008
EIA (Hectare).	40	2	20	20	20	5	15	17	9	7
ECA (Hectare).	80	20	42	20	20	100	15	28	30	38

EIA (Established initial area), ECA (Established current area); NGO (Fundación Produce Michoacán A.C.).

III. RESULTS AND DISCUSSION

A. Adoption of the Intensive Silvopastoral System (SSPI)

In this study one found that seven of ten farmers informed about the existence of the SSPI through of Fundación Produce Michoacán A.C. (non-governmental organization-NGO) and the rest for other farmers (Table I). [6] Points out that the SSPI are promoted by alliances between governments, farmers organizations and institutions of cooperation; therefore it is possible to corroborate the essential role that the associations have in the diffusion of new technologies, as it was observed in the region of Tierra Caliente, Michoacán, México.

The SSPI have been implemented shortly after being informed to him of the existence of the SSPI (Table I). The pioneers began to implement it in 2006, while they were implemented the biggest number in the year 2007 and 2008 and the most recent of the interrogated farmers was in 2010 (Table I). There was a possible relation between the area and date implemented, since the first production units in the year 2006 and 2007 established a 8.25 hectares small area in average, while those who realized it later, established major 20.4 hectares areas in average [12] mention that the diffusion of a technology in a sector continues a process in which fundamentally exist two groups: the first, the initial adoptive parents (pioneers

or innovators), who are those who run the risks inherent in the new technologies; and the second composed by the rest of the companies that adopt the technology when it has already demonstrated its potentialities, likewise these authors indicate: so that the second group adopts the technology it is necessary that in the sector there is transparency, high degree of information in circulation, of such form that there are known the experiences and results of the initial adoptive parents. This explains the observed in Tierra Caliente Michoacán, México, since the successful experience of the pioneers generated enough confidence for the adoption of the SSPI and even with a major extension.

At present seven of ten farmers have increased the area with SSPI (Table I), while the rest has not had chance of growing for lack of area availability. The [13] points out

that the maximization of the benefit and satisfactions are determining factors for the contribution of an adoption. Therefore this increase of the area with SSPI, it is explained by the rapid answer perceived by the farmers on the benefits and satisfaction that they had from the adoption of the SSPI; in addition to the rapid diffusion of obtained results.

B. Objective of the Farmers to Adopt the Intensive Silvopastoral System (SSPI)

Ten farmers adopted the SSPI with cattle ends (60% milk production, 20% meat production, 10% double purpose and 10% rearing foot). A relation was between the productive activity that they realized and the objective of production of the system (Table II).

TABLE II. OBJECTIVE OF PRODUCTION OF THE FARMERS WHO ADOPTED THE INTENSIVE SILVOPASTORAL SYSTEM (SSPI) IN TIERRA CALIENTE MICHOACÁN, MÉXICO

Municipality	Apatzingan Michoacán			Tepalcatepec Michoacán						
Production Unit	1	2	3	4	5	6	7	8	9	10
Previous productive activity	Agriculture	Agriculture and cattle	Agriculture	Agriculture and cattle	Cattle	Cattle	Cattle	Cattle	Agriculture and cattle	Trated
Initial objective	Meat	Double purpose	Meat	Milk	Milk	Milk	Milk	Milk	Milk	Rearing foot
Current objective	Meat	Double purpose	Double purpose	Milk	Milk	Milk	Milk	Milk	Milk	Milk

Most of the production units have remained with the same objective livestock and only two have modified it to production of milk and to double purpose since the daily sale of milk allows to the farmers the advantage of obtaining constant income and hence settling some expenses of the system.

C. Factors That Influenced the Decision the Farmer to Implement the Intensive Silvopastoral System (SSPI)

The factor that more influenced the decision of the farmers to implement the system was the confidence after knowing and observing the results and benefits that the SSPI offers; in addition the recommendation farmer to farmer.

The farmers expressed that it departs from the inputs for the establishment of the SSPI they were subsidized by an NGO; nevertheless they made sure that this was not a decisive factor for the implementation of the SSPI. [14], points out that sometimes the incentive can make less probable that a practice is supported in the future, because the farmer can associate the practice with the incentives acquisition and not understand the value that it has in itself. It was possible to observe that the results and benefits are so clear and tangible that the implementation of the SSPI did not depend on an incentive, on the contrary the farmers realized an investment.

D. Requests of the Intensive Silvopastoral System (SSPI)

The SSPI for its establishment needs high investment of capital, technical consultancy and major wage-earning labor; the realized investment is begun to recover in a space from six until nine months after established the

system when the first use of the same one is realized, the technical consultancy many of the times is provided by the NGO that promote the implementation of the SSPI and sometimes it is given by local farmers with experience and knowledge on the establishment and handling of these systems, the labor cost is paid by the income originated from the sale of products of the SSPI (milk and meat) and they contribute the generation of work places like a social benefit in the locality. The production units adoptive parents of the SSPI exercise in an indirect way the social responsibility since these contribute to the preservation of the environment and to the production of innocuous and quality food for human consumption, all this affects the social welfare.

E. Benefits Perceived to Farmer by the Adoption of the Intensive Silvopastoral System (SSPI)

All the farmers expressed to observe an increase in the production of milk and meat, major animal load, reduction of the costs for feeding of the cattle like main benefits. All this was mentioned by [6], in addition to the reduction of the costs of production, with an increase in the animal load (up to four times top opposite to the extensive pasture) and consequently the production for hectare for year.

Other of the factors that they contribute to the reduction of the costs, is for the least use of agricultural machinery, since only it is needed tractor and few agricultural implements for the only time in the implementation of the SSPI. This represents a big advantage for the farmers since they reduce the costs of

operation and of maintenance of the agricultural machinery that generally are very high.

Finally the farmers mentioned that the profitability is other of the benefits perceived on having preserved the SSPI; this coincides with [15], who in a study to evaluate the profitability of the SSPI thought that this one is major compared with extensive production systems by means of monocultures in the region.

F. Diversification with the Intensive Silvopastoral System (SSPI)

The adoption of the SSPI allows to the farmers to obtain additional income for the sale of fruit and seed of

Leucaena, therefore the SSPI are diversified systems that offer stability to the economy of the farmer; what represents an advantage expressed in the calmness of the farmer because they can aspire to new satisfactions and generate possible work places for these activities; also the SSPI allows to devote himself to other works. It was found that only two farmers are assigned full time to the management system and serve the remaining eight farmers partially (Table III).

[16] Indicate that these systems provide a mechanism to diversify livestock enterprises and intensify the use of soil resources, without impairment of its long-term productive potential.

TABLE III. PRODUCTIVE USE OF THE INTENSIVE SILVOPASTORAL SYSTEM (SSPI) FOR FARMER IN TIERRA CALIENTE MICHOACÁN, MÉXICO

Municipality	Apatzingán Michoacán			Tepalcatepec Michoacán						
Production Unit	1	2	3	4	5	6	7	8	9	10
Main productive activity in the SSPI	Meat and seed of Leucaena	Milk, cattle and fruit	Milk, cattle and seed of Leucaena	Milk, cattle and fruit	Milk and cattle	Milk, cattle and seed of Leucaena	Milk, cattle and seed of Leucaena	Milk and cattle	Milk and cattle	Milk and cattle
Time dedicated to the SSPI	Partial	Complete	Partial	Partial	Partial	Partial	Partial	Complete	Partial	Partial

The social contribution that the adoption of SSPI is evident; however farmers and institutions are promoting it by the productive benefits provided as they are, high forage availability, decreased costs for livestock feed, useful life of the system once established up to twenty years [17], and profitability.

IV. CONCLUSIONS

It is unquestionable that the adoption of System Intensive Silvopastoral (SSPI) has increased quickly; this increase is mainly due to the confidence generated by the farmer to the production model and not to external factors such as economic stimulus that often influence adoption programs; the SSPI are a great productive alternative that helps reduce negative impacts on livestock production caused by seasonality and low forage availability; the SSPI offer multiple opportunities as increased productivity, profitability and obtaining quality products. This favors environmental sustainability and social welfare of farmers and their families, considering the production model responsible to society, contributing to the sustainability and long-term competitiveness.

ACKNOWLEDGMENT

I would like to thank the CIC of the UMSNH for their support for this project. Acknowledge the extended help of Fundación Produce Michoacán A.C., for providing the facilities for experimentation. Finally I would like to thank Tierra Caliente, Michoacán farmers for their availability and cooperation.

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