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Holistic Conceptualization of the Sheep Production System of the Chiapas Highlands

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Abstract: The objective of this study was to carry out a holistic conceptualization of the sheep production system of the Tzotzil indigenous people of the Chiapas highlands region of Southeast Mexico. In this study, this system is geographically delimited and its importance described. Management, some social and cultural aspects and agricultural support policies are characterized. Researchers analyze limitations of this system and propose some alternative scenarios oriented toward achieving sustainable development of the system. Sheep raising constitutes a basic element in the identity of Tzotzil women and has great ecological, economic and socio-cultural importance. Nevertheless, current management of the system leads to irreversible deterioration of natural resources and loss of families capability for self-provisioning. Intermediaries and lack of governmental support are external factors which inhibit development of the system. Reversing this deterioration requires that sheep raising families receive appropriate technical advisory and training as well as permanent sources of financing to capitalize and reinvest part of their income into the system in order to propitiate technical change toward semi-intensification of sheep raising. In this manner, they may achieve efficiency, competitiveness and sustainability of the system.

Key words: Tzotzil shepherdesses, sheep raising zone, holistic qualitative analysis, alternative scenario, families, Mexico

INTRODUCTION

Unlike the disciplinary focus of agricultural research, the systemic focus allows for effectively integrating knowledge of various processes (Conway, 1987; Grant *et al*., 1997; Ostrom, 2009). Conceptualization is the 1st stage in the methodological process of the study of dynamic systems (Aracil, 1979; Hart, 1985; Grant *et al*., 1997). Until 1975, agricultural research with a holistic focus in Mexico was scarce, discontinuous, disperse and marginal. The first evidence of such a focus among Mexican researchers was presented in the first seminar on Agroecosystems of Mexico, organized by Professor Efraím Hernandez Xolocotzi in 1976. In 1978, this seminar was held for the second time and in 1980, the first seminar on Agricultural Production in Yucatan state took place with a similar focus. These precedents motivated several research studies (CIMMYT, 1980; Villarreal and Byerly, 1984; Parra *et al*., 1989; Ramos *et al*., 2009) in which the problems of campesino production were understood in a holistic manner as a prior requisite for formulating agricultural development proposals. Application of a systems focus is particularly important when studying complex systems (Aracil, 1979; Hart, 1985; Grant *et al*., 1997; Campbell, 2006) as is the case of Tzotzil indigenous agriculture. This production process is characterized by holistic, diversified use of resources and by management of various production systems with complex spatial arrangements interlinked by energy flows and circulation of materials. Sheep raising is integrated into these agricultural systems and constitutes a fundamental economic activity by contributing >30% of family income, including monetary income and production for family-consumption (Parra-Vazquez *et al*., 1993). The sheep raising system is developed under an agro-silvopastoral management scheme characterized by extensive pasturing of grasslands with varied histories of use, interdependence of sheep raising with production of basic grains (principally maize and beans and other agricultural systems such as horticulture and agroforestry through plot rotations, use of crop residues, weeds from the cornfield and foliage of forage trees and shrubs which

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make up the plant communities of forests and fallows, fertilization with sheep manure and division of labour and shared use of tools among family members (Nahed and Lopez, 2000). Scarcity of land in the region has led to permanent competition for use of grasslands, agricultural plots and forest areas, resulting in expansion of grazing areas at the cost of forests (Ramirez-Marcial *et al*., 2001), diminishing agricultural productivity, severe overgrazing and soil erosion. Other problems include low productivity of the sheep, deterioration of natural resources, low productivity of the labour force and deterioration of the population's living conditions.

These problems are a result of the following, a high number of animals distributed among small herds, surpassing the capacity of sustenance of the grasslands; scarce seasonal availability of forage due to an irregular climate; poor soils and low index of foliar area during the growth season due to excessive animal load; high caloric consumption by the animals due to long journeys during grazing and extended time dedicated to grazing as well as scarcity of family resources (Nahed and Lopez, 2000). In the face of this complex situation, it is necessary to identify those factors which could propitiate sustainable development of agricultural systems and propose production strategies congruent with rational natural resource use which have the capacity for increasing production and economic efficiency over time (Trujillo, 1990; Toussaint, 2006). Such strategy should be based on an approach which tends to neutralize or minimize effects of disturbances caused by natural phenomena and humans (Gligo, 1990; Ramirez-Marcial *et al*., 2001) and which allows for distributing resources among society in a just manner (Conway, 1987; Nahed *et al*., 2006). Attaining sustainable development of agricultural systems is one of the current challenges of producers to which we should commit. With this in mind, analysis of relations among producers, natural resource use and diversity and complexity of holistic systems may contribute to defining strategies of sustainable development of agricultural systems (Atieri, 1999; Speeding, 1995; Aleman *et al*., 2005; Rao and Rogers, 2006). The objective of this study was to carry out a holistic conceptualization of sheep production of the Tzotzil indigenous people of the Chiapas highlands of Mexico. The study geographically delimits the sheep raising zone; describes the importance of the production system and characterizes management, social and cultural aspects and agricultural support policies.

MATERIALS AND METHODS

Study region: The Chiapas highlands region (Fig. 1) is located in Southeast Mexico between 16°30' and 17°N

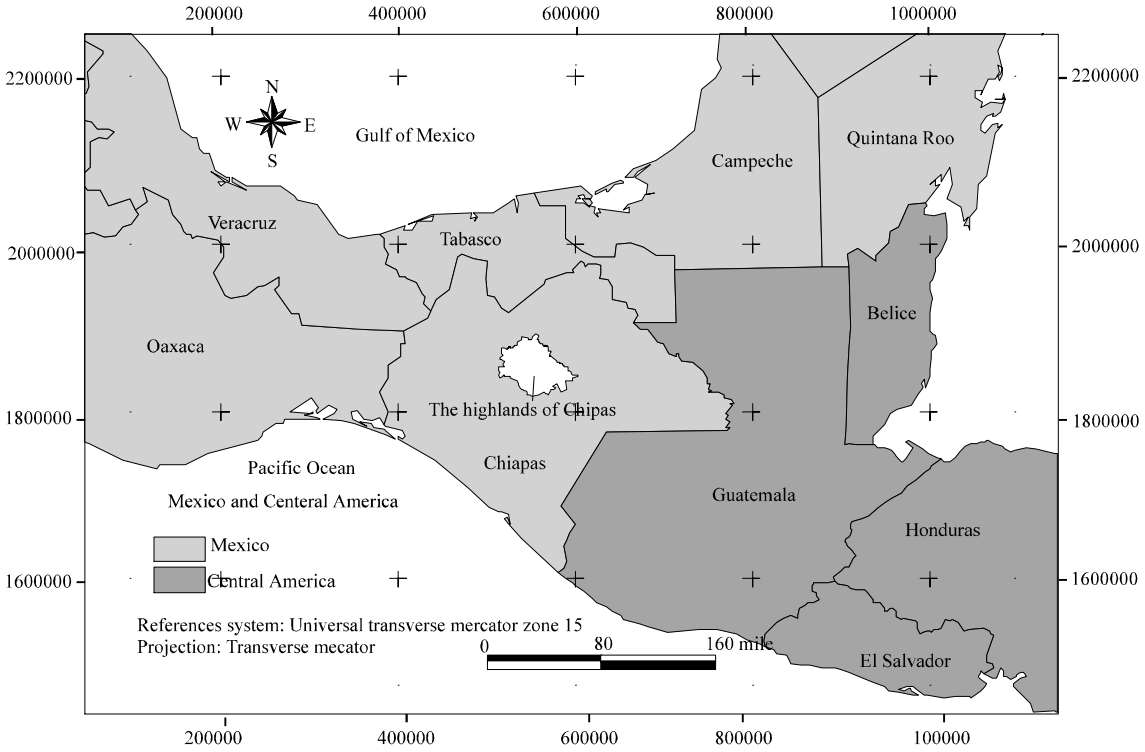

Fig. 1: Chiapas highlands, Southern border of Mexico

latitude and 92° and 93°W longitude and includes 15 municipalities with an area of 3,456.5 km^2. A large part of the population belongs to the Tzotzil or Tzetzal Mayan ethnic groups. According to Mera (1989), altitude of the highlands region ranges from 1,200-2,400 masl with the highest elevations being the Volcanoes Zontehuitz (2,876 masl) and Huitepec (2,760 masl). Although, most of the region's topography is abrupt, it includes a diversity of reliefs. Mera (1989) describe it as a series high plains with different altitudes which includes valleys, plateaus and gentle and steep slopes.

Delimitation of the sheep raising zone: Geographic delimitation of the sheep raising zone of the Chiapas highlands was carried out with currently available geographic information. For this, researchers considered the socio-cultural and economic importance of sheep raising in municipalities with >2,000 heads of sheep according to the VIII Agricultural, Livestock and Forestry Census (INEGI, 2007).

These 2000 heads of sheep are equivalent to 200 animal units, assuming 0.1 animal units per Creole sheep (churra, manchaga and lacha biotypes). Within these municipalities, researchers considered the zone with a median annual temperature of 14-18°C and a total annual precipitation of 1200-2000 mm which are optimal conditions for sheep reproduction, growth and production (Johnson and Hahn, 1982; Young *et al*., 1989). These climatic conditions are also optimal for production of forage plants which are used to feed the sheep (Evans, 1980). In order to elaborate the map of the sheep raising zone, researchers used a geographical information system, combining a map of municipal limits and a climate map. These maps had been previously transferred to digital format and edited in the Geographical Information Laboratory of The Colegio de la Frontera Sur (LAIGE-ECOSUR).

Sampling framework and data taking: Through participatory workshops (Campbell, 2006; Guevara-Hernandez *et al*., 2008, 2010), direct observations of the sheep raising families and a questionnaire applied to shepherdesses through the informal semi-structured interview technique (Gillham, 2005), researchers gathered information on, the ecological, economic and socio-cultural importance of sheep in the agricultural strategy, management of the sheep production system and socio-economic and cultural aspects and agricultural support policies which influence sheep production. Sample size for direct observation and application of questionnaires was calculated through simple random sampling (Zar, 1984) with 10% sampling precision, 90% confidence level and a 20% possibility of non-response. In this manner, we calculated a sample size of 80 sheep raising families throughout zone. Based on the importance of sheep production in the zone, representative communities chosen were Laguna Petej and Nichen (San Juan Chamula); Mitziton (San Cristobal); Balhuitz (Teopisca); Luquilho (San Andres Larrainzar); Chilil (Huixtan); Nachig (Zinacantan) and Belisario Dominguez (Chenalho). Within each community, 10 sheep raising families were randomly selected.

RESULTS AND DISCUSSION

Delimitation of the sheep raising zone: Figure 2 shows the geographic limits of the Chiapas highlands sheep raising zone which consists of two subzones; the Chamula subzone where sheep production is geared toward family-consumption and the San Cristobal subzone where production is directed to both family-consumption and the local market. Researchers did not observe considerable differences in management of the sheep production system between the two subzones. Nevertheless there is a possibility of adapting technologies to the system in function of availability of natural resources of each subzone.

Importance of sheep in the agricultural strategy: Tzotzil agricultural strategies include important aspects of sustainability which have allowed for permanence of the group to this day. For the families, sheep raising fulfils

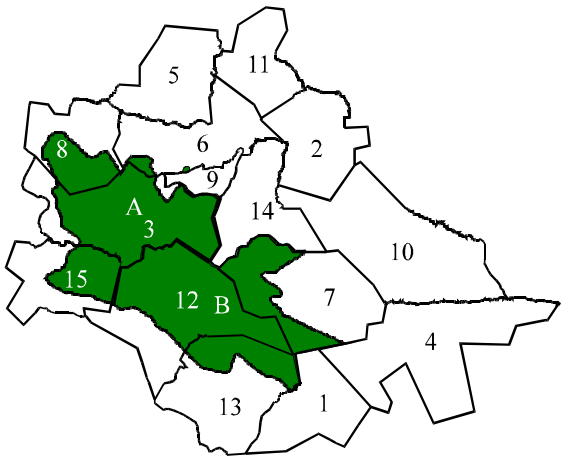

Fig. 2: Limits of the sheep production subzones (A = Chamula; B = San Cristobal) in the highlands of Chiapas. Municipalities; 1: Amatenango del valle; 2: Cancuc; 3: Chamula; 4: Chanal; 5: Chalchihuitan; 6: Chenalho; 7: Huixtan; 8: Larrainzar; 9: Mitontic; 10: Oxchuc; 11: Pantelho; 12: San cristobal; 13: Teopjaop; 14: Tenejapa; 15: Zinacantan

three important functions. The first function is ecological since, this system allows for nutrient flow and circulation of materials among agricultural and forest systems through rotation of land-use, use of foliage of some fodder species, weeds of crop fields and agricultural residues to complement sheep feeding and use of manure to fertilize crops, especially small-scale vegetable growing. The second function is economic sale of animals and provision of wool for production of handcrafts for sale provides money for food, clothing and family medical needs. Furthermore, sale of animals and handcrafts largely subsidize purchase of fertilizers, insecticides and herbicides which many Tzotzils use in their agricultural production strategy. The final function is socio-cultural given use of wool fibre as a fundamental prime material for elaborating traditional dress of great importance to maintaining the Tzotzil cultural identity.

Management of the system: In the sheep production system, the Tzotzil people use all available resources. Management of the system occurs at the level of individual sheep, herd and family unit. Traditional empirical knowledge and manual tools characterize the prevalent agro-silvopastoral management technique. This management is characterized by organized division of labour and a management calendar adapted to the variable environmental conditions. Through their labour, Tzotzil women maintain a strict relation with the sheep production system which is a basic element in the conformation of their identity.

Management practices at the level of the individual, herd and family unit are generally similar throughout the sheep raising zone. At the individual level, these include feeding supplemented with dry corn kernels or pozole (corn dough dissolved in water) and chilacayote squash (*Cucurbita ficifolia*) in the dry season (January to April) fed to lambs and pregnant and lactating females. Animals are sheared twice a year, principally in November and April. Little care and attention is given to females around the time of birth or to recently born lambs and therefore, some lambs die of asphyxia or by trampling. Nevertheless, adult females are relatively unaffected by the lack of attention upon giving birth as they only occasional suffer illness such as retention of the placenta. With respect to selection of broodstock, shepherdesses are conscious that some sheep have greater productive capacity and therefore they try to select and maintain such sheep within the herd. However, frequently the decision of the shepherdesses to discard an animal or the possibility of acquiring another, depends more on immediate economic circumstances than on the importance of selecting superior individuals in order to improve herd productivity. At the herd level, the most common practice is grazing, principally during the raining season (May to October). In the Chamula subzone, grazing is principally carried out in communal grasslands although, the majority of shepherdesses use them in an individualized manner, in fallow land and in post-harvest fields. Meanwhile in the San Cristobal subzone, grazing is essentially carried out in private grasslands fallow lands and post-harvest fields. After growers establish crops, they tie the animals to posts in order to avoid crop damage. Distances travelled during grazing are close to 3 km depending on the location. Sheep are provided with salt every 10 days throughout the year and during the dry season, the diet is supplemented with crop residues and foliage of trees and shrubs from forests, fallows and living fences. Corrals for guarding the sheep during the night are small and therefore each animal has insufficient space. Corrals are movable or fixed they have a single compartment usually without a roof although some have a straw or sheet metal roof. Moveable corrals have a wooden fence and fixed corrals have wooden walls. In both cases, the floor is earthen and therefore, muddy during the rainy season. Breeding and weaning are outside the control of the shepherdesses as they occur naturally. Medicinal herbs are used to treat digestive, respiratory and septicemic illnesses. Nevertheless, the shepherdesses recognize the limitations of this traditional method and often use allopathic veterinary medicines which has led to proliferation of veterinary pharmacies in the city of San Cristobal.

At the family and communitary level, management occurs through use of grasslands which are interrelated with agricultural and forestry systems in local land use dynamics. Change in land use pattern begins with the felling of a mature forest (Ramirez-Marcial *et al*., 2001) through the practice of slash and burn agriculture in order to plant cornfields. Depending on the producer's needs for cropland, land use may be intensified or left to regenerate toward a forest state (Nahed *et al*., 2003). Scarcity of agricultural land puts great pressure on natural resources and leads to competition among crop, livestock and forestry uses. This in turn leads to a process of inefficient land use intensification based on increasing frequency of land use which impedes the land from recovering fertility in a natural manner. This is due to decreasing fallow time through substitution of crops with long planting cycles with others which are more continuous, leading to loss of fertility, upon which the plots are left to revert to grasslands which are used for several years before again being used to establish agricultural crops or increase in grazing intensity in fallow areas or permanent grasslands. This reduction in rotation

of land use and greater pressure per unit of area grazed leads to extractive exploitation which increasingly generates greater degradation of grasslands and animal mal-nutrition (Nahed and Lopez, 2000). In this manner, management of the sheep production system is integrated into the rotational land use dynamics of the sheep raising family (Nahed *et al*., 2003).

The dietary situation of the sheep is attributable to three fundamental characteristics; the high number of animals which surpasses the carrying capacity of the grasslands, seasonal availability of fodder due to an irregular climate and high caloric expenditure due to long distances travelled during grazing. These factors in turn cause disequilibrium in reproductive behaviour, health, growth and wool production. Added to this much time is dedicated to pasturing small herds due to lack of organization of the shepherdesses which leads to low labour productivity. If these probable tendencies continue, we may anticipate a worsening of the current deterioration which is already severe of the sheep production system. Shepherdesses in general hope to improve the physical and productive conditions of their sheep and to learn more about sheep production. They also hope that their production will not decline in the future. Nevertheless, reproduction of the system through expanding grassland areas is not feasible due to the current high demand for crop land. For the system to continue, it should be reproduced in a restricted manner (Parra-Vazquez *et al*., 1993) through reinvestment of economic resources which lead to semi-intensification.

Socioeconomic and cultural aspects: As with indigenous highland campesinos in general, Tzotzil sheep farming families are smallholders who work the land with manual tools such as hoe and machete. Families are increasingly becoming dependent on the labour market; children seek employment as wage labourers on large farms in construction as gardeners, popsicle vendors, servants, waiters, hotel workers, etcetera. This dependence on increasing modernization and use of purchased inputs has extended to markets for agricultural inputs (tools, seeds, fertilizers, pesticides, etc.) and for consumer goods (sugar, cooking oil, candles, soda and snack foods, fireworks, etc.) at unfavourable exchange rates. Furthermore, migration generates seasonal scarcity of labour for agricultural activities, upsetting production. In the highland region, sheep raising is essentially women's work. Ownership of means of production, particularly land and animals, guides social relations of production. According to current inheritance pattern, all sons and daughters inherit some land from their parents and receive several sheep upon marriage which favours reproduction of the agricultural system and leads to increasing sub-division of agricultural plots which in turn leads youth to lose interest in farming. Shepherding consumes a great deal of the women's time and effort and although, they take advantage of grazing time to card and spin wool weave skirts with backstrap looms or gather firewood, work productivity is low. In the San Cristobal subzone, a considerable part of sheep products are destined for sale, aside from satisfying family consumption thanks to a growing market for mutton and handcrafts due to national and international tourism. However, the principal beneficiaries of this market development are not the shepherdesses but rather intermediaries who pay only a small fraction of the final sale price (Nahed and Lopez, 1989). Despite unfavourable exchange rates, sheep raising is of great importance to total family income. According to Parra-Vazquez *et al.* (1993) in the region, sheep raising families obtain 68% of total family income from sale of sheep and woollen textiles. With respect to the sociocultural context, a group of social relationships bind the Tzotzils together as an ethnic group and govern their structure of social duties, language, dress their inheritance system and land ownership, etc. These social relationships are based on a set of values of use (products for self-provisioning) which give rise to the characteristic features of the Tzotzil way of life; housing, food, medicine and dress all of which are produced in the home and are based on diversified land use. Demand for woollen clothing has increased with a growing population. However, production does not increase as a result of greater efficiency but rather with expanding, inefficient use of grazing land and increased labour invested whose productivity is low. Nevertheless, sheep raising is indispensable to their way of life.

Development policies which influence production: Regional, national and international economic policies have had a notable influence on the economic and social development of the Tzotzil people and have led to economic polarization of the campesino families. According to Calva (1988), although small-scale campesino production has shown great capacity to continue to function under increasingly unfavourable conditions, their subsistence is greatly threatened by the agricultural and food crisis which Mexico has suffered in recent decades. This situation has been aggravated by the process of opening the national economy to international markets through the North American Free Trade Agreement (NAFTA) and Mexico is undergoing a transition to an economic model governed by the free market (Tarrio *et al*., 1995). Rural Mexican farmers who lack technical and financial support are at an obvious

disadvantage in competition with highly subsidized United States farmers. In 1993, the Mexican President announced the withdrawal of maize subsidies and their replacement by a program of direct support to campesinos with the goal of increasing their chances of competing under unequal circumstances with farmers from the US and Canada (Chapela, 1995). However, the government program of support to the countryside (PROCAMPO) instead of providing significant agricultural support for poor rural campesinos rather represents a dietary handout and a tool to achieve political allegiance due to its small sum and the fact that it is not delivered at the time of the year when farmers invest in their crops (Espinosa, 1995). In this new economic model where productivity, efficiency and competition prevail and where producers and nations must compete under unequal conditions, campesinos are finding it increasingly difficult to subsist. This model clashes with the logic of the Tzotzils whose prime objective is self-provisioning in order to achieve physical and cultural survival.

These objectives are fulfilled through a variety of agricultural activities, through use of a diverse germoplasm and recurring to diverse agricultural practices. Such is the case for sheep production whose fundamental purpose is not to obtain economic gain but rather to provide manure for fertilizing crops and wool for the unique traditional dress of this ethnic group (Nahed and Lopez, 2000; Gomez, 1978). Poor infrastructure, limited capital accumulation, lack of trained human resources and low technological level, etc., form a breach which prevents not only highland Tzotzil campesinos but in general all small-scale farmers of the State of Chiapas from becoming integrated into the globalised economy, a breach which tends to widen, leaving Chiapan society in a state of permanent underdevelopment (Parra and Moguel, 1995). Although, Tzotzil logic of production does not seek to increase competitiveness but rather to satisfy family consumption, it is necessary to take into account particular climatic and soil characteristics as well as destination of sheep products in order to achieve careful, holistic planning of the sheep production system and thus convert the current situation into a more desirable one (Kaine and Tozer, 2005). This requires precise identification of varying socio-economic levels among sheep farming families and should take into account; prospects for change of these different social groups their knowledge and experiences and local resources in order to define actions necessary to propitiate desired technological change and achieve sustainable development of the system. This process of alternative development should be viewed as a not necessarily linear sequence which initiates with alternative technologies for efficient agro-silvopastoral intensification and should promote congruence between natural resource use and conservation. This sequence should take into account the following Tzotzil agricultural strategies:

Technical-ecological sustainability: The negative nutrient balance of the agricultural system should be reversed in order to significantly improve the sheep's health, reproductive efficiency and production. Proposals for technical change should include management practices which enable farmers to control biological principles of sheep production and maintain the system's equilibrium. For example, some animals should be sold in order to prevent an increase in the sheep population from leading to increased pressure on natural resources and thus to low animal productivity.

Socioeconomic sustainability: Live sheep and woollen handcrafts should be directly marketed in order to reduce the power of intermediaries. Such a strategy would lead to higher income for sheep raising families, increase labour productivity and open possibilities for economic investment for technological development. Formation of farmer production and marketing organizations could result in greater economic equity and social well being and prevent intermediaries from controlling economic exchange of goods.

Cultural sustainability: Adapting technologies to the sheep production system will help maintain a viable system in which wool fibre will continue to be the fundamental prime material for elaboration of traditional dress which will contribute to maintaining the Tzotzil cultural identity.

CONCLUSION

Campesino communities such as those of this study are immersed in socioeconomic and political processes of global impact which greatly threaten their survival. Any effort toward rural development should start with local strategies and identify the system`s limitations and potential with the goal of designing alternatives appropriate to each circumstance.

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