

Characteristics of smallholder sheep farms in Yucatán, and implications for nutrient cycling research

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Abstract

The rural poor of the Yucatán Peninsula, Mexico rely primarily on shifting cultivation in forested areas to generate income from crop and livestock production. The objectives of this research were to examine the characteristics of smallholder sheep farms, and create a conceptual framework as a step towards the development of a simulation model. A survey of 65 sheep producers was undertaken encompassing characterizations of household, livestock, cultivation, infrastructure, and technical and financial assistance. Of the farms surveyed, 78% were classified as smallholder sheep producers. Smallholders demonstrated diverse combinations of farm management practices including different techniques of sheep feeding, crop and forage production, and use of crop and animal products. In nutrient-poor agroecosystems such as found in Yucatán, understanding how farm management practices affect nutrient cycling is an important step in predicting the long-term evolution of the system.

Key Words

sheep, nutrient cycling, Mexico, systems

Introduction

Low stature tropical forests, such as those in parts of the Yucatán Peninsula, Mexico, are a threatened ecosystem. The virtual abandonment of sisal production in Yucatán has led to the regeneration of large areas of secondary forest (Gonzalez-Iturbe et al., 2002). These forests provide multiple environmental services, including carbon sequestration, and are havens of biodiversity. On a local scale, the forests are the principal agricultural resource for smallholder farmers, and landholders make land-use decisions based on economic opportunities, incentives, and constraints. Many farmers in Yucatán practice traditional 'slash and burn' agriculture, known as *milpa*, whereby a portion of forest is slashed, burned, cropped for two or three years, and then returned to forest fallow. Increasing population density and uncertain land tenure have shortened the fallow from 25 years to 10 years or less in some areas (Caamal-Maldonado et al., 2001). Shorter fallows result in insufficient nutrient regeneration, lower crop yields and heightened demand for more cleared forest to meet food needs. In the foreseeable future the *milpa* system will continue to be a significant land-use practice by the rural poor. Thus, the tropical forests of Yucatán are inextricably linked with agriculture, and attempts to achieve ecological goals need to focus on the socioeconomic context of current land use.

Concurrently, hair sheep production has grown in importance in the Yucatán, due to rapidly growing demand for mutton in Mexico City. There are many potential complementarities between livestock and cropping systems, the result of which may reduce the impact on the surrounding forested areas. Livestock have the potential to sustain and to enhance the productivity of cropping systems through increased cycling of soil nutrients (LEAD, 2005). In addition there are advantages from spreading income and risks over both crops and livestock production with flexibility to adjust crop/livestock ratio to economic needs and opportunities. The objectives of this study were to understand the characteristics of smallholder sheep farmers in Yucatán state, and develop a conceptual framework for understanding the

impact of management practices on nutrient cycling. Future extension of this study will involve design of experiments and data collection, and the development of a farm-level simulation model.

Methods

During June to August 2004, 65 sheep producers were interviewed in the State of Yucatán, Mexico. An extensive description of the survey methods and results are contained in Parsons et al. 2006. Producers were located in randomly selected towns. Survey questions focused on characterizing households, livestock practices, cultivation, infrastructure, and technical and financial assistance. The survey results were used to focus thinking on developing a model to assess the consequences of combinations of management practices.

Results

Survey Results

The results presented here concentrate on key farm characteristics, and aspects of crop and livestock management practices that impact nutrient cycling. Of the producers located and interviewed 51 (78%) were classified as smallholder producers, based on having 50 or less breeding sheep and 10 or less breeding cows. Other producer types included commercial sheep producers and predominantly cattle ranches that also raise sheep. Because of the distinctness of these producer types and the prevalence of smallholder producers the focus of this paper is on smallholders.

The principal source of income for smallholders (based on recall data) and how it has changed over time is presented in Figure 1. Although the sisal industry had greatly declined by 1989, it was still the primary source of income for 14 of the 48 smallholders who responded. The importance of sisal continued to decline, and in 2004 none of the farmers stated sisal as their major source of income. In comparison, sheep production only recently became an important source of income for these households. Less than half of the households surveyed in 2004 claimed that sheep production was their primary source of income, with both agricultural and non-agricultural activities continuing to be important.

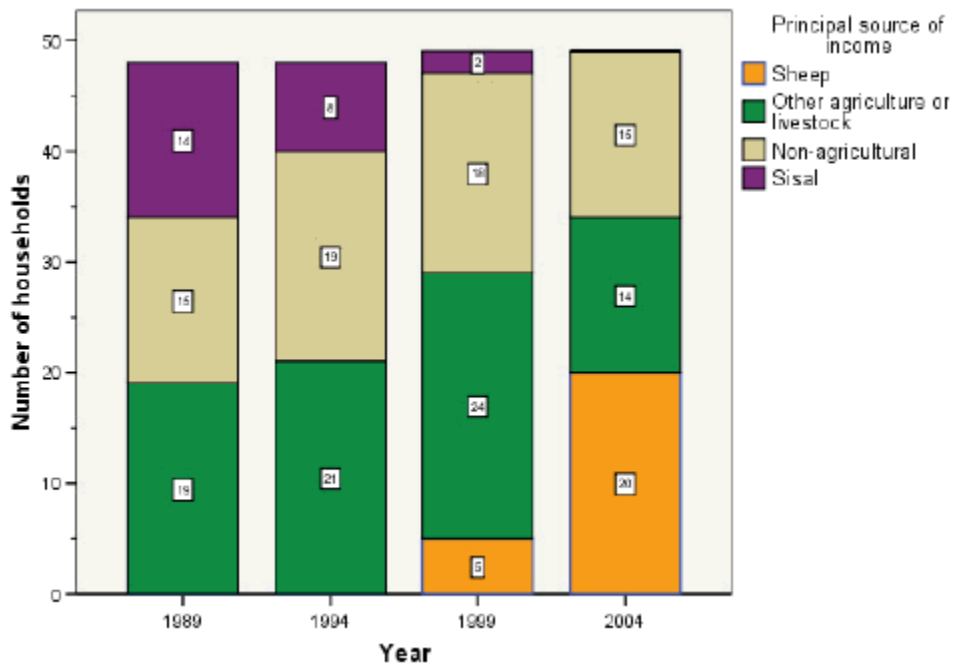


Figure 1. The principal source of income for surveyed Yucatán smallholder sheep producers from 1988 to 2003.

Strategies for feeding animals differ between farmers and also between the distinct wet and dry seasons. Seventy one percent of smallholders grow forage, which is either grazed or cut and carried. The most commonly grown forages were *Pennisetum* species. Forage produced with irrigation is a particularly important source of feed in the dry season. Harvesting tree foliage is common (90% of producers) and a wide range of species, many of which are leguminous, are collected from forests, other types of common land, from the home garden, or purchased. Crop products are also important, with 79% of producers using some form. The frequency of use of different types of crop product is shown in Figure 2. Maize (*Zea mays*) is the most important plant, with 22 producers reporting the use of maize stover and nine producers reporting the use of maize grain. Pumpkins (*Cucurbitae* spp.) and beans (*Leguminosae* spp.) are less commonly used for feeding sheep.

Seventy five percent of farmers reported the cultivation of field crops (*milpa*) and there are various reasons why farmers do so in addition to producing sheep. Thirty three producers cited home consumption as the most important reason for crop cultivation (Figure 3) whereas feeding livestock was a less important reason (13 producers). Sale of crop products and acquisition of government assistance were minor reasons for crop production. In addition to crop production, 82% of producers cultivated a home garden. The home garden is a diverse mix of animal and plant species which may include poultry, bees, vegetables and herbs for cooking, fruit trees, medicinal plants, and trees for forage, firewood, and building materials.

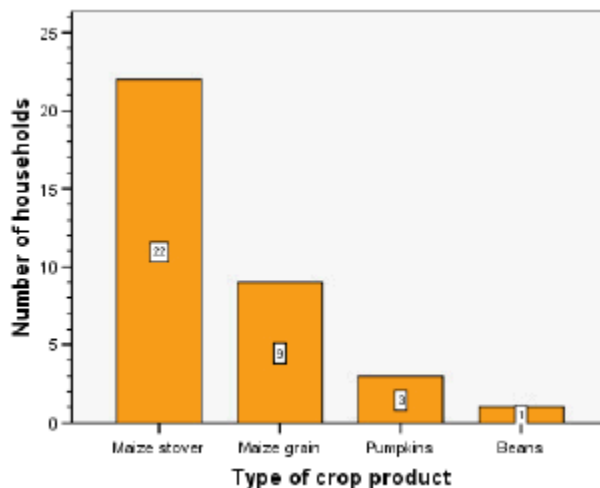


Figure 2. Types of crop products used by Yucatán smallholder producers to feed sheep.

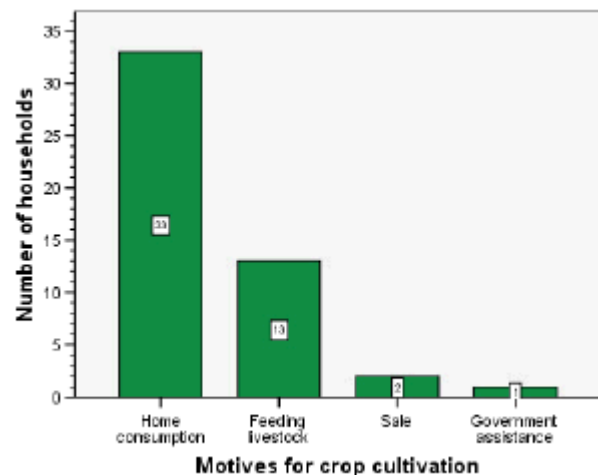


Figure 3. Motives for crop production of Yucatán smallholder sheep producers.

Manure is an important product of mixed farming systems. The locations of manure application are shown in Figure 4. Of the 36 producers who grew forage, 10 used manure on forage during the previous year. Manure use was less common on home gardens, and uncommon on crops. There are a number of potential reasons why manure is most commonly used on forage. Use of manure on forages may be perceived to give the greatest returns, particularly if sheep are the main agricultural product sold. In addition it may be physically easier to apply manure to forage than crops, as sheep pens and forage are often located on private land close to the house, whereas *milpas* are usually located on common land some distance from the house. It is curious that manure use was not more widely reported. Virtually every producer would pen sheep in corrals either permanently or during the night, resulting in manure accumulation; however only 33% of producers reported manure use. These results suggest that producers may benefit from improved manure management practices.

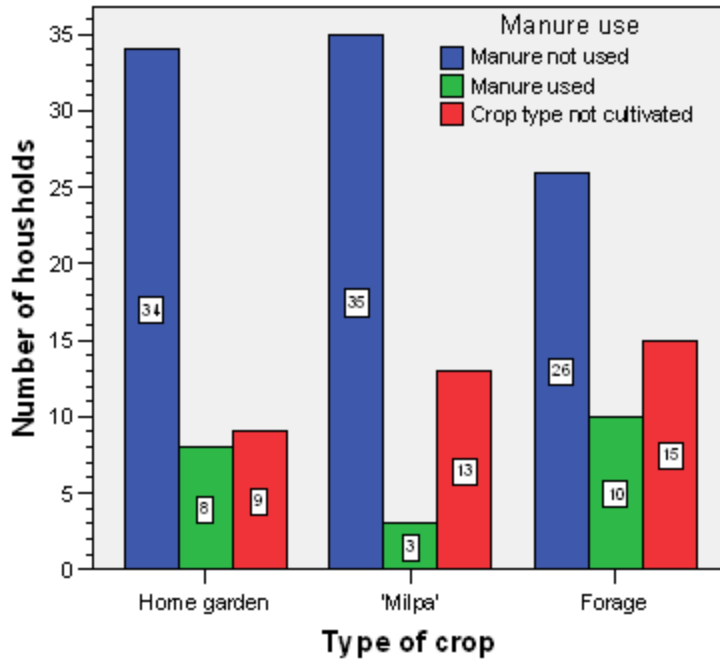


Figure 4. The choice of location for manure use by smallholder sheep producers.

Conceptual framework of nutrient stocks and flows in mixed farming systems

There are numerous farm practices that affect nutrient cycling, including different techniques of sheep feeding, crop and forage production, manure use, and use of crop and animal products. Farms exhibit diverse combinations of these practices, the biophysical result of which is unclear. Figure 5 shows a conceptual stock and flow diagram for an example nutrient (phosphorus) in a Yucatán mixed farming system. Stocks, represented by boxes, are accumulations of nutrients. Inflows and outflows are represented by pipes with the direction of flow indicated by arrowheads. Green arrows (inflows) and red arrows (outflows) are linked with clouds, which represent sources and sinks for flows that are not within the boundary of the model. The rates of flow are controlled by natural processes and human decisions, and are indicated by valves. Because farms differ in their management practices, not all of the flow paths will be present on an individual farm. For example, the 'P in crop stubble consumption' flow will only be active for a farmer who feeds crop stubble to sheep. It is clear from Figure 5 that there are numerous locations where farmer decision making can affect the flows of nutrients within the system and in and out of the system. For those producers who combine livestock and cropping there should be more opportunities to choose practices that result in more efficient nutrient cycling. In particular, there is the potential to direct the flow of nutrients towards cropping, potentially resulting in longer use of cleared areas, and consequently reducing the land needed for cropping.

Parsons D, Calderín-Quintal A, Nicholson CF, Blake RW, López-Cervantes C, Felipe Torres-Acosta F, Cárdenas-Sarmiento R and Ros-Arjona G. 2006. Diagnóstico y necesidades de investigación en los sistemas de producción ovinos en Yucatán. Universidad Autónoma de Yucatán.