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PARTICIPATORY CARTOGRAPHY IN A TRADITIONAL GOAT PRODUCTION SYSTEM OF A SMALLHOLDER COMMUNITY IN NORTHERN MÉXICO

[CARTOGRAFÍA PARTICIPATIVA EN UN SISTEMA TRADICIONAL DE PRODUCCIÓN DE CABRAS EN UNA COMUNIDAD RURAL EN EL NORTE DE MÉXICO]

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SUMMARY

A community mapping procedure was developed to identify and characterize communal land area used for a traditional goat production system. Participatory cartography indicated that producers have good knowledge of their territory; more than 80% of the spatial distribution and localization of the elements and shapes present in the community map agreed with the map constructed with GIS. All flocks were mainly grazed on communal rangelands where the most important native forage plants were *Opuntia* spp. *Yucca filifera, Condalia mexicana, Dalea* spp. and *Euphorbia cinerasiens*, and corn stover the main crop by-product supplement used during dry season.

Key words: Goats; rangeland; maps; shrubs; forage.

RESUMEN

En una comunidad rural se implementó un procedimiento de mapeo para identificar y caracterizar las áreas de tierra comunales utilizadas por un sistema tradicional de producción de cabras. La cartografía participativa indica que los productores tienen buen conocimiento de su territorio; más del 80% de la distribución espacial y la localización de los elementos y figuras presentes en el mapa realizado por la comunidad coinciden con el mapa construido por el GIS. Todos los rebaños fueron pastoreados principalmente en pastizales comunales donde las plantas nativas forrajeras más importantes fueron *Opuntia* spp. *Yucca filifera, Condalia mexicana, Dalea* spp. y *Euphorbia cinerasiens*, y rastrojo de maíz el principal subproducto suplementado durante la época de seca.

Palabras clave: Cabras; pastizal; mapas; arbustos; forraje.

INTRODUCTION

Approximately 25% of the world's land surface supports about 20 million pastoral households or about 180–200 million people. Pastoral societies are generally defined as those that raise livestock under extensive conditions using natural rangelands as the main forage for their animals (Degen, 2007). In Mexico, the animals are goats, which provide milk and meat, for home-consumption and cash. Mexican goatherds generally graze their goats on lands that cannot be cultivated or used by other livestock species. In northern Mexico, these lands usually fall under the categories of deserts, where goat production occurs primarily on rangelands (Pinos-Rodríguez et al., 2007) and residues of staple crops in small plots of rainfed agriculture (Charcas et al., 2010). The main factors explaining the limited progress of goat farming are probably socioeconomic. In many countries, raising or eating goat products often means that you are at the bottom of the

social scale and that your life is not successful (Morand-Fehr et al., 2004). In situations where the land is poor, unproductive and constrained by several environmental factors, crop cultivation is often difficult and limited. Under these circumstances, goats make a significant contribution to poor farmers and the stability of their small farm systems. The importance and contribution of goats increases with decreasing quality of the land and its sustainability, and thus they constitute a major component of the extensive production system (Chicagwa and Banda, 2006). In arid and semi-arid zones of Mexico, goats are managed under traditional extensive systems and are grazed on communal lands throughout the year with no supplements. Thus, the typical peasant goat production system involves several large flocks of goats that often surpass the carrying capacity of these rangelands. The result is a severely overgrazed range and poor range and animal condition. An increase in stocking pressure generally represents a decrease in quantity and/or quality of forage available to the grazing animals (Mellado et al., 2003). Rural participative diagnostics comprises a group of methods and techniques which permit assessing the resources of a group of famers and of their community to identify problems and priorities, and evaluate strategies that may be able to help solve them. One of these methods is participatory cartography, which constitutes an instrument for community reflection relative to territorial problems and management of natural resources. This methodology combines qualitative, quantitative, scientific and humanistic approaches that together validate local knowledge and allow applying geo-informatics technologies to community data processing for the generation of a standardized cartography. This participative process arises from the principle that the communities' spatial knowledge is extensive and detailed (Herlihy, 2003; Herlihy and Knapp 2003). The objective of the present study was to develop participatory cartography to characterize forage vegetation for grazing goats in a communal rangeland of a rural community in northern Mexico.

MATERIALS AND METHODS

This study was carried out at a San Luis Potosi highland community called San Jose de la Peña (Figure 1), which is a fraction of Ejido Zaragoza de Solís, San Luis Potosi, a state in northeastern Mexico. The community (23º12' to 23º19' LN and 100º44 to 100º 48' LW) was suggested by the local staff of the Department of Agriculture, Matehuala, San Luis Potosi. The climate is semiarid with average annual rainfall of 390 mm, 75% of which falls from June to October, and mean temperature is 18ºC; it is located at 1730 meters above sea level.

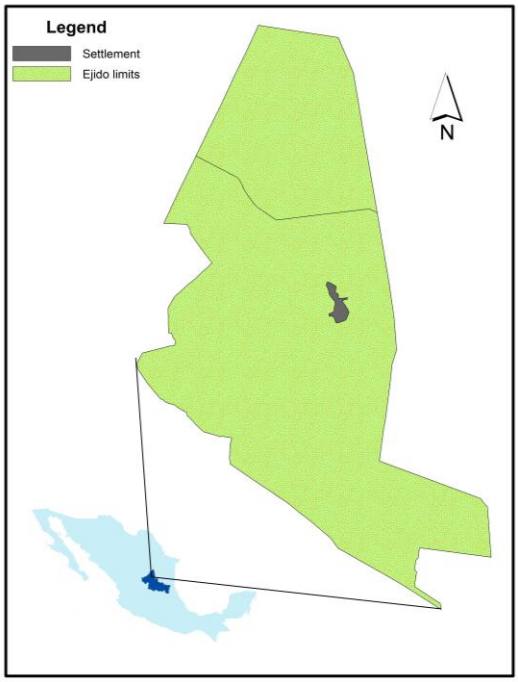

Figure 1. Area of study.

The main native vegetation is characterized as Chihuahuan desert rangeland. In the study area three kinds of plant associations are found: a) xeric microphyll scrublands (*Larrea tridentata, Acacia spp.*); b) rosette-like scrubland (*Yucca carnerosana, Agave spp.*) and c) succulent scrubland (*Opuntia spp.*) (INEGI, 2002).

For the participatory cartography, eight workshops were performed with 12 peasants selected under the criteria that they must have goats and experience in this practice, the age of the participants rank between 40 and 60 years old. A first workshop was held to explain the concept of participatory land cartography and its implications with land use by the community. Based on the process of participative research (Herlihy, 2003; Herlihy and Knapp 2003), a community land territory map was draw by the peasants, who also gave a detailed description. A community resource mapping procedure was developed to identify and characterize communal land area. Using a photographic interpretation analysis of digital aerial photos (orthophotos), scale 1:20,000, maps of rangeland condition were

constructed. With the support of digital and printed cartographic material, vegetation and land use, soil and topographic maps were made. For this procedure the ArcView 3.3. geographic information system was used. The scale presentation for the thematic maps was 1:10,000. The created maps were contrasted against the map draw by peasants ; an interpretation was given in a second participatory workshop, and at this point necessary corrections to the created maps were given by the farmers. In addition, walking trials were done together with goatherds and flocks to identify the species of plants goats browsed and grazed and regular grazing routes. With the use of GIS in each one of the grazing routes, every five minutes a point of information was obtained and represented spatially to determine the areas of highest grazing concentration. At the same time during the walking trials, information on the general condition of the area, grazing pressure on rangeland, and dominant species were recorded. A total of 12 walking trials were conducted with the peasants, during which 42 plant species, which represent the basic goat diet, were collected. These collected plants were processed as herbarium specimens in the Desert Zone Research Institute of the Autonomous University of San Luis Potosi to identify them taxonomically. Finally, the information on grazing routes and grazing pressure on rangeland during a dry season and during a wet season was validated. This information was spatially represented and overlapped onto maps previously prepared. The maps were then presented to the peasants in another workshop to analyze the information and explain the dispersion or agglutination of the grazing routes and to make decisions about rangeland management.

RESULTS AND DISCUSSION

The communal land of the community covers 4,839 ha. The results showed that the peasants of San José had good knowledge of the spatial distribution of the main elements present in their rangeland. In this matter, more than 80% of the spatial distribution and localization of the elements and shapes in the community map agree with the GIS map based on aerial photographs and digital cartography (Figure 2). During the joint interpretation of the vegetation, land-use and rangeland condition maps with the peasants, it was established that the areas considered as of poor rangeland condition are coincident with those areas that in the past were probably overgrazed, particularly those located in the area southwest of the community and close to the village area. It is important to mention that most of the overgrazed areas with serious problems of erosion correspond to the routes where livestock transits normally (Figure 3). During the dry season (Figure 4), the highest stocking rate focuses on the area northwest of the village. However, these routes do not change drastically during the wet season (Figure 5); the only difference is that in the wet season the route distances were shorter.

These rangelands are used exclusively by San José de la Peña peasants but reserved to be used only by members with livestock. The problem of the fair use of the resources is very complex with no rules; the peasants' opportunism will lead them to pressure the rangeland until they have used it up completely. Even though the peasants know that the consequences of their individual decisions will increasingly deteriorate the rangeland condition, it is a fact that no one will decrease the number of animals in their flock. This, in turn, will drive these ecosystems to become highly fragile against droughts leading to greater deterioration and lower productivity (Cruz and Aguirre, 1992). The plants identified during walking trials are shown in Table 1 and 2.

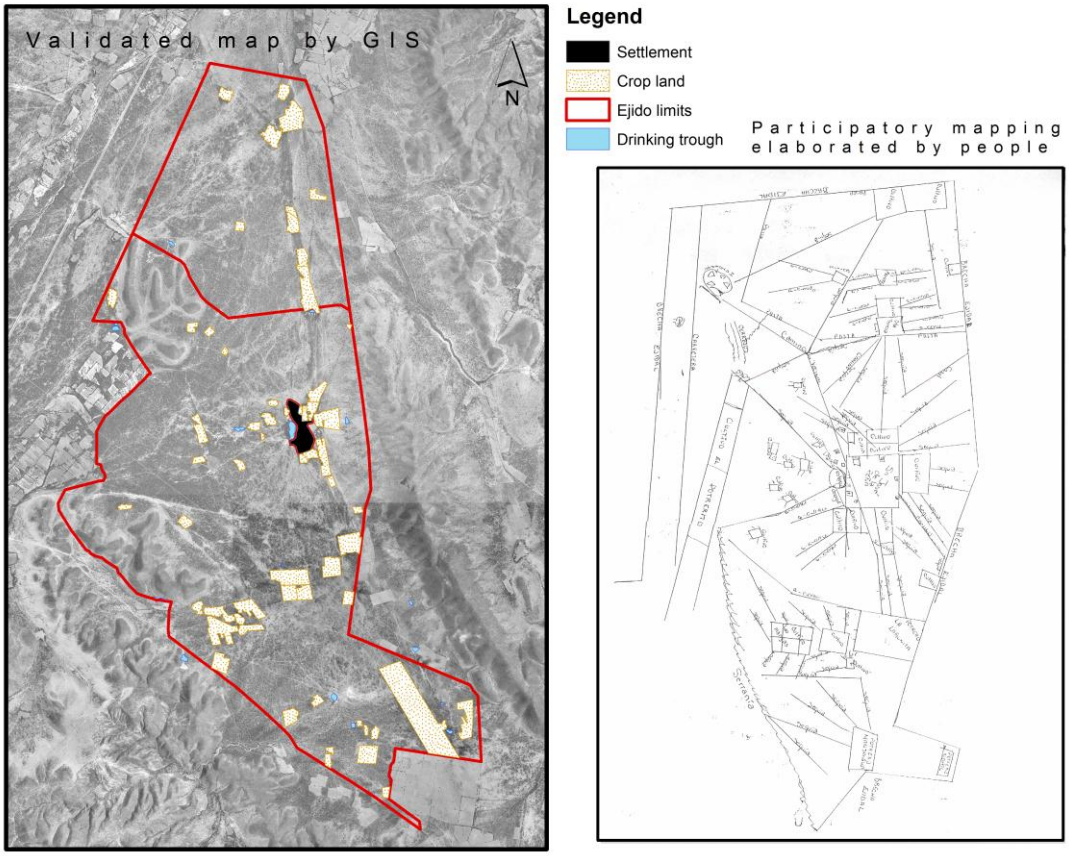

Figure 2. Map comparison.

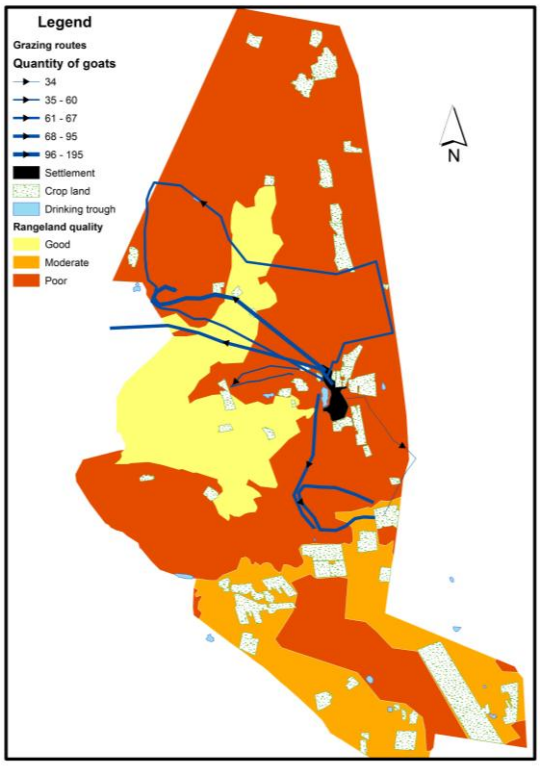

Figure 3. Pastoralism routes and rangeland condition

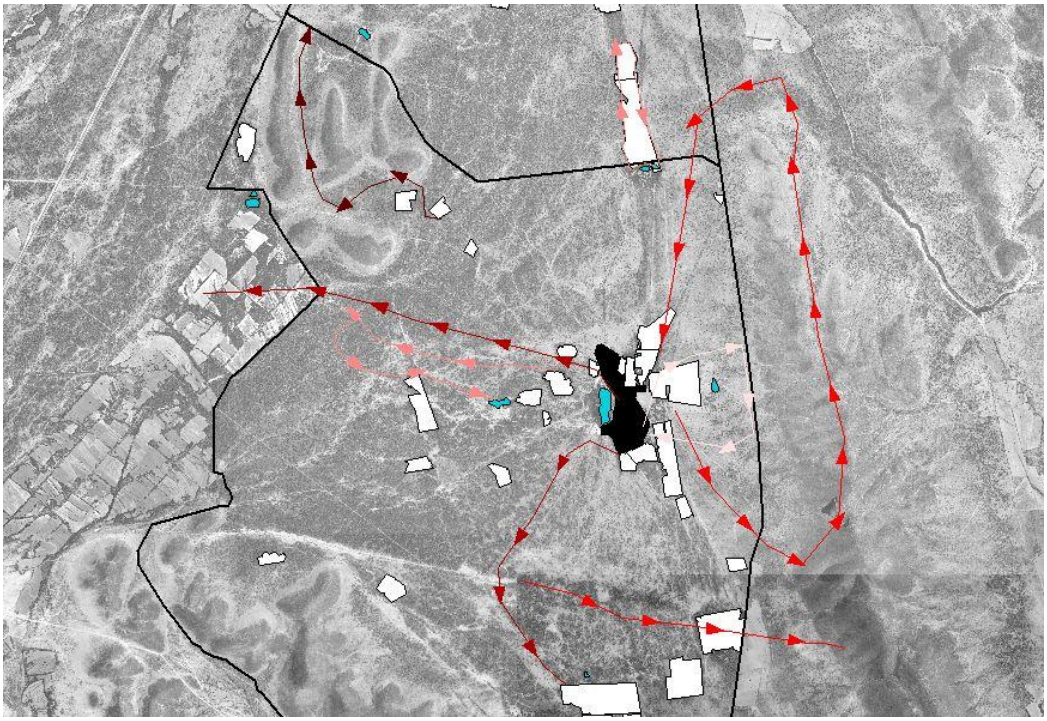

Figure 4. Grazing routes in the dry season.

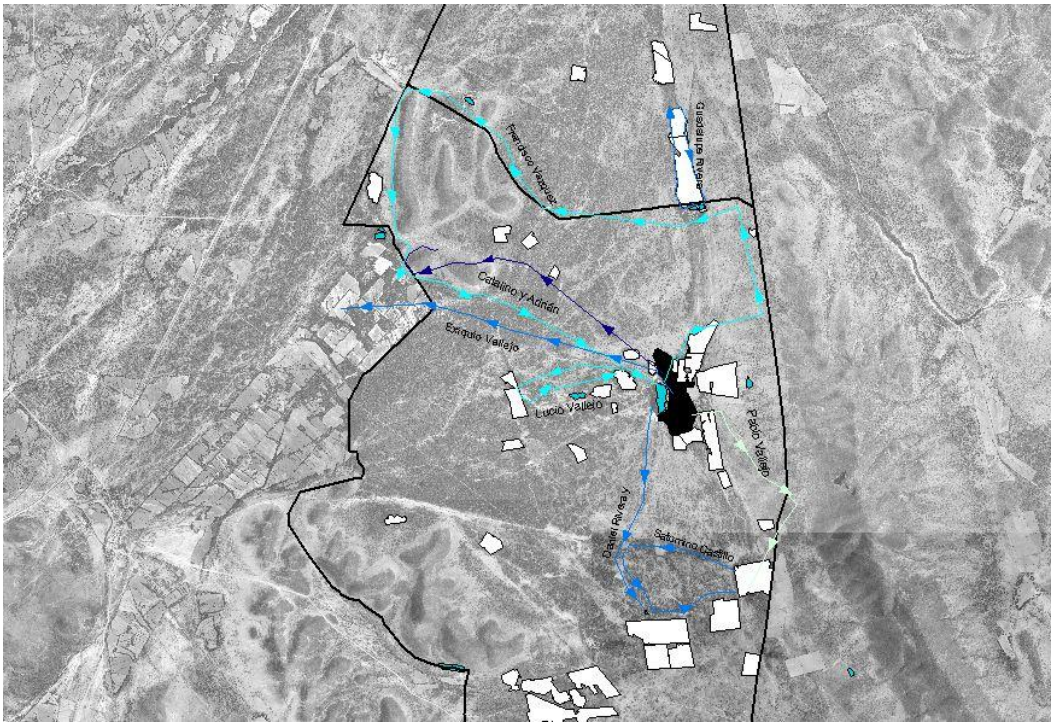

Figure 5. Grazing routes in the wet season.

Table 1. Forbs, grasses, epiphytes, and succulents consumed by grazing goats.

Group/Family	Scientific name	Common name	Part Consumed
Forbs			
Asteraceae	*Zaluzania triloba* (Ortega) Pers.	Altamiz	Early leaf
Asteraceae	*Ambrosia artemisiifolia* L.	Tabaquillo	Whole
Asteraceae	*Ambrosia psilostachya* DC.	Fresadilla	Whole
Asteraceae	*Calyptocarpus vialis* Less.	Chamiz	Whole
Asteraceae	*Parthenium hysterophorus* L.	Jiguite loco	Whole
Chenopodiaceae	*Chenopodium album* L.	Quelite	Whole
Euphorbiaceae	*Euphorbia cinerascens* Engelm.	Golondrina	Leaf, stem
Malvaceae	*Malva parviflora* L.	Malva	Whole
Malvaceae	*Sphaeralcea angustifolia* (Cav.) G. Don	Hierba del negro	Whole
Verbenaceae	*Verbena menthaefolia* Benth.	Picarro	Whole
Grasses			
Poaceae	*Erioneuron pilosum* (Buckley) Nash.	Zacate	Leaf
Poaceae	*Dasyochloa pulchella* (Kunth) Willd. ex Rydb.	Zacate	Leaf
Poaceae	*Sporobolus airoides* (Torrey) Torrey	Zacatón	Leaf
Epiphyte			
Bromeliaceae	*Tillandsia recurvata* L.	Paxtle or paixtle	Whole
Suculents			
Cactaceae	*Terocactus pilosus* (Galeotti ex Salm-Dick)	Biznaga	Fruit
Cactaceae	*Opuntia* spp.	Chicharroncillo	Stem, fruit

Table 2. Shrubs and trees consumed by grazing goats.

Group/Family	Scientific name	Common name	Part consumed
Shrubs			
Agavaceae	*Agave salmiana* Otto ex Salm-Dyck	Maguey	Flower
Zygophyllaceae	*Larrea divaricata* Cov. ssp. Tridentata	Gobernadora	Early leaf
Asteraceae	*Parthenium argentatum* A.Gray	Copalillo	Leaf
Fabaceae	*Senna wislizeni* A.Gray	Pinacate	Leaf, pod
Fabaceae	*Dalea bicolor* Humb. & Bonpl. ex Willd.	Engorda ganado	Early leaf
Asteraceae	*Brickellia veronicifolia* (Kunth) A. Gray		Early leaf
Asteraceae	*Zinnia acerosa* (DC.) A.Gray	Hierba del burro	Early leaf
Anacardiaceae	*Rhus microphylla* Engelm.	Manzanita	Leaf, fruit
Rhamnaceae	*Condalia mexicana* Schltr.	Pata de gallo	Leaf, fruit
Asteraceae	*Gochnatia hypoleuca* (DC.) A.Gray	Ocotillo	Leaf
Koeberliniaceae	*Koeberlinia spinosa* Zucc.	Junco	Leaf
Krameriaceae	*Krameria navae* Rzed.		Early leaf
Euphorbiaceae	*Jatropha dioica* Sessé ex Cerv.	Sangre de grado	Leaf, seed
Buddlejaceae	*Buddleja scordioides* Kunth	Suelda	Leaf
Boraginaceae	*Tiquilia canescens* (DC.) A.T. Richardson		Leaf
Chenopodiaceae	*Salsola tragus* L.	Maroma	Early leaf
Asteraceae	*Flourensia cernua* DC.	Hojasén	Leaf
Rhamnaceae	*Condalia fasciculata* I. M. Johnst.	Mora	Leaf, fruit
Trees			
Ulmaceae	*Celtis pallida* Torrey	Granjeno	Early leaf
Solanaceae	*Lycium berlandieri* Dunal		Early leaf
Fabaceae	*Prosopis laevigata* (Willd.) M.C. Johnst.	Mezquite	Leaf, fruit
Agavaceae	*Yucca filifera* Chabaud	Palma china	Leaf, fruit

The main plants that goats grazing were *Opuntia* spp., *Yucca filifera, Condalia mexicana, Dalea* spp.*,* and *Euphorbia cinerasiens*. Although data were not available, it was observed in the recorded grasses an apparently low forage value which in turn would be some kind of evidence of former overgrazing by cattle, sheep and equidae, and the consequent encroachment of forbs **a**nd shrubs. But the dominance of these species created a very favorable annual forage supply for goats rather than for cows and sheep (Holecheck et al., 2011). These plant species can probably conform a feeding resource, to achieve this goal the peasant has to organize an annual grazing schedule with the objective of match the animal feed requirements with feed resource availability which changes from season to season (Lécrivain, 2004; Agreil et al., 2008)

CONCLUSIONS

All flocks were grazing in total freedom, guided by goatherds in pastoral grazing circuits and fed on communal rangelands where the most important native forage plants were *Opuntia* spp. *Yucca filifera, Condalia mexicana, Dalea* spp. and *Euphorbia cinerasiens*, and corn stover the main crop by-product supplement used during dry season.

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