Common resource use in a Zapotec community

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I dedicate this research to my parents Sixto Garcia and Paula Fernandez.

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ABSTRACT

Who uses the forage resources under a communal land tenure system? Using data from a Mexican Indian community with a history of communal land tenure extending prior to the Conquest, the research explores and attempts to answer this question. The analysis is based on 1970 socio- economic data for 533 households, secondary sources, and 1987 field observations in a community of Zapotec farmers in the State of Oaxaca, Mexico. The factors influencing who uses the communal resources include livestock ownership, wealth ranking, migration history, and participation in the local labor market. Although all members of the community have the right to graze animals on the commons, only a fraction of the wealthier households exercise this right. Consequently grazing pressure is minimized (reduced) compared to the potential grazing pressure that otherwise would be exerted if all the members of the community were to exercise their rights to use the forage resources at the same time.

INTRODUCTION

One criticism of physical scientists is that they often ignore socio-economic and cultural factors. This criticism is especially directed at scientists from developed countries who work in developing countries. By overlooking the social aspect, they overlook the factors which determine the success or failure of their projects. Range scientists are not immune to this criticism. Despite considerable advances in management practices and technical knowledge for improving rangeland, applications to third world countries have been less than stellar.

Numerous scientists (Heady 1975, Helland 1978, Downing and Ffolliott 1981, Box 1983, Rogers 1983, Oxley et al. 1983, Gupta 1984, Dwyer 1985, Massey 1985) have suggested that range management should be part of an overall management scheme and coordinated with the ecological, social, and economic objectives for the use of a given area. Artz and his associates (1984) emphasized the need to consider the social aspect in formulating range development plans. Also, in their review of the initiation of range management in Morocco in the late 1960's, Fagouri and Gray (1984) listed lack of knowledge of the social structure as one factor that limited the success of the earlier range management projects in reversing the rangeland problems of Morocco. It is this argument, the need for a deeper understanding of the social- economic and cultural aspects of range management, that initiated ideas for this study.

Objective

My goal is not to determine the definitive socio-economic or political factors which, either singly or combined, affect the use and management of rangelands, but to scratch the surface by asking: in a communal land tenure system, who uses the resources found within the communally held lands and what are the mechanisms regulating their use?

This topic was chosen because in many parts of the world, rangelands are usually lands held in common. Secondly, communal ownership of land is an important system of land ownership in developing countries. Thirdly, there is a growing debate between developers, conservationists,

environmentalists, and recreationists, as to who should exploit, or benefit from the public resources. Therefore, there is a need for research into the mechanisms that regulate the use of communal land resources, especially with respect to the range resources of the third world.

Diaz Ordaz, a Valley Zapotec Indian community, located in the ex- district of Tlacolula, Oaxaca, in southern Mexico (Nader 1969, Downing 1973, Sutro 1983, Whitecotton 1984, Fuente 1949)was selected for this study. Diaz Ordaz, a farming community with a communal land base, exemplifies some of the situations or cases that are found in the 4,529 communities (Government of Mexico 1986) in the State of Oaxaca and in many developing countries, especially in Latin America.

I must clarify that the village of Diaz Ordaz was chosen and not the *Municipio de Diaz Ordaz*, which is a much larger political division encompassing several villages under one political jurisdiction. In this case, the government of the municipio is also located in the village of Diaz Ordaz. The choice was based on the fact that in the Indian communities, most of the development or improvement decisions are made at the village level.

Constraints and Opportunities

In the United States, the range manager's job is facilitated by relatively easy access to ecological data bases, to experts in various related fields, to governmental institutions dealing with specific concerns and good communication systems and transport. In the developing countries, especially in the problem areas, these components are absent and, furthermore, where there are data available or where government institutions exist, the bureaucratic process to obtain assistance sometimes is overwhelmingly obstructive.

Overriding constraints faced this project: a lack of reliable database, poor maps at the village level, absence of land title, and unclear land boundaries with neighboring villages. Moreover, I lacked formal training, and was less experienced in dealing with a group of decision makers at the village level rather than on an individual basis.

The positive aspect of this research is that as a result of an anthropological field study undertaken by T.E. Downing from 1965-1970, an extensive socio-economic database exists for the village of Diaz Ordaz.

My thesis is based on library search, personal observations and interviews during Spring and Summer of 1987, and on analysis of T. E. Downing's socio-economic data on Diaz Ordaz collected in 1970.

LITERATURE REVIEW

The concept of the commons has long been a topic for debate among mankind. Aristotle, in the fourth century B.C., observed about the commons: "...that which is common to the greatest number has the least care bestowed upon it." (Hutchins 1968, p. 456d). The debate continues to this day and engulfs not only supporters of private versus communal ownership rights, researchers, and diverse interest groups but also governments. Hardin's argument in the "Tragedy of the Commons," embodies one contemporary perspective of the commons:

> Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a common brings ruin to all. (Hardin 1968, p. 1244).

This perspective contrasts that of Ciriacy-Wantrup and Bishop (1975), who believed that although there were problems with overgrazing, overfishing, groundwater depletion, air pollution and other problems the "theory of common property resources" was an inadequate conceptual tool for the solution of such problems. They held that the institution of common property facilitates rather than hinders the solution of such problems with respect to mobile resources, resources that must be captured (reduced to possession) before they can be allocated to groups or individuals. They argued that capture and allocation might lead to exclusion, therefore, institutional regulations tend to develop to prevent this from happening. With what they call the ubiquitous resources, resources which are not scarce, nobody is excluded from their use.

Although the term "commons" can be used to refer to all resources that fall within the public realm, in my thesis it refers primarily to communally held tracts of lands and their derived resources, i.e., forests, watershed, land for cultivation, forage, fuelwood, etc., or in case of the sea, fishing resources. The commons is defined as "a tract of ground, the use of which is not appropriated to an individual, but belongs to or is used by the public," Webster (1979, p.366). Ciriacy- Wantrup and Bishop (1975) define common property as the distribution of property rights in resources in which a number of owners are co-equal in their rights to use the resource.

This means that their rights are not lost through non-use. But co-equal ownership does not necessarily mean that they are equal in terms of the amount of resources that they use over a period of time. Taylor (1987, p. 291) defines it as "some delimited piece of the world claimed by some equally delimited group of people, a corporate group." According to Ciriacy-Wantrup and Bishop and Taylor's definition, then, the boundaries of the commons and the social group must be defined to determine who the "public" is with the rights to the resources and what those resources are. Communal lands have other characteristics which were identified by Netting (1976) in his study of Trobel, an Alpine village in southern Switzerland: a) value of production per unit area is low, b) frequency and dependability of use or yield is low, c) possibility of improvement or intensification is low, d) area required for effective use is large, and e) amount of labor and capital-investment is large.

Given these characteristics of the commons, what factors affect the intensity of use of the common pool resources? At least five factors have been suggested which appear to influence the intensity of use of the commons: legal and social constraints, technological efficiency of exploitation, population pressure, yield, and value.

Legal or Social Constraints. Legal or social constraints are rules and regulations imposed either by an external agency or agreed upon by the majority of the local people for the exploitation of a given resource in the form of permits or taxation. The government owned and managed lands in the United States are a good example of this form of regulation. Although, theoretically the land is owned by the public, the government manages it and allows only a select few to remove mobile resources for profit under a permit system.

In contrast, third world situations are very different. Wade (1987), in his analysis of 41 villages in India, found a complex local corporate system regulating the use of the commons. The regulatory system was all financed by the people except water distribution which was financed

by the users. The regulating body consisted of a village council with a village standing fund, a group of village guards to protect the crops from livestock and thieves and a group of irrigators.

Changes in the socio-political structure will intensify the use of the commons. Buzdar (1984), in a comparative study of traditional and non-traditional tribal areas in Baluchistan, Pakistan, found that although both traditional and non-traditional range areas tended to be overstocked, the problem was more severe in the non-traditional areas. The penetration of the British colonial government into the political structure of the Baluchi government changed the social relations. Prior to the penetration, the relation between the chiefs and the people was that of mutual regulation, the chiefs vested with an authoritarian power, were selected on the basis of heredity, but the people or tribe could take action against them. After the penetration, the socio- political structure changed. The power of the chiefs decreased. Their relation with the tribe changed from that of ruler to that of intermediaries between the people and the government. The impact of this change on the resources was twofold, a) decreased regulation, and b) increased appropriation of the common rangelands on the part of the chiefs, their families, and supporters. Other changes that influenced the pressure on the rangelands according to Buzdar were changes in customary laws. Self reliance rather than mutual help became the norm. Self reliance was accomplished through an increase in livestock numbers which increased the pressure on the common range resources. Traditional grazing practices such as "closing off" selected ranges to allow regeneration of the vegetative cover were no longer observed.

Technological Efficiency of Exploitation. As technological efficiency increases, exploitation of the communal resources increases. This argument is implied by Anderson (1987) in his study of a Malaysian fishing community of Kampong Mee near Penang in which he described a case where the introduction of a new technology brought disequilibrium to the commons. The introduction of motorized, large fishing vessels which competed with the small fishing boats created

a tragedy of the commons and conflicts which were resolved only by external military and police intervention.

Population Pressure. The population pressure argument says that as population increases, so does the pressure on the resource (Hardin 1968). This argument suggests, that a stable population and emigration will maintain or reduce the intensity of use of the commons, and population growth and immigration will increase the intensity of use of the resources. Stocks (1987), in his study of a lake ecosystem in the Cocamilla communities of the Huallage River of eastern Peru, found that migration into the area increased the population from approximately 300 to nearly 1000. As the population grew, the fish declined.

Yield. In Wade's (1987) aforementioned study of 41 villages in India, he found that areas with high yields where certain inputs of production, i.e. irrigation water, land, and fertilizer were scarce but valuable, had a more complex corporate structure regulating the use of the scarce resources than areas with low productivity or areas where resources were more plentiful but less valuable.

Value. The value of a resource will positively affect the intensity of its use. Anderson's (1987) description of the Malaysian fishing commons is a case where the value of the fishing resource compounded with the introduction of a new technology, the motorized boats or trawlers, led to the decline of the more valuable fish.

From the factors listed above several facts come to light:

a) the intensity of use of the common resources is dependent on several factors,

b) all these factors might or might not be present at the same time,

c) some factors are controllable by the communities or groups involved through some type of regulations while other factors such as technological changes and other external pressures are more difficult to control,

d) regulatory mechanisms are dynamic, and

e) commons comprise many resources within an ecosystem.

With the exception of Wade (1987), whose study concentrated on more than one resource, most of the studies have dealt with single common resources, i.e., fishing, forage, water, etc. and have been concerned with a) the pros and cons of private vs. communal ownership, b) the issue of who should regulate the commons, and c) the issue whether the commons are open access or whether there are regulatory mechanisms controlling it. The research on the topic of the commons have provided an understanding of the regulatory mechanisms that operate within the commons. My objective is to show with respect to the forage resources that, although theoretically everyone has access to the commons, not everyone uses the resources equally. This effect follows Ciriacy-Wantrup and Bishop's (1975) model. Institutional, social, and economic mechanisms limit access to the commons.

METHODS

The methods that were used in this study included personal observations, interviews with livestock and non-livestock producers, and wealth ranking statistical analysis of existing 1970 census data from the village of Diaz Ordaz, collected by T. E. Downing.

Originally I intended to study both cattle and small livestock production but conversations with members of the community and formal interviews with five elderly and reliable members of the community and personal observations revealed that although cattle were present in the village, their use of the most accesible and depleted grazing areas was limited. Oxen were kept in the valley, or at home and fed with alfalfa, corn stubble, and other products. People who were involved in cattle production kept their stock in the distant mountains with infrequent roundups. In contrast to cattle, goats and to a much lesser degree sheep, were observed grazing everywhere, by the roadsides, and on the nearby hills and mountains. Furthermore, some residents felt that goats were contributing to the erosion of the hillsides and were preventing regeneration of not only grass and forbs but also wooded vegetation; therefore, decreasing the availability of forage and firewood. They also felt that the children who were responsible for herding did not know enough to avoid overgrazing an area. Children were observed to combine herds so that they could socialize.

Based on these observations, I decided to concentrate on small livestock, since they appeared to be most responsible for use of the commons' forage resources near the village. Therefore, as a second step, through an initial interview with some reliable members of the community I made a list of small livestock producers. Then I developed a questionnaire that covered various aspects of production, emphasizing numbers of animals, patterns of grazing, and grazing areas to determine whether the areas that were being grazed were private or communal. When I started interviewing, I found that from the original list of 25 people that were known to have small livestock, some had sold their stock either to build a house, or to buy a

team of oxen and either had quit the goat business or were in the process of rebuilding their herd. Some had recently lost their herd due to disease. The interviews were done opportunistically, that is, interviews were obtained with people who were willing to be interviewed. From the original list, a total of 11 people were interviewed.

The questionnaire included inquiries on management practices and socio-economic aspects of livestock production. The questions on management practices included: a) type of livestock (sheep or goat), b) feed (grazing, and supplementation), c) breeding and selection, d) productivity (birth and mortality rate), e) diseases, f) market and marketing time (where and when), g) prices, h) profitability and economics of sheep and goats and i) other benefits. The socio-economic questions included: a) sources of income, b) land ownership, c) grazing privileges in the community, d) length of time in the business, e) livestock preference, f) production system (sole owner, partnership, or sharecropping) and g) herd size. The objective was to understand the management practices and the socio-economic processes involved in small livestock production at the village level.

The socio-economic census data were collected by T. E. Downing in 1970 using a method identical to that described by Grandin (1988) in Wealth Ranking in Smallholder Communities: A Field Manual. The wealth ranking method involves several steps. The first step is identification and delimitation of the community or group under study. In this case a complete census of Diaz Ordaz comprising 533 households was conducted.

The second step involves selection of indigenous concepts for wealth ranking (i.e. lands, livestock, etc.). This insures the comparability of data obtained from the informants and it also insures the units are being ranked according to the criteria that the researcher wants. In this case the criteria was a composite ranking of wealth based on lands, livestock and occupation.

The third step involves the definition of the household, nuclear family, extended family or other. Household was defined as the production-consumption unit. Moreover, household members shared a common residence.

The fourth step involves obtaining a list of households or the unit of study (census, land registry, or reunion places in case of nomadic people). In this case a complete census was made of the village.

The fifth step involves the preparation of three-by-five inch cards, one for each household, with the names of household heads written on one side.

The sixth step involves the selection of informants. In this case a total of five reliable members of the community were selected and given the cards for each of the 533 households at different times and separately and each was asked to rank the cards.

The seventh step involves coding the information obtained from the rankings. The rankings were coded on the reverse side of the card, the card shuffled, and then given to the next informant to rank.

For each of the 533 households, the rankings of the five informants were averaged. As a result there were twenty one wealth ranking groups. The twenty one rankings were combined to obtain four rankings: poor, middle poor, middle wealthy, and wealthy. It was observed that consistency in ranking was high among the informants.

On each card, supplemental information was coded for the following: household location, ownership of oxen teams, cattle, small ruminants, inheritance status, participation in the traditional religious services, involvement in the labor market (buying or selling), migration history, land acquisition behavior, a subjective comparison of the wealth of the household head compared to his or her parents, occupations including and apart from agriculture, and age of the household head.

One of the advantages of this technique, as Grandin (1988) points out, is that it allows the researcher to determine who controls the resources. In terms of livestock production, it might determine the number of animals or species, management strategies, and use. A disadvantage with this method is that it only gives qualitative data rather than quantitative data. Therefore, if a project needs to be implemented on the basis of the data, census data might be more appropriate.

I used the chi-square test to evaluate the relationship between animal ownership and social attributes such as wealth, occupation, seasonal migration, parental wealth, involvement in the labor market, and agricultural land purchasing behavior.

For wealth ranking and animal ownership analysis, a 4 x 4 contingency table was set up with wealth rank in columns (k) being "poor," "middle poor," "middle wealthy," and "wealthy" and animal ownership in rows (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

For occupation and animal ownership analysis, a 3 X 4 contingency table was set up with (k) being "farmer," "farmer and other occupation," and "non-farming" and (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

For migration and animal ownership analysis, a 3 X 4 contingency table was set up with (k) being "has not migrated," "has migrated once," and "has migrated frequently" and (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

For wealth relative to parents and animal ownership analysis, a 3 X 4 contingency table was set up with (k) being "less than parents," "equal to parents," and "more than parents" and (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

For involvement in the labor market and animal ownership analysis, a 4 X 4 contingency table was set up with (k) being "works his own lands," "sharecropper," "gives out land to share-

croppers," and "peon" and (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

For land purchasing behavior and animal ownership analysis, a 2 X 4 contingency table was set up with (k) being "no" (has not purchased agricultural lands) and "yes" (has purchased agricultural lands) and (r) being "none," "oxen," "oxen and or small livestock," and "oxen and/or cattle."

RESULTS AND DISCUSSION

The first part of this section provides a description of the study area, livestock management and an overview of resource management in Diaz Ordaz. This village and its adjacent hills suffers from overgrazing and deforestation, although no quantitative estimates of the extent of these problems is available. The second part deals with the analysis of the 1970 and 1987 socio-economic data, and some changes which have occurred from 1970 to 1987.

Description of Study Area

Before I focus specifically on the commons, some background on the village is necessary.

Location

Diaz Ordaz, formerly known in Zapotec as "Niguigo," at the foot of the river, and as Santo Domingo del Valle (Candiani 1883), is a Valley Zapotec Community. It is located in the southeastern corner of the Oaxacan Valley, in the state of Oaxaca in southern Mexico, at longitude 96°26', and latitude 17°00' N, at approximately 1680 m above sea level (Sutro 1983). The land area was estimated to be between 20 square miles or five square leagues (a league is approximately equivalent to four English miles) in 1883 (Candiani 1883), and 50 square kilometers in 1974 (Downing 1974).

Boundaries

The village of Diaz Ordaz occupies the southern portion of the Municipio de Diaz Ordaz. It borders with the Municipio de Villa de San Pablo Mitla, to the east, and southeast. To the south, and southwest, it borders with the Municipio de Tlacolula. To the west it borders with the Municipio de Santa Ana del Valle. (Fig. 1).

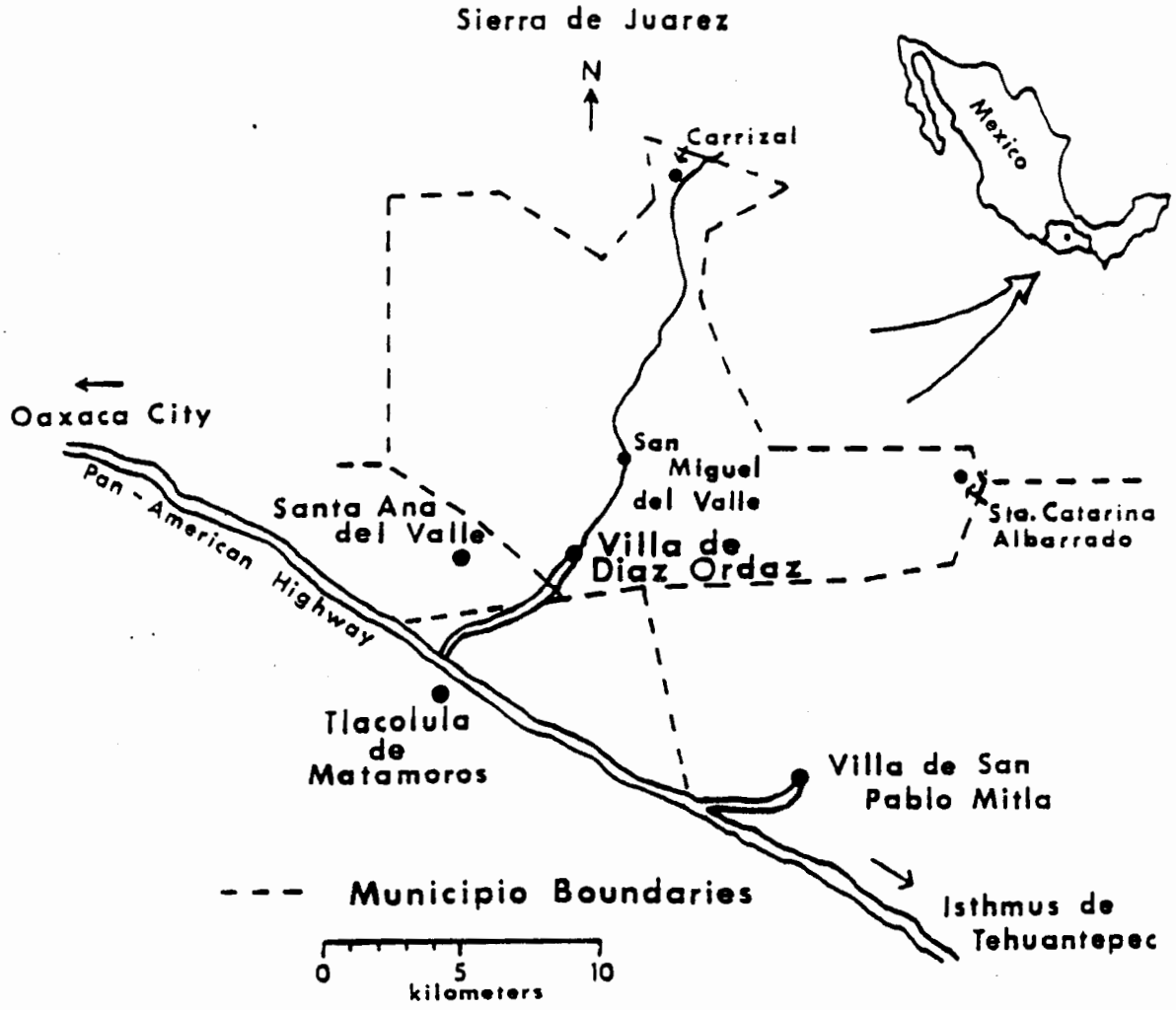

Fig. 1. The Village of Diaz Ordaz and its Boundaries (Bufete de Profesionistas del Sur 1982, Map 24).

History

Diaz Ordaz is located within an area that has been inhabited since 10,000 B.C. (Winter 1988). However, as it currently exists, Diaz Ordaz was founded in 1526. Titles to the land were extended in 1646. It appears that the village was founded by a group of small livestock herders from the town of Tlacolula (Sutro 1983). Historical records from the village archives, (Document # 39, book 12, 1890 and 1960 extract from title) reveal that in 1588, in addition to what it already had, "livestock, houses, and corrals," the Spanish crown granted Diaz Ordaz an additional site known as *Yactayaba,* for the production of small livestock. This site is located about one quarter of a league from the village at the base of a mountain on the east side of the village (this site is probably at the base of the mountain known as "El Campanario"). The following conditions were included in the Spanish grant:

1. Within a year they should populate the site with 4000 head of small livestock.
2. They could not sell, mortgage, or transfer said site.
3. They could not depopulate the area for a period of more than four years.

Population

In 1986, the population of Diaz Ordaz was approximately 3137 inhabitants, 1535 men and 1602 women (Municipio de Diaz Ordaz 1986).

Language

The native language is Zapotec and is spoken by everyone in the village. Spanish, the official language is also spoken, but infrequently.

Communication

Diaz Ordaz has approximately six kilometers of paved road which links it to the west with the Pan-American Highway and dirt roads which link it to other villages in the north and northeast. It also has a single long distance phone located at a private house in the downtown area.

Climate

Although in the valley of Oaxaca, precipitation ranges from 435 mm to 825 mm (Downing 1974), the mean annual precipitation reported for Diaz Ordaz is 492.5 mm, with 76 days of more than 0.01 mm (Sutro 1983). The amount of precipitation that the Oaxacan Valley receives is influenced by its location in the western shadow of the continental divide. The dry season is between October and April. There is some scattered rain during May and June and afternoon rains during the month of July. Precipitation is low in August, but it is followed by heavy rains in September (Downing 1974).

Annual temperature ranges from 0.0°C to 38.8°C with an average of 20.4°C. In early winter, Diaz Ordaz gets about 15 days of frost a year (Sutro 1983).

Topography

The topography of Diaz Ordaz is characterized by a valley in the southern portion of its territory and small hills on the west. East of the village, the mountain known as *El Campanario* rises from south to north and penetrates the lands of San Miguel del Valle where it joins the mountains of La Neveria (Candiani 1883).

Vegetation

The Oaxacan valley with its contiguous chain of mountains is within several vegetational zones. The hills and mountains of Diaz Ordaz contains four of these vegetation zones (Secretaria de Agricultura y Recursos Hidraulicos 1980), induced pasture areas, oak forest, deciduous tropical forest, and oak and pine forest and interspersed with rainfed agriculture, while the valley floor is dominated by rainfed agriculture and limited irrigated agriculture (Fig. 2).

The induced pasture are areas where the original wooded vegetation has gradually been replaced by grasses. The conversion to pastures in the induced pasture areas has occurred either intentionally as in the case of seeded pastures or unintentionally as in the case of the hillsides of the Oaxacan Valley, where removal of the wooded vegetation through slash and burn

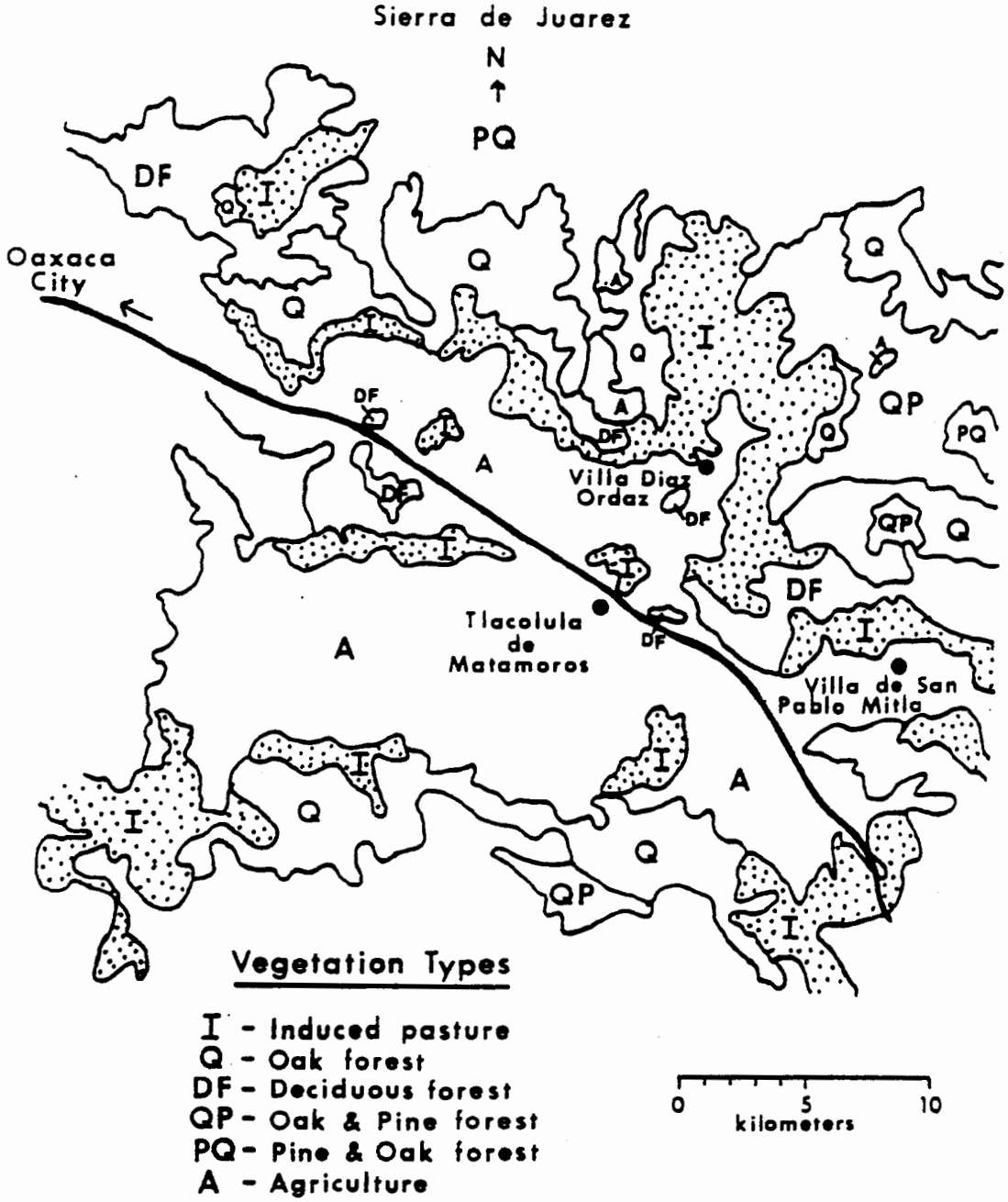

Fig. 2. Land Use and Vegetational Zones of the Tlacolula Wing (Government of Mexico 1985).

agriculture, timber cutting, and fuelwood collection has converted these areas into pastures. The induced pastures are in the valley, and hills, with 0 to 65% slopes, at 1,420 to 2,000 m elevations, temperature range of 16°C to 20°C, and annual precipitation of 500 mm to 1000 mm (Secretaria de Agricultura y Recursos Hidraulicos 1980).

Although data for the ex-district of Tlacolula where Diaz Ordaz is located is not yet available, data from other ex-districts within the Oaxacan Valley with similar climate, and topography indicates that within the induced pastures the following species can be found: *Aegopogon cenchroides*, *Andropogon gerardi*, *Aristida schiedeana*, *A. ternipes*, *A. wrightii*, *Bouteloua curtipendula*, *B. media*, *B. repens*, *B. triaena*, *Brachypodium latifolium*, *Brachypodium mexicanum*, *Bromus carinatus*, *B. porteri*, *Chloris aristata*, *C. submutica*, *C. virgata*, *Eragrostis diffusa*, *E. minor*, *Eragrostis* sp., *Heteropogon contortus*, *Hilaria cenchroides*, *Leptochloa dubia*, *Microchloa kunthii*, *Muhlenbergia* sp., *Opizia stolonifera*, *Panicum bulbosum*, *Paspalum setaceum*, *P. notatum*, *Piptochaetium fimbriatum*, *Setaria adhaerans*, *S. geniculata*, *S. macrostachya*, *Setaria* sp., *Sphenopholis obtusata*, *Sporobolus indicus*, *Stipa eminens*, *S. ichu*, *Tripsacum pilosum*; the introduced species are *Bothriochloa saccharoides*, *Eragrostis barrelieri* *Hordeum vulgare*, *Rhynchelytrum repens*, *Setaria lutescens*, and *Sorghum halepense* (Secretaria de Agricultura y Recursos Hidraulicos 1980).

Based on the native vegetation and in years with reliable rainfall and in good condition these areas yield 518 kg of useable dry forage per hectare, an equivalent carrying capacity of 9.5 ha/animal unit (cow and its calf)/year (Secretaria de Agricultura y Recursos Hidraulicos 1980).

The oak forest vegetation is found in the hills and piedmont areas with 12 to 65% slopes or greater, at elevations ranging from 1800 to 2000 m, with an average temperature of 18°C and an annual precipitation ranging from 600-800 mm (Secretaria de Agricultura y Recursos Hidraulicos 1980).

The wooded species included in this category are: *Acacia tortousa, Baccharis conferta, Pinus oaxacana, P. patula, Quercus crassifolia, Q. obtusana, Q. segoviensis, Tephrosia talpa,* and *Rhus* sp. The grasses include species such as *Aristida arizonica, Bouteloua filiformis, Bromus* sp., *Cynodon dactylon* (an introduced species), *Hilaria* sp., *Sporobolus atrovirens*, and others (Secretaria de Agricultura y Recursos Hidraulicos 1980).

The deciduous forest (Government of Mexico 1985) or deciduous tropical forest (Rzedowski 1986) is found at elevations ranging from 0 to 1900 m, with 20 to 29°C average temperature, and annual precipitation in the 600 to 1200 mm range.

This vegetation type includes, species such as *Acacia farnesiana, Adenostoma* sp., *Arbutus* sp., *Bursera* sp., *Byrsonima crassifolia, Cassia* sp., *Ferocactus* sp., *Ipomea intrapilosa, Prosopis* sp., *Myrtillocactus* sp., and other *cactaceae* (Government of Mexico 1985).

The oak and pine forest vegetation is found at elevations ranging from 2,000 to 2,600 m, with an annual temperature range of 14 to 18°C and annual precipitation range of 600 to 1,200 mm (Secretaria de Agricultura y Recursos Hidraulicos 1980).

Some of the wooded species that are found in this vegetation zone include, *Arctostaphylos pungens, Calliandra albensis, Pinus teocote, P. lawsoni, P. michoacana f. cornuta, P. oocarpa, Quercus acutifolia*, and *Q. crassifolia,* The grasses include species such as *Andropogon hirtiflorus, Aristida wrightii, Bothriochloa saccharoides, Calamagrostis tolucensis, Eragrostis lugens, Eragrostis* sp., *Muhlenbergia rigida, Panicum bulbosum, Paspalum botterii, Polypogon interruptus*, and *Trisetum deyuxioides* (Secretaria de Agricultura y Recursos Hidraulicos 1980).

In good condition and based on native vegetation, forage yield in this area is estimated at 560 Kg/ha of usable dry forage and an estimated carrying capacity of 8.8 ha/A.U./year (Secretaria de Agricultura y Recursos Hidraulicos 1980).

Land Tenure

There are three types of land tenure systems in Diaz Ordaz: *ejido* property, private property, and communal property. An unpublished map based on T.E. Downing's 1970 field work displays the areas of different land tenure. Out of its estimated 5000 ha, approximately 266 ha is *ejido* land, government owned property assigned to an individual during his lifetime. *Ejido* lands might be used by heirs but can not be sold or transferred by the individual. The local committee in charge of the *ejido* lands is the only group empowered to make any decisions with respect to *ejido* lands. Approximately 1084 ha (including approximately 200 ha of housesites) is privately owned. The privately owned land can be sold at will, and to whom it might be sold is a personal matter, not a village decision as some authors have argued (Dennis 1976). The remaining 3650 ha of the village land is under communal ownership (Fig. 3). The *Comite de Bienes Comunales*, the committee of communal resources, is in charge of regulating the use of the communal

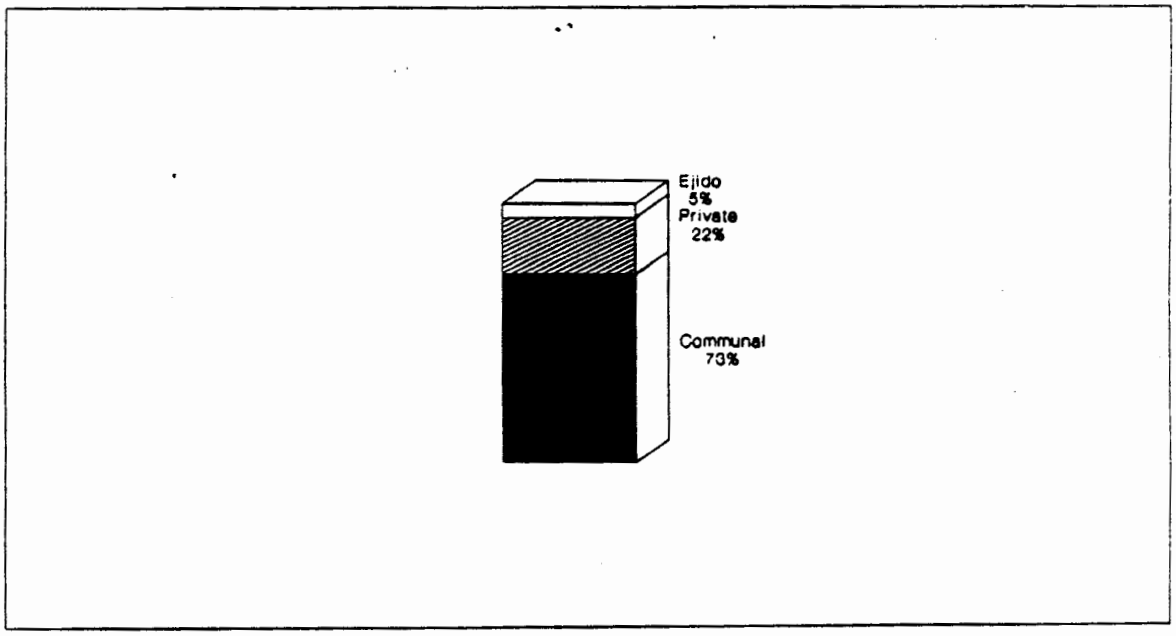

Fig. 3. Land Tenure Distribution in Diaz Ordaz (Data from T. E. Downing's Unpublished Map, 1970).

resources. All members of the community have the right to use or to participate in the exploitation of the communal resources, i.e., land, firewood, sand, gravel, rocks, water, and forage resources. These resources are not under the federal or state jurisdiction, such as oil, or ore mining which are classified as national resources. Forest exploitation is theoretically shared with the federal government. But in the past, forest exploitation has basically been a government concession to extracting companies with the intervention of the *Fondo Nacional de Fomento Ejidal*, a government organization in charge of channeling the moneys generated from the forest resources, which theoretically is supposed to reinvest 50% of the funds generated into projects for the collective benefit of the community. The remaining 50% is used to develop agricultural activities outside of the community from where the resource is being extracted and outside the state (Acevedo 1969).

Land Use

Out of its estimated 5000 ha, approximately 1100 ha is regularly under cultivation with corn, alfalfa, beans, peas, and squashes. Two hundred and fifty hectares are regularly irrigated and 850 hectares are rainfed agriculture. The town covers an area of approximately 200 ha. Out of the remaining 3700 ha (99% communal), approximately 300 to 400 is covered with oak and pine forest at the higher elevation. Most of the 3700 ha is grazed; intermittent rainfed cultivation is practiced at the lower elevations and in those areas adjacent to the village.

Livestock Management

This section focuses on various aspects of small livestock management in Diaz Ordaz including feed, breeding and selection, productivity, diseases, prices, market and marketing time, profitability and economics of sheep and goats and other benefits.

Feed

With the exception of weaklings who are kept at home on "atole," a corn drink, or other available feed until they are able to join the herd, small livestock depend on grazing. All the

interviewees grazed their animals on communal lands. Most of the people grazed their animals north, northeast, east, and southeast of Diaz Ordaz. When asked why, they said that those were the best areas because there is more space and pasture. The southern, western, and northwestern portion of Diaz Ordaz's land is occupied by croplands. There is scattered rainfed agriculture within the grazing areas in the hills and mountains.

Breeding and Selection

Both sheep and goats are bred year round. Selection involves keeping large animals, productive animals, and "good" mothers. Old animals, excess males, small and unproductive animals are sold. Recently, some organizations have attempted to introduce some new and improved breeds of sheep but they did not do well due to lack of pasture. People like the improved goat breeds such as Nubia but they feel that the does do not search for food as efficiently as the criollo does because imported breeds require more attention and care. Therefore, some producers are attempting to improve their stock by crossing the billy from the improved breed to a criollo nanny.

Productivity

Owners reported the birth rate to be one kid per doe and one lamb per ewe per year. Mortality rate was reported to be high, at 52%. One case reported a 94% mortality rate in one year of newborn and additional losses of 45 does, more than half of his stock.

Diseases

Some of the most devastating problems faced by the producers in Diaz Ordaz are related to diseases. Among the interviewees there were cases where more than half of the stock was lost to disease. Although I was given the symptoms of various diseases, there wasn't enough information to determine the specific diseases. However, conversations with Dr. Carlos Reggiardo from the Department of Veterinary Sciences at the University of Arizona suggests that given some of the symptoms that were described it appears that some of the diseases might be

associated with malnutrition and parasites. One of the diseases that was described appears to be *caseous lymphadenitis* as a search through the literature reveals that the symptoms coincide with those described by Campbell, Ashfaq and Tashjian (1982).

Market and Marketing Time

The major market for the animals produced in Diaz Ordaz is a weekly stock market in the town of Tlacolula, six kilometers from Diaz Ordaz (Fig. 4). Other markets include Diaz Ordaz itself, San Miguel del Valle, and other villages nearby. Best marketing time is November, December, January, August, September, and October when major holidays are celebrated. The worst marketing time is in March, April and May because the animals weigh less; therefore, they do not bring good prices. However, animals also are sold whenever there is a major financial need in the household.

Prices

Prices ranged from 800 to 3000 pesos for kids or lambs. Prices for the larger animals ranged from 10,000 to 40,000 pesos per live animal, both sheep and goats.

Profitability and Economics of Sheep and Goats

Fifty five percent of the people who were interviewed thought that goats were more profitable than sheep because of their hardiness. Nine percent considered sheep more profitable. Eighteen percent thought that they were equally profitable and 18% had no comment (Table 1). Goats were considered to be more profitable because they are not as "fragile" and susceptible to disease as are the sheep, therefore, they had greater chance of survival and yield. Some remarked that the small livestock business is a good economic alternative if there is no land to work, and no other job opportunity. This occupation was considered better than being a laborer, providing that the animals do not die. Due to the high animal mortality rate, it is a risky business. Interviewees also remarked that there has been an increase in the number of goats which has decreased the profitability, and that the animals take a long time to grow.

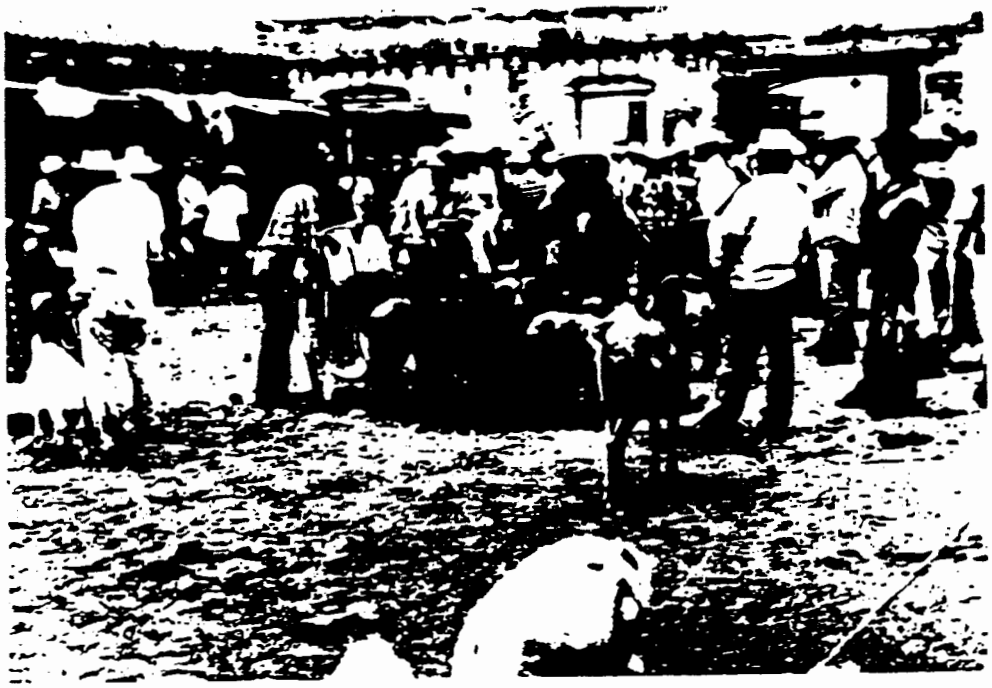

Fig. 4. People Selling Animals at the Regional Market of Tlacolula, 1984.

It appears from the size of the herds that sheep and goat raising is both a means of saving and earning a livelihood. Some owners mentioned that unless you have more than 200 sheep or goats you can not make a livelihood out of the business. Considering that only 18% of those interviewed reported having in their care more than one hundred goats, and 9% owning more than one hundred goats, with the average being 46, the percentage of households whose sole livelihood is small livestock raising is very low.

Table 1. Profitability and economics of sheep and goats in Diaz Ordaz based on 1987 survey.

Profitability	Interviewees (%)
Goats are more profitable than sheep	55
Sheep are more profitable than goats	9
Equally profitable	18
No comment	18
Total	100

Other Benefits

Apart from cash, other benefits obtained from the animals were wool and meat for personal consumption (Fig. 5). Another reason given was that it teaches children discipline and sensitivity. It occupies the children until they become strong and old enough to either work in the fields or to get an alternative occupation (Fig. 6).

Fig. 5. Women Carding Wool in Preparation for Blanket Weaving in Diaz Ordaz, 1985.

Fig. 6. Young Herders on Their Way to Graze Their Animals, 1984.

The Diaz Ordaz Commons

Communal land controlled by Diaz Ordaz is relatively large as compared to the amount of private and *ejido* lands, 73% communal lands vs. 27% of private and *ejido* lands (Fig. 3). Apart from the land, other common resources include firewood, timber, sand, gravel, rocks, potable water, irrigation water, forage and forest.

Theoretically every member of the community is guaranteed access to the communal resources in exchange for his participation in the community government. However, access to the various resources is limited in some cases, and cyclical in other cases.

The Communal Land

The land itself plays an important economic role in the lives of the people, since it is the only means of production for the landless farmers or farmers with limited private lands. Permission rights to cultivate communal land is obtained from the *Comite de Bienes Comunales*. While in some other villages in the valley a small fee is required (Dennis 1976), in Diaz Ordaz access to the land is free.

Potable Water

One of the most important resources which is accessible to everyone is potable water. This valuable resource is derived from the communal lands, and is captured from three streams, one approximately nine kilometers east of the village, another about one and a half kilometer east from the center of the village and the third one about one kilometer north from the center of the village. The water has been free, but any expenses involved in the water development project, i.e., pipe, cement, etc. is shared by the beneficiaries. There is a committee in charge of the potable water. If conflicts arise which the committee members are unable to solve, then these conflicts are delegated to the municipal authorities.

Irrigation Water

Unlike potable water, use of irrigation water is limited to farmers who own lands or work lands along the river bed or along the irrigation canals. Thus, the amount of land that can be irrigated or is within reach of the irrigation canals limits access to this specific resource. Like the potable water, cost of improvements or repairs along the canals is shared by the beneficiaries (Downing 1974). Like the potable water, a committee composed of users is in charge of regulating the use of irrigation water. Also, serious conflicts or conflicts which the committee can not handle are delegated to the authorities.

Fuelwood

Next to potable water, the other valuable resource for the community is firewood. Most of the population is still dependent on firewood. Although precise data is not available for Diaz Ordaz, excluding Oaxaca, census data for the state indicates that 80% of the rural population depends on firewood for fuel (Fig. 7). In the case of Diaz Ordaz, everyone has free access to this resource as long as it is for personal consumption. If it is for sale and in large quantities, i.e. a truck load,

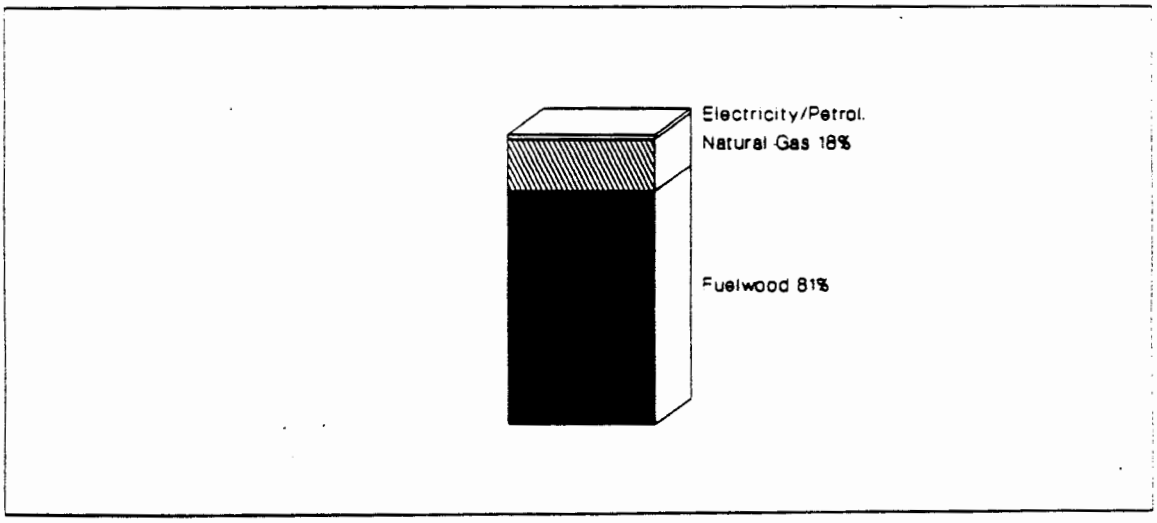

Fig. 7. Fuelwood Consumption in the State of Oaxaca, excluding Oaxaca City (Government of Mexico 1986).

then there is a charge of $ 1000.00 (one thousand pesos) an U.S. equivalent of 0.45 dollar. The opening of the new road to the Diaz Ordaz forest by the extracting company encouraged outsiders to penetrate into Diaz Ordaz's land to exploit the forest for firewood by truck loads. The road was located on Diaz Ordaz's communal lands, so when the municipal authorities observed the increased intrusion, they put up a gate to prevent people exploiting their resources without their permission.

Sand, Gravel and Rock.

Like the other resources, everyone in the community has free access to these resources for personal use. However, if it is for commercial purposes then there is a charge. Currently, there is a group of people from the community exploiting and selling these resources outside the community. For commercial exploitation they require a permit from the municipal authorities, and they also contribute sand, gravel or rock when needed for community projects.

Forest

Diaz Ordaz still has a few hectares of oak and pine forest remaining, thanks to a few members of the community and an order from the forest service. According to one of the elderly people who was interviewed, the pine trees were being harvested prior to 1938 -1939 (?) for timber both for personal and commercial use by members of the community. However, in 1938-39 the municipal authorities received an order from the forest service to stop the exploitation of the forest. The community complied and so the forest remains. However, as the forest resources began to dwindle in other parts of the state, the pressure to exploit the remaining forest has increased in recent years. Thus, pressure to exploit the forest resources of Diaz Ordaz still divides the community. In the past, forest exploitation has taken the form of government concessions to large extraction companies with minimum compensation to the communities whose forests were being exploited. But, some communities are becoming more aware of the economic value of their forests; therefore, they are requesting more active participation and

involvement in the exploitation of their forest resources or they refuse to exploit it. Diaz Ordaz is one of those villages. In discussing the resources with one of the ex-presidents of the community, he said that just recently, in the last 8- 10 years or so, there was heavy pressure from a large extracting company for Diaz Ordaz to sell its forest. The community was almost persuaded to sell its forest as the extraction company was offering some "major" incentives such as the building of a dirt road to reach Diaz Ordaz's forest, and that of another village, Santa Catarina Alvarradas, one of the bordering villages that was willing to sell its forest. But the villager's awareness of the economic value of the forest per se, and its importance as shelter to the remaining fauna, protection for the watershed and as protection and source of species such as mushrooms, other plants such as moss and lichens which have economic value during the Christmas season and most of all "its value to future generations" convinced the people of Diaz Ordaz not to sell their forest.

Since an access road was needed through the communal lands of Diaz Ordaz in order to reach the village of Santa Catarina Alvarradas, Diaz Ordaz ended up bargaining with the extraction company, and obtained a "free" road and partial help with materials for the construction of a new school for the community without parting with its forest. The old ex-president is very proud that Diaz Ordaz still has a forest. If the forest is eventually sold, the income will be converted into a communal project for the benefit of the community.

Forage Resources

The communal land areas are the only areas where the animals can graze, since most of the arable land in the valley is under cultivation throughout the year. The users of the grazing areas can be classified into four groups. The first group are the farmers who own a pair of oxen. The second group are the farmers who own more than a pair of oxen, these people tend to have somewhere between 10 to 40 head of cattle. The third group is comprised of small livestock producers with herds averaging more than 20 or more heads, predominantly goats. The people

interviewed were in the third group. The fourth group are the people who own just a couple of animals.

Because of the large capital investment their team of oxen represent, people who own oxen, tend to graze them in the valley when the land is not under cultivation or they keep them at home on alfalfa or stubble collected after each harvest. In contrast to the oxen owners, cattle producers keep their cattle in the mountains, basically in the forested area and round them up infrequently.

Therefore the animals that graze the communal lands in the area intermediate between the mountains and the valley lands are the small livestock, especially the smaller and the intermediate size herds. It was observed that the small herds were usually under the care of young children, ages 8 to 12, and grazed in the areas adjacent to the village. There were two reasons for this behavior: 1) that the children were usually of school age, therefore, the animals were kept at home while the children were in school and were taken into the hills in the afternoons, and 2) might have been their age, older children ages 13 and over traveled longer distances and usually had larger herds ranging from 20 to 25 or more. Both groups usually bring their animals back home after the end of the day. The older herders with herds comprising over fifty head usually go even further. These people sometimes keep their animals in a corral somewhere in the fields or they also bring them home. The older children and older herders, when asked where they usually grazed their animals and why, responded that there was more forage and there was more open space.

Analysis of 1970 Socio-Economic Data

Using the wealth ranking method described under the methods section, the factors influencing who uses the communal forage resource were determined by comparing several characteristics of 533 households with animal ownership. These characteristics included wealth,

the population. The judges ranked the households with small livestock as wealthier than other households. Therefore, the results support Ciriacy-Wantrup and Bishop's (1975) proposition that co-equal ownership doesn't necessarily mean equal use.

In addition, it appears that the communal grazing ground is further "subdivided" among users with the cattle owners using the remote mountain or forested areas at the higher elevations for open grazing with infrequent roundup. Next, the small livestock owners with larger herds graze their stock in the intermediate mountains or fields, close enough for the herders to be able to leave and return home everyday. The hills most adjacent to the village (within a few minutes walk) and the roadsides are used by the small herds usually under the supervision of children. After harvest and between crops, the oxen graze the arable land in the valley, along the roadsides, and they are also fed alfalfa, corn husk or stubble and graze the immediate hills to a limited extent. Although there is no current record on the number of teams of oxen, the number was estimated at 160 pairs in 1970. Oxen appear to have decreased due to the introduction of tractors

In the case of Diaz Ordaz, the results show who the livestock owners are, therefore, who uses the forage resources. But who uses the communal lands for cultivation purposes is unknown, as the presence of intermittent rainfed agriculture was observed within the areas considered as communal lands. Therefore, these users and their degree of utilization also must be clearly identified in order to make sure that they are included in any improvement or development project or plan.

Occupation and Animal Ownership

Although Diaz Ordaz is perceived as a farming community, not everyone farms. The results indicate, that of the households surveyed, 58% were involved only in farming, 21% were in farming and some other occupation and 21% were involved in various non-farming activities, i.e.

bricklayers, bakers, butchers, painters, weaving, etc. People who were involved in farming, either full or part time were more likely to own livestock than those not involved with farming (Table 3). The percentages observed were, respectively, 62% of the households did not own livestock, 34% owned a team of oxen, 3% owned oxen and/or small livestock, and 1% owned cattle. Of the households that were involved in farming, 42% owned a team of oxen. In contrast, only 4% of the people who were involved in activities other than farming owned a team of oxen. Only 4 percent of the households were involved in small livestock or cattle production. Of those that were involved in livestock production, 3% were farmers and 1% were involved in other activities.

Table 3. Occupation and animal ownership in Diaz Ordaz based on 1970 survey.

	Occupation			
Livestock ownership	Farmer	Farmer and other occupation	Non-farmer	Total
None	146	73	98	317
Oxen	133	35	4	172
Oxen and/or small livestock	10	1	2	13
Oxen and/or cattle	6	0	1	7
Total	295	109	105	509

CHI-SQUARE = 68.236, D.F. = 6, PROB. = 2.000E-12

The value of chi-square for these data was 68.236 with 6 degrees of freedom, and level of significance $p < 2.000E-12$. Therefore the null hypothesis that occupation and animal ownership are independent was rejected.

People who were involved in farming were more likely to own livestock. In terms of the commons, alternate occupation decreases the use of the common forage resource. Therefore,

the creation of new occupations for the people other than farming might reduce the intensity of use of common forage.

Seasonal Labor Migration and Animal Ownership

In 72% of the households that were ranked, the head of the household had no history of long distance seasonal migration to the United States and 28% had migrated to the United States (Table 4). Of those households that had migrated, 30% had migrated more than once. Of those households that had no history of migration, 34% owned livestock, oxen and small livestock or cattle. Of those households who had migrated once, 54% owned livestock, oxen and small livestock or cattle. And, of those households that had migrated more than once, only 26% had livestock, in the form of oxen. Livestock production was associated with the first two groups of households, the ones with no migration history and one time migration.

The value of chi-square for these data was 18.278 with 6 degrees of freedom, and level of significance $p < 5.575E-03$. Therefore the null hypothesis that migration and animal ownership are independent was rejected.

The results obtained in the analysis of the socio-economic data show that a greater percentage of households with a history of one-time migration owned livestock than those with no migration history. However, households where migration was frequent, the proportion of households with livestock was less than that observed in either the households with no migration or one-time migration. These results seem to indicate that one-time migration tends to increase the likelihood of livestock ownership. On the other hand, frequent migration reduces the likelihood of livestock ownership especially in the productive sector. In terms of the common forage resources we can conclude that infrequent seasonal migration is more likely to increase the likelihood of livestock ownership; therefore, use of the forage resources will more likely increase. But, frequent seasonal migration reduces the likelihood of livestock ownership, which in turn, reduces use of the forage resources. Whether the people who migrate frequently are the

poor people, therefore, their use of the forage resources would have been limited from the onset is unknown, since the relationship between migration and wealth was not determined.

Table 4. Seasonal labor migration to the United States and animal ownership in Diaz Ordaz based on 1970 survey.

	Migration			
Animal ownership	No migration	One-time migration	Frequent Migration	Total
None	246	46	32	324
Oxen	112	50	11	173
Oxen and/or small livestock	10	3	0	13
Oxen and/or cattle	5	2	0	7
Total	373	101	43	517

CHI-SQUARE = 18.278, D.F. = 6, PROB. = 5.575E-03

Wealth Relative to Parent's and Animal Ownership

A greater proportion of the people who were ranked as being wealthier than their parents owned animals when compared with people ranked equal to or less wealthy than parents. Upward mobility appears to be linked to livestock ownership. Only 26.5% of the households that were ranked less wealthy than their parents owned animals, and 1.7% were involved in livestock production. In contrast, 55.4% of those households that were ranked wealthier than their parents owned livestock and 9.5% participated in livestock production (Table 5).

The value of chi-square for these data was 46.995 with 6 degrees of freedom, and level of

significance $p < 1.876E-08$. Therefore, the null hypothesis that wealth relative to parent's and animal ownership are independent was rejected.

Table 5. Wealth relative to parent's and animal ownership in Diaz Ordaz based on 1970 household survey.

	Wealth relative to parents			
Livestock ownership	Less than parents	Equal to parents	More than parents	Total
None	175	79	70	324
Oxen	56	45	72	173
Oxen and/or small livestock	3	1	9	13
Oxen and/or cattle	1	0	6	7
Total	235	125	157	517

CHI-SQUARE = 46.995, D.F. = 6, PROB. = 1.876E-08

People who were ranked wealthier than their parents were more likely to own livestock. This finding could possibly be interpreted as evidence that people who want to improve their wealth status in a farming community are more likely to put their surplus production into animals as savings, especially where no other alternative means of investment is possible. In many of the areas where subsistence agriculture predominates, other factors such as the short supply of agricultural lands in the market and lack of banking opportunities makes livestock and other domestic animals such as chicken and turkeys the only means of savings or as Gudeman (1978) calls it, the "storehouses of surplus production."

Involvement in the Labor Market and Animal Ownership

Households where the head worked his own lands, worked somebody else's lands, or gave out land to sharecroppers tended to own more livestock and participate more in livestock production than the landless people who sold their labor (Table 6).

Table 6. Involvement in the labor market and animal ownership in Diaz Ordaz based on 1970 survey.

	Selling or buying of labor				
Livestock ownership	Works his own lands	Share-cropping	Gives out land	Sells his labor	Total
None	126	23	45	130	324
Oxen	97	66	4	6	173
Oxen and/or small livestock	9	2	2	0	13
Oxen and/or cattle	2	5	0	0	7
Total	234	96	51	136	517

CHI-SQUARE = 158.229, D.F. = 9, PROB. = 4.486E-07

The value of chi-square for these data was 158.229 with 6 degrees of freedom, and level of significance $p < 4.486E-07$. Therefore the null hypothesis that involvement in the labor and animal ownership are independent was rejected.

Households where the head sells his labor is less likely to own livestock. This fact further supports the finding that households where people were involved in farming activities were more likely to own livestock than those who were involved in other activities. And it also supports the

finding that the wealthier households were more likely to own livestock than the poorer households where the head of the household sold his labor.

What does this mean for range management? What does this mean for the commons? This finding again does nothing more than identify the users or non-users of the communal resources. Therefore, like the findings on the relationship between wealth and livestock ownership, its significance for range management is the lack of uniformity in the use or exploitation of the communal range resources of a community with a communal land base. Improvement projects must be developed with this lack of user uniformity in mind.

Agricultural Land Purchasing and Animal Ownership

Only 8.3 % of the households purchased agricultural lands, the rest received their property through inheritance (Table 7). However, of those who purchased land, a disproportionately high

Table 7. Agricultural land purchase and animal ownership in Diaz Ordaz based on 1970 survey data.

	Agricultural land purchases		
Livestock ownership	No	Yes	Total
None	310	14	324
Oxen	150	23	173
Oxen and/or small livestock	8	5	13
Oxen and/or cattle	6	1	7
Total	474	43	517

CHI-SQUARE = 28.225, D.F. = 3, PROB. = 2.809E-06

percentage owned livestock. Sixty seven percent of those who purchased agricultural land owned livestock and only 35% of those who did not purchase lands owned livestock. Also, a greater percentage of the land purchasers is involved in livestock production, 14%, versus 3% of the non-purchasers.

The value of chi-square for these data was 28.225 with 6 degrees of freedom, and level of significance $p < 2.809E-06$. Therefore, the null hypothesis that agricultural land purchasing and animal ownership are independent was rejected.

The findings on the relationship between livestock ownership and land purchases, parental wealth association, and livestock ownership support the hypothesis that animals are used as a means of saving. Land and animals are the two basic means of savings. Households in the process of increasing their wealth are likely to purchase land, or livestock if agricultural land is scarce.

Analysis of 1987 Socio-Economic Data

The socio-economic questions to the small livestock producers who were interviewed during the Spring and Summer of 1987 included: sources of income, length of time in the business, livestock preference, sharecropping or partnership in livestock production and herd size.

Sources of Income

All of the livestock producers who were interviewed were also involved in other activities, i.e. farming, woodcutting, butchering, commerce, laborer, construction, and other occupations. The mean number of small size plots for corn or other subsistence crop owned by the interviewees was 2.33 plots of private or ejido land. These lands were poor quality lands known locally as second and third class lands.

These findings suggest that for those people involved in small livestock raising, although this might constitute their primary means of subsistence, it is not their only source of income. The people engage in farming on small plots of land, and other complementary activities.

Length of Time Raising Commercial Livestock

Herders' average length of time raising commercial livestock was 13.82 years. The shortest length of time was 2-3 years and the longest being 50 years. One of the 11 interviewees reported that his father and grandfather were herders. It appears that with the exception of a couple of long term producers, livestock production is a transitory activity. Of the original list of 25 livestock producers to interview, a common answer to my request to interview was that they had recently sold their livestock to buy a team of oxen, build a house or other major expense, therefore, they were no longer in small livestock production.

Table 8. Livestock preference in Diaz Ordaz based on 1987 survey.

Livestock preference	Interviewees (%)
Sheep and goats vs. cattle	
Sheep and goats	55
Cattle	36
No comment	9
Goats vs. Sheep	
Goats	64
Sheep	18
No preference	9
No comment	9

Livestock Preference

Fifty five percent of the people preferred sheep and goats rather than cattle, 36% preferred cattle and 9% had no comments. Sixty four percent preferred goats over sheep, 18% preferred sheep, 9% had no preference, and 9% had no comments. Goats were preferred because of their hardiness. And because goats do not require as much grass as sheep and they travel longer distances in search of food (Table 8).

Sharecropping or Partnership in Livestock Production

Due to labor cost or the unavailability thereof, sharecropping and partnership in livestock production is practiced in Diaz Ordaz. Sharecropping involves sharing the product in halves. In other cases, a partnership is formed among relatives or other individuals and herding time is shared.

Among the interviewees, partnership was more prevalent than sharecropping (Table 9). Sharecropping appears to be present in the build-up stages, and when children are probably not available to care for the animals. In the build-up stage, it is not economical to hire a herder either part or full time, since the number of animals is too small as illustrated by the response of one of the interviewees who said that she had bought a doe in 1976, and built her herd to 12 through sharecropping. Subsequently she sold four animals and four died. In 1987 she had only 4 does

Table 9. Management of small stock in Diaz Ordaz based on 1987 survey data.

Management systems	Interviewees (%)
Sole owner	45.5
Partnership	45.5
Sharecropping	9.0
Total	100.0

left and a kid. Her neighbor, who had a larger herd, used to take care of her animals but is no longer doing it, so now she pays a boy to care for them.

Average Number of Small Livestock Reported

Two factors complicated my objective of determining the average number of animals owned by the individual producers. One was the hesitancy of the people to divulge the number of

animals they owned. Secondly, assuming I was able to physically count the number of animals in a herd, the system of partnership and sharecropping prevents me from determining who owns the animals because the herd might belong to several people. Nonetheless, the average number of goats reported by those who were interviewed was 46 animals, including young and old ones. The average number of sheep was 18 animals, including young and old ones. Of the 11 interviewees, 10 owned goats, five owned both sheep and goats, and one owned only sheep.

Changes from 1970 to 1987

In 1970 when the first set of data was collected, Diaz Ordaz's population was 2411 inhabitants and the number of households was reported to be 574. However, data for analysis purposes was available for only 533 households. From the data available it was determined that 33% of the households owned oxen, and 4% owned cattle, sheep and goats for purposes of livestock production. In 1981, the population had risen to 2895, an increase of 1.8% a year. And the number of households had increased to 640, an increase of 1.5% per year (Sutro 1983). Assuming Sutro's estimated rate of increase per year had remained constant, the potential number of households in 1986 would have been 690.

Unlike the 1970 study which covered a broad socio-economic area and was based on a census of all the households that existed in Diaz Ordaz at that time, the 1987 survey involved only a small percentage of the households and only people who were currently involved in small livestock production. I based my decision to study the small livestock because goats and sheep were the most numerous although cattle in the form of oxen were observed in the valley and infrequently in the adjacent hills and roadsides. Also, since oxen graze primarily in the uncultivated areas of the valleys and are supplemented with fodder they weren't impacting the communal grazing areas as much as the sheep and goats. Since I did not make a census of current household numbers, it is difficult to determine what percentage of current households are involved in livestock production. A record of the people who are involved in livestock raising and

who pay a small contribution of two hundred pesos (U.S. equivalent of nine cents) for the rights to graze is kept by the village treasury. The record only lists people who own livestock but it does not include the numbers of livestock owned.

Informal conversations with members of the village council revealed that if a household's herd is perceived by the municipal authorities to be visibly large, 25 animals or more in the case of small livestock, then the herd is recorded as a potential business enterprise. Smaller herds are considered as stock for personal consumption. The argument was that people face such difficulty in increasing their herd size due to disease and slow growth that there is no sense in recording them until the herd becomes sufficiently large. Another reason why small herds of sheep and goats are probably not taken into account is that when they are used as a means of saving, animals are not sold until they number in the twenties. Then they are sold and converted into either cattle or used for major expenses, such as construction of a house or other major household expenses. For example, one producer I interviewed mentioned that he was in the process of "building up" his herd again since in 1980 he had sold 90 goats to build his house. Another producer mentioned that he had sold his small livestock and bought a pair of oxen.

Out of the 46 people listed by the municipal government (the treasurer) as being involved in livestock raising, unknowingly, I interviewed 15% of them. I say unknowingly because I did not have access to the official record kept by the treasury department of the municipal government until toward the end of my study. The record also listed 24 people who were involved in cattle production, no numbers of livestock were available.

The percentage of households that owned small livestock in 1986 was estimated to be 7% based on the village treasury's list of people who own small livestock and estimated 690 households which was based on Sutro's estimated annual rate of household growth. However, the households that owned livestock in 1986 were more likely to include only large herds, i.e. herds that could be considered commercial or productive herds, since the list was more or less

an "official" record. In 1970, the percentage of households who owned small livestock was 2.5%. It is hard to determine whether this percentage included all the households that owned small livestock regardless of size of the herd, or whether only large herds, herds which could be considered "commercial," were included. The term "commercial" livestock means that, unlike the full time farmer whose livelihood might be complemented with small livestock raising, a farmer whose livelihood depends more on his livestock rather than on cultivation is considered here as a commercial producer. Since the survey was not official, the possibility that the observed percentage might have included small and large herds is very likely. There appears to have been an increase in the number of small livestock owners in Diaz Ordaz within the last 18 years. In 1986, it is estimated that 10% of the households owned cattle or small livestock as compared to 4% in 1970.

CONCLUSIONS AND RECOMMENDATIONS

Wherever resources are held in common, the question of the commons underlies discussions of range management issues. In a system of communal ownership of resources, theoretically, every one has access to the communal resources. However, in reality, access to communal resources follows Ciriacy-Wantrup and Richard Bishop's (1975) proposition: not everyone uses the resources equally.

Using the village of Diaz Ordaz, a community with a communal land tenure system, as a case study, my objective was to determine the pattern of use of the communal resources with emphasis on the exploitation of the forage resources.

In the community of Diaz Ordaz, it was discovered that the intensity of use varies a) among resources and b) among households. Arable land, potable water, irrigation water, fuelwood, sand, gravel, rock, forage, forest, and other resources, within the communally held lands are exploited at various degrees by the members of the community. Whereas the intensity of exploitation of some resources such as potable water and fuelwood is more egalitarian, the intensity of exploitation of other resources like irrigation water and forage is more differentiated.

In the partial review of the rich and extensive literature on communal resources, five factors were suggested as affecting the intensity of use of the communal resources: legal or social constraints, technological efficiency, population pressure, yield, and value. Most of these factors are operating in Diaz Ordaz. First, at the village level, legal (land title, and government regulations), and social constraints (participation in the government of the community) restrict access to the communal resources to members of the village. Second, technological efficiency plays a complex role. In some cases, such as the construction of new road, and the availability of trucks, it has facilitated an increase in the exploitation of certain resources such as fuelwood, timber, sand, gravel and rock not only by the community members but also by outsiders. Countervailing tendencies are also present; the introduction of stoves decreased fuelwood consumption. Third,

population growth increases pressure on the resources. In 1970, 4% of the household population owned livestock. Based on Sutro's (1983) estimated annual household growth rate, and the list of livestock producers from the village treasury, household population was estimated at 690 and livestock ownership was estimated at 10%. Therefore an increase in household population was associated with an increase in livestock ownership, consequently, increased pressure on the forage resources. Fourth, yield affects use. Communal lands are poor quality rainfed lands (3rd/4th class), their cultivation therefore is limited. Also, the availability of more productive private and *ejido* lands in the valley has minimized the exploitation of the communal land for cultivation purposes. Fifth, demand for mobile resources such as firewood, sand, gravel and rock, outside the community has created a new external market for these resources thereby intensifying their exploitation.

The significant findings of this study relative to forage resource use are:

a) the fraction of the household population that owns livestock for production purposes was small,

b) livestock ownership was associated with the relative wealth of households,

c) livestock ownership increased with infrequent seasonal migration, and frequent migration decreased livestock ownership,

d) households that were involved in farming were more likely to own livestock, and

e) possibly uses of forage resouces have increased with population growth.

The reasons as to why such a small fraction of the household population is involved in livestock production is speculative but could be because a) the capital investment required to start a herd is relatively large, b) several years are required before return on investment is obtained, c) low return on investment, d) local level labor shortage and costs, and e) low productivity. The relationship between relative wealth and animal ownership and its association with infrequent seasonal migration further support the capital investment hypothesis. Wealthy households are more likely to invest in livestock than poor households. Moreover, infrequent

seasonal migration increases a household's earning potential, therefore, its general potential to invest, including investment in livestock.

Is labor a limiting factor in entry into small livestock production? Although this question needs further exploration, the practice of sharecropping and partnership in small livestock production suggests that labor might be limiting entry into small livestock production. The slow return on investment, and low productivity of the enterprise make alternative occupations more attractive for the adult male. Therefore, the labor demands are placed on the school age children and old men.

Low productivity because of disease and lack of forage during critical times of the year might be another factor limiting entry into small livestock production.

The significance of the findings with respect to the forage resources is that they establish the lack of uniformity in the exploitation of communal resources within a small, third world society. The use of communal resources is limited not only by some of the factors identified in the literature review but also by other economic factors such as wealth. A model for forage resource use might be suggested (Table 10):

Table 10. A model of forage resource use in Diaz Ordaz.

Factors	Impact on livestock and forage use	
Wealth		increases
Ratio of farmers to non-farmers		increases
Infrequent seasonal migration		increases
Frequent migration		decreases
Population growth	increases	+

Although this study has its limitations, as it deals with only one community and undoubtedly conditions vary from one community to another, its findings emphasize the importance of determining the dynamics of resource exploitation in a communal land tenure system in terms of resources and users. I suggest that when considering management practices or development plans that their effects in such a system of ownership be considered, keeping in mind the existing local management practices, size of communal lands, available resources, plow vs. tractors, human labor vs. machine, regulations, and most of all, the differential access to and exploitation of resources.

Even though the amount of land that is involved when dealing at the community level seems insignificant, when one considers the number of communities that exist in a state like Oaxaca with its 570 municipios and 4529 communities, the number of hectares involved become significant. Given the great number of communities, it is economically unfeasible for the national or state government to try to handle the problem by itself, the communities need to take responsibility for their commons. Perhaps the best role for the government is to establish some standard guidelines for resource management, provide technical training for members of the community who are in charge of safeguarding the communal resources and provide technical expertise and advice to the community.

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